

FALL UNDERGRAD RESEARCH EXPO

PURDUE UNIVERSITY

NOV. 16-20, 2026

POSTER PRESENTATIONS

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1000
Presentation Time: Session 1: 9:00-10:00am

Geospatial Optimization of Data Center Cooling

STEM

Authors(s):
Md Sadat Aarik† (Engineering)

Abstract:
The expansion of artificial intelligence workloads and high-density computing has significantly escalated water and energy consumption by data centers; estimates show that U.S. data centers account for over 500 billion liters of total annual water consumption across direct on-site cooling and indirect thermoelectric power generation. While evaporative systems offer high thermal efficiency, direct water consumption by such systems causes substantial strain on local water sources, whereas dry cooling eliminates on-site water use at the cost of reduced efficiency under high ambient temperatures. To balance cooling performance with local water and electrical grid availability, this study evaluates climate-adaptive cooling strategies across the United States. Geospatial datasets are developed to map Community Water Systems (CWS) alongside national power generation facilities, tracking plant-level energy generation, cooling water withdrawals, and net water consumption to evaluate regional water demand. In parallel, component-level thermodynamic models are developed for air-cooled, water-cooled, and adiabatic chillers, as well as direct, indirect, and membrane-assisted evaporative architectures. These models calculate supply air conditions and cooling power requirements across varying weather regimes. Combining these HVAC performance results with regional water and power plant maps informs data center siting and cooling system selection. This approach identifies locations suitable for non-evaporative cooling and reserves hybrid or evaporative systems only for climates with severe ambient constraints.

Mentor(s):
David Warsinger (Engineering); Clark Lay (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1001
Presentation Time: Session 1: 9:00-10:00am

Predicting AI Exposure to Support Workforce Planning and Reskilling Decisions

Business Case Study

Authors(s):
Sheldon Abramtsis† (DSB); Anvitha Mandhadi† (DSB); Henry Reuben Koevary† (DSB); Zachary Loftus Baxtrom† (DSB)

Abstract:
As artificial intelligence becomes more integrated into the workplace, how can organizations avoid misallocating training resources, hiring for the wrong skills, and reacting too slowly to changing job requirements when they do not know where AI exposure is concentrated? We develop a model that estimates a professional's AI exposure from experience level, job type, and other employment characteristics, giving an earlier indication of which roles may face greater exposure so organizations can prioritize limited training resources, identify employees who may benefit most from reskilling, and make more proactive workforce and hiring decisions. Our dataset contains 71,913 job records and 17 features from the foorilla AI Jobs Net Salaries dataset, combined with occupational AI-exposure scores from Gmyrek et al.'s 2025 Global Index of Occupational Exposure to Generative AI. The data include job title, role family, experience level, employment type, company size, work arrangement, and location. Initial EDA showed hundreds of job titles, including closely related roles such as Data Analyst, Data Scientist, and Machine Learning Engineer, which makes job grouping important so the model can identify broader patterns. We begin with an average AI-exposure baseline and then develop regularized linear regression and Random Forest models. Linear regression provides interpretable relationships between professional characteristics and exposure, while Random Forest captures interactions between factors such as role and experience level. Cross-validation will evaluate how consistently each model performs, and Mean Absolute Error will compare models because it measures the typical difference between predicted and actual AI-exposure scores. We expect job type to be among the strongest predictors. The model can help organizations identify higher-exposure roles, target reskilling investments, and prepare for changing skill demands before workforce disruptions occur.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1002

Presentation Time: Session 1: 9:00-10:00am

Regulation of bone remodeling through co-delivery of STING antagonist and phenamil nanocarriers.

STEM

Authors(s):
Abigail Catherine Alexander† (Agriculture); Gabrielle Marie Barrido* (Science)

Abstract:
Rheumatoid arthritis (RA) is a systemic autoimmune disease distinguished by severe bone erosion and inflammation of the synovial joints. Bone remodeling is balanced by osteoclasts and osteoblasts. Osteoclasts are multinucleated cells that resorb old bone, and dysregulation of osteoclastogenesis causes severe bone and joint degradation. RA has no cure, and most therapeutics cannot attenuate inflammation and restore bone homeostasis. One target for reducing RA-associated bone degradation and inflammation is the cGAS-STING pathway, which regulates NF-κB to control inflammation and osteoclastogenesis. Additionally, phenamil regulates bone morphogenic protein 2 to upregulate pro-osteogenic genes. Phenamil and STING antagonist co-delivery will be achieved through co-encapsulation for efficient co-delivery to joints. To enhance targeted delivery, nanocarriers will contain a sialic acid coating. This targeted delivery may help improve bone formation and reduce inflammation. We hypothesize that delivery of nanocarriers containing STING antagonist and phenamil can simultaneously suppress osteoclastogenesis and promote balanced osteogenesis. We will characterize osteoclastogenesis by treating RAW264.7 cells with free or nanocarrier treatments and Receptor Activator of Nuclear Factor-κB Ligand (RANKL) to stimulate osteoclastogenesis. Next, we will perform qPCR to measure pro-osteoclast gene regulation and Tartrate Resistant Alkaline Phosphatase (TRAP) staining to measure osteoclast differentiation. Additionally, we will assess osteogenesis using MC3T3-E1 murine pre-osteoblasts. We will assay for improvements in osteogenesis by quantifying pro-osteogenic gene expression and performing alizarin red staining. Future directions will focus on investigating how macrophages impact the bone remodeling process via a co-culture assay. This study seeks to improve RA treatment options by investigating strategies that can rebalance bone homeostasis and reduce inflammation.

Mentor(s):
Marxa Figueiredo (Vet Med)

Other Acknowledgment(s):
Gabriel Steven Harris* (Vet Med); Kurt Ristroph* (Agriculture|Engineering); Herman O Sintim* (Science)

Poster Presentation Abstract Number: 1003

Presentation Time: Session 1: 9:00-10:00am

Analysis and Simulation-Guided Design of a Quasi-Common-Path Biprism Configuration for Depth-Selective Digital Holography

STEM

Authors(s):
Juan Jose Alvarez Cardona† (Science); Alex G Rodriguez-Gonzalez‡ (Engineering|Science|JMHC)

Abstract:
Interferometric digital holography is used in cancer research to evaluate how living tumor tissue responds to anticancer drugs, by detecting ultra-low-frequency Doppler shifts (down to about 10 mHz) caused by intracellular motion. Such measurements demand phase stability, which common-path interferometers favor by reducing the effect of mechanical disturbances. However, their performance depends strongly on alignment and design, and biprism self-referencing does not provide the explicit depth selection needed to probe living tissue. This work presents the design and construction of a quasi-common-path configuration that combines a Fresnel biprism with controllable delays in the reference arm. These delays provide depth selection via coherence gating while relaxing the strict common-path condition. Two tools support its design and interpretation: a reproducible pipeline for analyzing experimental holograms, developed from a review of a MATLAB acquisition code, and an optical simulator based on geometric and wave-optics models. The pipeline reconstructs the correlation sideband, computes temporal spectra, and diagnoses illumination, stability, and phase. Preliminary comparisons show that the position of the maximum-overlap region, and hence of the hologram, is highly sensitive to the incident field, biprism angle and position, focal lengths, and pupils. It must therefore be evaluated together with contrast and sideband separation. These results guide the design of the new configuration, whose illumination stage has been built and aligned using specular reflection. The Fourier stage and the biprism integration are the next steps. The simulator will be used to study the response to reference delay and source spectral bandwidth, and the analysis pipeline will be adapted to process the expected signals and measurements.

Mentor(s):
David D Nolte (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1004

Presentation Time: Session 1: 9:00-10:00am

ERIS: An LLM-Based Advisor for Parametric CAD Model Robustness

STEM

Authors(s):
Mahrukh Muhaimeen Anindya† (Engineering|JMHC); Daniel Skomorovsky† (Engineering); Joseph Gregory Kain‡ (Engineering); Sophia Kristina Alvarez‡ (Engineering)

Abstract:
Engineering workflows are slowed by the time spent iterating on and repairing CAD models, often because of how those models were built. Hard-coded dimensions reduce flexibility and must be edited individually, over-constrained sketches fail when a value changes, and features referencing unstable datums tend to break downstream. We propose ERIS (Engineering Robustness Intelligence System), a history-aware Siemens NX peripheral for modifying existing models without losing design intent. ERIS extracts a part's feature history, dependencies and constraints into a structured representation, along with the engineer's stated intent and analysis data. An LLM interprets requests and plans strategies, including parametric conversion, while NX executes all geometry and constraint solving. ERIS's robustness tools rest on a centralized verification and documentation framework. Each tool that alters the model produces an accuracy summary measuring how closely the resulting geometry matches the imported part. Each edit is logged with the original request, the justification for the chosen operation, and its downstream effect. Each score comes from a deterministic fragility calculator, so no result is a black box. Before export, a verification suite compiles all accuracy and justification reports into master documentation, while cryptography ensures that any subsequent file modifications can be detected. In a preliminary case study, ERIS rebuilt a fragile 121-feature servo clamp into a fully parametric 73-feature model in 14 minutes. Separately, robustness testing on 19 CAD models with 1,534 parameters showed that 38% of parameters caused regeneration failures and another 19% produced shape changes. These findings motivate combining ERIS's history-based diagnostics with direct parameter-change testing to assess CAD robustness and support design modifications while preserving engineering intent.

Mentor(s):
Jitesh H Panchal (Engineering); Charles Jensen (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1005
Presentation Time: Session 1: 9:00-10:00am

Social Determinants of Firefighter Lifestyle: A Pilot Feasibility Study Using a FANTASTIC-Aligned Assessment and the MANifest

Social Science

Authors(s):
Daniel Felipe Arenas Avila† (HHS)

Abstract:
Firefighters' lifestyles are shaped by role expectations linked to masculinity, group culture,

work schedules, rest needs, and access to resources. The main aim of this pilot study is to

assess the feasibility and acceptability of a survey for male firefighters. Exploratory aims will

be to describe lifestyles and social barriers and explore their relationships with family

support, access to healthcare, and the perceived legitimacy of self-care in this population.

This cross-sectional study will use an anonymous online survey, targeting 30 completed

surveys from men aged 18 or older who are active firefighters in the United States, serve in

volunteer, career, or combination fire services, and can read and understand English.

Recruitment will use remote strategies such as mentor-distributed emails, professional

networks, firefighter-relevant social media groups, colleague contacts, and snowball

sampling. The survey will include a FANTASTIC-aligned lifestyle module, social and

structural barriers, and perceptions of the legitimacy of self-care based on MANifest Health

Theory. Feasibility and acceptability will be assessed through survey completion, completion

time, missing data, and ratings of ease, relevance, and length. Descriptive statistics and

exploratory analyses will summarize survey outcomes and examine associations. The study is

under ethics review, and data collection has not yet begun. The expected immediate outputs

will be a dataset on survey feasibility and acceptability and a preliminary assessment of item

performance in the firefighter-specific instrument. These findings could guide survey

refinement and also create a stronger foundation for future firefighter wellness work by

shifting the emphasis from individual choice alone to the social and structural conditions that

shape healthy living.

Mentor(s):
Julian Leandro Gallegos (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1006
Presentation Time: Session 1: 9:00-10:00am

Design and Implementation of a Motor Characterization Dynamometer Using an Active Load Bench

STEM

Authors(s):
Daniel Arnett† (Engineering); Xavier Zuniga† (Engineering); Anish Madhan Raj† (Engineering); Jeongin Shin† (Engineering); Riya Singh† (Engineering); Ishika Bhagya Pandurangam† (Engineering); Daniel Gurenko† (Engineering)

Abstract:
Having accurate knowledge of an electric motor's performance is critical for selecting, controlling and validating drive systems in fields like robotics automation, and vehicular engineering. Manufacturers provide datasheets of nominal values, so characterizing is needed to confirm a motor's true operating behavior across the full torque and speed range. This project develops a dynamometer test platform to experimentally characterize a permanent magnet synchronous motor and establishes a foundation for a future, larger scale test platform.

The platform is built on the Texas Instruments 2MTR-DYNO evaluation kit, which couples two Teknic M-2310P-LN-04K low-voltage, sinusoidal back-EMF servo motors on a common aluminum frame. One motor serves as the motor under test while the other acts as an active, programmable load. The motors are driven by BOOSTXL-3PHGANINV 48-V three-phase GaN inverters with in-line shunt-based phase current sensing and controlled by a LAUNCHXL-F28379D C2000 microcontroller running field-oriented control. Rotor position and speed are obtained from the motors' built-in encoders, which combine with phase current and voltage measurements to calculate the motor's torque and power consumption. We will also be able to study how the motor's characteristics change across varied loads and speeds.

Findings from this small-scale system will be incorporated into the development and design of a larger dynamometer with a higher power motor and a custom test bench. The result is a scalable, low-cost framework for motor testing and control development.

Mentor(s):
Woongkul Lee (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1007
Presentation Time: Session 1: 9:00-10:00am

Chemoselective Hydrogenation of Arenols via Surface Modification Using DBU over Pt/C under Mild Conditions

STEM

Authors(s):
Victoria Baranets† (Science|JMHC)

Abstract:
Arene hydrogenation is key to the pharmaceutical industry as a late-stage functionalization technique that increases that lipophilicity and solubility of drugs. Arene systems have a large energy barrier for hydrogenation due to high aromaticity, making arene hydrogenation require a high energy input or high hydrogen pressure to complete. These conditions lead to hydrogenolysis. Selective hydrogenation of one ring in a bi-arene system is a challenge. Additionally, chemoselectivity is the selective hydrogenation of one functional group over another in a molecular system. Chemoselectivity in hydrogenating one arene over another in a bi-arene system has been explored successfully in heteroarenes (low aromaticity). Our goal is to achieve chemoselectivity in higher aromaticity systems (phenol vs. benzene), which has not been explored much due to their close levels of aromaticity and difficulty in selectivity.

First, we studied kinetics of simple model molecules such as phenol, benzyl alcohol, and phenyl ethanol against ethyl benzene (non-directing group) to see if there was a directing effect or preferential binding with a hydroxy group. These were run with noble metals such as Ru/C and Rh/C. We found that hydroxy-containing arenes hydrogenate preferentially over ethyl benzene, with a bidentate effect.

Next, we optimized reaction conditions for our model substrate, 4-benzylphenol. We used noble metals such as Ru, Rh, and Pt with 5 mol% of Pt/C with 5 mol% DBU as a base, we found the phenol ring to be hydrogenating over the benzene with excellent selectivity.

Finally, we are exploring the substrate scope of the reaction. We have found success when using molecules with different linkers (number of carbons between the two arenes). We also found that electron donating groups are tolerated on benzene.

In the future, we will expand the substrate scope to see generality of the methodology. Additionally, we will perform mechanistic studies using kinetics, and a DFT.

Mentor(s):
Vinay Vinay (Science); Christina W Li (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1008
Presentation Time: Session 1: 9:00-10:00am

AI for Music: Sound Evaluator

STEM

Authors(s):
Amy Michelle Basca† (Engineering); Rohan Bajpai‡ (Engineering); Megan Ashley Wolin‡ (Engineering|JMHC); Alejandro Luis Cordero‡ (Science); Alexander S Park‡ (Polytechnic); Jonathon Jinwoo Lim‡ (Science); Navya Gupta‡ (Engineering); Ropan Datta‡ (Science);

Abstract:
Our project aims to apply AI-based music analysis techniques to help musicians improve intonation and rhythmic accuracy. Learning an instrument can be challenging for beginners, especially when practicing without a teacher, as the lack of real-time feedback often leaves learners struggling to identify where they are making mistakes. By providing that instantaneous guidance, our system makes self-guided practice more productive and accessible.

We are developing a mobile application using Flutter (Dart) that analyzes a player's performance alongside a reference score. Live audio is processed using aubio and Online Time Warping is used to align detected notes with the score and track the musician's position throughout the piece. A separate mode using a custom machine learning model for more detailed musical analysis will be explored as well. The model outputs detailed analysis based on an uploaded recording of the user's performance.

The app's effectiveness will be evaluated through accuracy measurements for pitch, timing, and note detection. Planned user studies will gather input on the app's features, ease of use, and effectiveness as a practice tool. The gathered feedback will guide improvements and bug fixes. Currently, the project is limited to monophonic analysis on Android systems however future expansions to polyphonic analysis and alternate operating systems will be researched to broaden accessibility.

Mentor(s):
Yeon Ji Yun (Liberal Arts); Yung-Hsiang Lu (Engineering)

Other Acknowledgment(s):
Benjamin Shiue-Hal Chou* (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1009
Presentation Time: Session 1: 9:00-10:00am

Characterizing the Effects of Liquid Ingress on Electrochemical Impedance Measurements in Ultramicroelectrode Arrays

STEM

Authors(s):
Jessica Bazel† (Engineering)

Abstract:
Ultramicroelectrode arrays (UMEAs) are implanted in the brain to record neural activity and deliver electrical stimulation, often over months of chronic implantation period. Electrochemical impedance spectroscopy (EIS) is the standard tool for monitoring electrode health during this period, so a change in measured impedance is usually interpreted as a change in the electrode itself. However, the electrode is only one part of the measurement path. During chronic experiments, liquid can reach the connector that links the implant to the recording hardware, for example, through moisture exposure during chronic implantation. Liquid bridging adjacent contacts can create unintended current paths between channels, making it unclear which site is actually being stimulated or recorded, and saline may also corrode the contacts and degrade the connection over time. Such effects could make a healthy electrode appear damaged, or mask genuine electrode failure. This study aims to characterize how liquid ingress at the connector contacts alters the measured impedance of UMEA channels, and whether these changes are reversible. EIS is measured on each channel at a dry baseline, after deionized water or phosphate-buffered saline (PBS) is introduced at the contacts, and again after the contacts are cleaned and dried. We hypothesize that deionized water, being poorly conductive, produces small and largely reversible changes, whereas PBS produces substantial crosstalk and may leave lasting changes through salt residue or corrosion. Identifying the impedance signatures of connector ingress will help distinguish measurement artifacts from true electrode degradation and inform handling and cleaning protocols for chronic neural interface experiments.

Mentor(s):
Qiwei Dong (Engineering); Elizabeth Tarami Su (Engineering); Kevin John Otto (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1010
Presentation Time: Session 1: 9:00-10:00am

Radiation Hardness Testing and Characterization of Photonic Transceivers for Space Qualified Optical Links

STEM

Authors(s):
Andrew Paul Becker† (Engineering|JMHC)

Abstract:
Satellites in low orbit are increasingly using laser light instead of radio waves to send large amounts of data back to Earth. Light based communication can carry far more information, but the devices that send and receive these signals may be damaged by the intense radiation of space. This is a serious concern for satellites that must work reliably on long missions, and the performance of commercially available parts in these conditions needs to be better understood. Because optical transceivers contain sensitive semiconductor components, such as lasers and photodetectors, that can degrade under radiation, and because specially built space qualified versions are costly, there is strong interest in whether low cost, off the shelf optical devices can be trusted, which first requires a reliable way to test them.

This project develops a testing method to measure how well off the shelf optical communication devices hold up in space like conditions. A specialized tester sends data through the optical transceivers and counts how many bits arrive incorrectly. A connection board, a temperature sensor, and a steady power supply keep the test conditions carefully controlled. The transceivers will be exposed to radiation and temperature changes while their performance, meaning the rate of incorrectly received bits, is monitored for any increase.

This approach is expected to show how much radiation these devices can tolerate before their data transmission begins to degrade. The work will give engineers practical reliability information to help decide whether commercial components can safely be used in future space communication systems.

Mentor(s):
Andrew Owen Fewell (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1011
Presentation Time: Session 1: 9:00-10:00am

Why Do Airline Fares Fluctuate? Using Data to Improve Pricing Decisions in U.S. Markets

Business Case Study

Authors(s):
Joshua John Beigel† (DSB); Jenner Yucong Lim† (DSB); Ethan James MacKinnon† (DSB)

Abstract:
In a competitive airline industry, setting fares that attract passengers while maintaining profitability is a persistent business challenge. This project aims to predict average passenger fares across U.S. domestic airline markets and identify how route characteristics and competitive conditions relate to pricing. By improving fare prediction, airlines may make more informed pricing and route-planning decisions.

Using the Airline Market Fare Prediction Data, derived from U.S. Department of Transportation data, we analyze approximately 1.58 million observations, with each observation representing an airline serving an origin–destination market. Exploratory data analysis will examine fare distributions, price variability, potential seasonal patterns, and relationships between average fares and four predictors: flight distance, route directness, airline competition, and the presence of competing airports.

Methodologically, we will establish a multiple linear regression baseline and compare its performance with alternative predictive models. Temporal data splits will evaluate how well models trained on historical observations predict fares in more recent periods. Performance metrics will identify the most accurate approach, while feature importance analysis will assess the relative contribution of market characteristics to fare predictions.

The project aims to translate predictive modeling into actionable business insights by helping revenue managers understand market-level pricing patterns, assess competitive pressures, and identify routes warranting further investigation. Ultimately, this approach could support more targeted pricing strategies and data-informed commercial decisions in the U.S. airline industry.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1012
Presentation Time: Session 1: 9:00-10:00am

A Quantum Machine Learning Approach to Diagnosing Blood Disorders from CBC Data

STEM

Authors(s):
Jake Belenkiy† (Engineering); Owen Zane Bianchi† (Science); Parth Jain† (Science); Gurucharan Mannur† (Engineering)

Abstract:
Doctors use a routine blood test called a Complete Blood Count (CBC) to help diagnose blood disorders like anemia, but different diseases can produce very similar results, making diagnosis difficult and sometimes unreliable. This project explores whether quantum computing can help identify patterns in CBC data that are more challenging using classical methods in order to help doctors making these diagnoses. Using a dataset of 1,281 patient records covering 9 different diagnosis categories, we reduce the measurements in a CBC down to a small set of informative features using Principal Component Analysis (PCA), then confirm those features are meaningful using k-means clustering. These features are then loaded onto a 4-qubit quantum circuit. We compare two ways of encoding this data onto the circuit, angle encoding and the ZZ feature map, to determine which is better suited for this problem. We then compare the quantum model to a standard classical machine learning model trained on the same data. All approaches are first tested on a quantum simulator before any run on real quantum hardware. The results are compared using accuracy and F1 score, a metric that measures performance for diagnosis categories with fewer cases. This project is meant as an exploration of whether quantum methods offer any advantage over classical approaches for this kind of medical problem. It is expected to show that quantum computing results are at least as viable as classical computing in this field.

Mentor(s):
Andy Jung (Science); Noah Charles Singer (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1013
Presentation Time: Session 1: 9:00-10:00am

Mathematical Modeling of Avian Oil Droplets: Existing Approaches, Limitations, and Future Directions

STEM

Authors(s):
Laura Beltran Sarmiento† (Science)

Abstract:
Oil droplets in the eyes of birds play an important role in visual processing by selectively filtering the wavelengths of light that reach photoreceptors. Their physical and optical properties, as well as their biological functions, have been investigated through various mathematical and computational approaches. However, differences in the assumptions, mathematical formulations, and parameters used across existing models make it important to evaluate how these approaches represent oil droplets and how their characteristics influence model predictions.

This project aims to review and compare the development of mathematical models of avian oil droplets, evaluating their strengths and limitations. Through a review of scientific literature, existing models will be examined in terms of their mathematical formulations, underlying assumptions, input variables, and representations of the physical and optical properties of oil droplets. Selected models will then be reproduced in R to assess their sensitivity to changes in key parameters. This sensitivity analysis will help identify which variables have the greatest influence on model outputs, how parameter changes affect predictions, and whether different models respond similarly to the same variables.

The main outcome of this project will be a comparative evaluation of existing mathematical models of avian oil droplets, supported by computational reproduction and sensitivity analysis. By identifying the parameters that most strongly influence model predictions, as well as the assumptions and limitations that shape their behavior, this project will provide a clearer understanding of the capabilities and limitations of current approaches. The findings will help identify priorities for future research and potential improvements to existing models, contributing to a more comprehensive understanding of how mathematical models represent the physical and optical properties of avian oil droplets within the context of avian vision.

Mentor(s):
Esteban Fernandez-Juricic (Science); Ryan B Lunn (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1014
Presentation Time: Session 1: 9:00-10:00am

From code to map: Automatically visualizing how parameters flow through real scientific simulation workflows

STEM

Authors(s):
Wendy Daniela Benitez Gomez† (Engineering)

Abstract:
Modern simulations are rarely a single program; they are chains of steps, called tasks that pass data to one another. RHINO is a C++ simulation framework developed in Professor Tillmann Kubis's group. One of its workflows simulates a microdroplet, it packs the molecules into a droplet (Packmol) and relaxes their structure with a quantum-chemistry code (DFTB+) on a computing cluster. Understanding how each input is validated, transformed, and passed through loops before it reaches the simulation means tracing values through hundreds of lines of code. Previously, our code visualizer had been built on small toy examples and showed only 1 of the 11 task calls in this real workflow.

We extended the visualizer so it reads research code exactly as scientists write it, without changing that code. Using static analysis (reading the source code without running it), the tool follows the helper functions each task delegates to and draws two complementary views. The first one is a control-flow view that shows the order of tasks, with boxes around loops and helpers (so it’s easier to read). The second one is a new data-flow view, inspired by visual programming environments such as AVS/Express, that draws each task as a module with typed inputs and outputs, and each value passed between tasks as a wire colored by data type, so matching colors mean compatible connections.

On the microdroplet workflow, the tool now shows every task call and traces, without running the code, which of the workflow's inputs end up in the Packmol and DFTB+ simulation inputs and where they land, linking every connection to the line of code that creates it. The same analysis applies, unchanged, to the other tasks of the framework.

Next, we aim to turn the data-flow view into an editor in which researchers build and modify simulation workflows by connecting compatible modules, with every change written back to the code.

Mentor(s):
Robert A Campbell (PWL); Tillmann C Kubis (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1015
Presentation Time: Session 1: 9:00-10:00am

What Role Should Super Shoes Play in Competitive Distance Running?

Social Science

Authors(s):
David N Best† (HHS)

Abstract:
[Abstract Redacted]

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1016
Presentation Time: Session 1: 9:00-10:00am

Simulating Hypomagnetic Conditions for Space Exploration: A Low-Cost Helmholtz Coil System for Plant and Animal Studies

STEM

Authors(s):
Katrina Uma Boland† (Engineering|JMHC)

Abstract:
As we push towards lunar exploration and an increased human presence in space, it is important to understand what factors can impact life. Spaceflight exposes both the human body and plants to a drastically different environment that can have negative short- and long-term effects. The same is true on the surfaces of other planetary bodies, like the Moon and Mars, because of differences in gravity, atmosphere, and magnetosphere. Past studies have focused on the impacts of the radiation environment and lowered gravity on human physiology and crop growth, but low magnetic (hypomagnetic) field environments have not been thoroughly studied. Earth's magnetic field lies around 50 μT, but the Moon and Mars have none. To understand if the absence of magnetic fields will impact astronauts and agriculture in space, we must design low-cost experimental setups that can easily maintain a hypomagnetic environment for laboratory experiments. To do this, a triple-axis Helmholtz coil was developed. The coil is small enough to fit inside other devices, such as an incubator, in which zebrafish or plants can be kept for the duration of the experiments, while still allowing easy access to the subjects from all sides. By adjusting the current in each axis using programmable direct current power supplies, the magnitude and direction of the magnetic field within the system can be controlled with a precision of 50 nT per 1 mA of current applied. The system is connected to a magnetometer to monitor the interior field strength in all three directions. The base model for the coil can be manufactured using a 3D printer, allowing for easy replication of the system. Enameled copper wire is wrapped around the frame on all three axes, and the magnetic field in each axis is controlled by its own power supply. Easy to produce and modify, this system will allow us to broaden our understanding of the effects of hypomagnetic fields on living organisms, which is essential for future space exploration.

Mentor(s):
Caue Sciascia Borlina (Science)

Other Acknowledgment(s):
Daniel Suter* (Science); D. Marshall Porterfield* (Agriculture|Engineering); Richard John Barker* (Engineering)

Poster Presentation Abstract Number: 1017
Presentation Time: Session 1: 9:00-10:00am

Evaluating Structural Encodings and Limitations in Chemical Machine Learning

STEM

Authors(s):
Advait Bragadeesh† (Science)

Abstract:
Recently, Chemical Language Models (CLMs) have been a topic of fervent attention and research as chemists use recent advances in Machine and Reinforcement Learning algorithms and new computational technologies to represent chemical reactions. Researchers typically embed molecules as Simplified Molecular Input Line Entry System (SMILES) strings or Self-referencing embedded strings (SELFIES) to apply standard ML techniques to train these models. These models are then able to predict structures and generate molecules suited to a particular purpose. This contrasts with previously established Graph Neural Network (GNN) encodings which used graphs, with nodes and edges, to describe chemical and physical structure. While both architectures have found use in retrosynthesis and de novo drug discovery, both methods require abstractions away from the physical reality that they describe. Consequently, these models often struggle with interpretability and frequently produce chemically invalid structures. My research seeks to investigate these limitations and suggest potential avenues for improvement.

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1018
Presentation Time: Session 1: 9:00-10:00am

Food Fast Sampling and Lipid Composition Analysis by Surface Touch Extraction and Multiple Reaction Monitoring profiling

STEM

Authors(s):
Sara Sofia de Fatima Bucheli Lazo† (Purdue University); Silvia Helena Lopez Serrano‡ (Purdue University); Isabella Zuluaga Gomez‡ (Purdue University)

Abstract:
Food lipids determine nutritional quality, flavor and shelf life, yet conventional lipid analysis relies on sample homogenization and lengthy solvent extraction, which destroys the sample and averages differences between regions of the same product. Here we present Surface Touch Extraction (STE) coupled with multiple reaction monitoring (MRM) profiling as a rapid, minimally invasive approach for screening the lipid composition of foods. In STE, lipids are collected by brief contact of the food surface with a solvent-wetted substrate, and the extracts are analyzed by MRM profiling, a targeted mass spectrometry screen of hundreds of lipid transitions without chromatography.

As a proof of concept, we applied STE-MRM profiling to six charcuterie products: three aged cheeses (cheddar, gouda and provolone), two cured meats (serrano and salami) and salmon. Ninety-six surface extracts were analyzed, and 744 of 902 screened transitions were detected (signal at least 2-fold above the procedural blank in at least one sample). The profiles were dominated by triacylglycerols (TG, 409 MRMs) and diacylglycerols (DG, 284 MRMs), and phospholipids, cholesteryl esters and ceramide were also detected. Multivariate analysis discriminated the samples by food type, with about 89% cross-validated classification accuracy. Cheeses clustered together, with shorter, more saturated TG and higher DG levels, consistent with milk fat and ripening-associated lipolysis. Cured meats showed longer, oleate-rich TG, whereas salmon was distinguished by highly unsaturated TG consistent with omega-3 fatty acid content.

These results show that STE-MRM profiling captures broad lipid coverage and discriminates chemically diverse food matrices with minimal sample preparation and solvent use. The approach offers a practical platform for exploratory foodomics, regional comparison within

products, and future applications in nutritional assessment, authentication and quality control.

Mentor(s):
Christina R Ferreira (Centers & Institutes); Ryan T Hilger (Science); Devender Arora (Centers & Institutes)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1019
Presentation Time: Session 1: 9:00-10:00am

Development of Optically Active Chiral Molecules for Visible-Range Fluorescence Optical Rotatory Dispersion (F-ORD)

STEM

Authors(s):
Alexander Peng Fei Symonds† (Engineering); Kaia Katherine Lee Starnino† (Engineering); Ezra Lee Buzzard-Cooke† (Engineering)

Abstract:
Chirality, or molecular handedness, is a property that exist in non-superimposable mirror image pairs known as enantiomers. Enantiomeric pairs cannot be differentiated via standard techniques, rather they are only identifiable by differences in their interactions with polarized light. Developing techniques for identifying chirality is crucial to pharmaceutical manufacturing because enantiomers often have differing biological effects. One such technique, F-ORD, Fluorescence Optical Rotary Dispersion, has so far only been demonstrated with samples emitting in the UV-spectrum. This research focuses on developing sample preparation and techniques to characterize Poly-L-Lysine conjugated with Fluorescein Isothiocyanate, a chiral molecule with a fluorescent tag within the visible spectrum. By developing a chiral monolayer that can be probed with visible light to produce a chiral response, samples can be mounted on ITO, Indium Tin Oxide, slides which are opaque to UV-light. ITO's conductive properties will allow interrogation of samples under induced electrical fields. In conjunction with the polar properties of the sample molecules, the chiral effects can be measured simultaneously with molecular scale rotation of the sample within the induced field. The rotation is hypothesized to be both a signal amplifier and be capable of inducing sign flip to act as a conformation of chirality.

Mentor(s):
Garth J Simpson (Science)

Other Acknowledgment(s):
Alexander William Litts* (Science)

Poster Presentation Abstract Number: 1020
Presentation Time: Session 1: 9:00-10:00am

AI Brain Interfaces and Their Impact On Neurological Conditions

STEM

Authors(s):
Kiara Travero Cabriana† (HHS)

Abstract:
The issue I am interested in researching is the use of AI-powered brain-computer interfaces to restore communication in people with paralysis and neurological conditions. These modern technologies can record brain activity and use artificial intelligence to translate neural signals into text or speech. I am interested in this topic because it combines neuroscience, medicine, and innovative technology in a way that could directly improve people's ability to communicate.

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1021
Presentation Time: Session 1: 9:00-10:00am

Analyzing Methodologies for Video Game Data Collection

STEM

Authors(s):
Jayden Lee Cammarata† (Liberal Arts|Science|JMHC)

Abstract:
Abstract: Many studies have been published using video games as a medium for analyzing human behavior. This technique offers several benefits, including increased participant engagement and automated data collection. However, little research has been done on the most effective ways to collect data from video games. This study will aim to answer the following question: “How can researchers create effective data collection methodologies that utilize video games to gather the data needed to answer their research questions?” This project centers on a preliminary literature review of past studies which have involved recording data from video games. It will also incorporate reflections on my past experience working on these types of studies, and an analysis of the data aggregated from both of these sources. The results will ultimately include a breakdown of commonly-used data collection methodologies for video games, an analysis of the degree to which accompanying surveys are effective and/or necessary for video-game-based studies, and an investigation of the correlation between the types of data gathered from a game (e.g. time playing vs. actions taken) and study efficacy. The project promises to help researchers working on these studies design a data collection methodology which will provide them with all the data necessary to successfully address their research questions.

Mentor(s):
Adam Watkins (JMHC)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1022
Presentation Time: Session 1: 9:00-10:00am

Statistical Process Control for Device Characterization and Yield Improvement of RC Circuit

STEM

Authors(s):
Pin-Yu Chen† (Engineering); Muhammad Mahdi Marzan† (Engineering); Su Yeon Choi† (Engineering); Ankit Pulivendula† (Engineering); Henry N Kuehl† (Engineering); Haneul (Sky) Kim‡ (Polytechnic)

Abstract:
This study presents a statistical process control (SPC) framework to improve fabrication reliability and yield in passive microelectronic device arrays, establishing a scalable foundation for integrated resistor-inductor-capacitor (RLC) resonant circuits. Building upon prior research on resistor-capacitor (RC) networks utilizing metal-insulator-metal (MIM) capacitors and serpentine resistors, this work pursues two parallel objectives: optimizing baseline microfabrication processes and developing an architectural framework for RLC circuit integration. Devices were fabricated in a cleanroom environment using photolithography, electron-beam physical vapor deposition (PVD), and lift-off techniques. Electrical characterization was systematically conducted to assess device performance, focusing on capacitance and resistance uniformity across multiple fabrication runs. SPC methodologies, including control charts and defect tracking, were implemented to identify failure sources and correlate process variations with deposition parameters and surface conditions. Extending these baseline findings, preliminary mask designs and layout strategies incorporating planar spiral inductors are presented to transition the validated RC platform toward complete RLC systems. This work demonstrates the practical integration of SPC methodologies into microfabrication workflows, providing a robust pathway for enhancing process stability and device consistency in passive component manufacturing.

Mentor(s):
Zhihong Chen (Engineering); Peter Bermel (Engineering); Joerg Appenzeller (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1023
Presentation Time: Session 1: 9:00-10:00am

Live Deepfake Detection

STEM

Authors(s):
Henry Cheung† (Science); Nakul Iyer† (Engineering); Chris Jun Park† (Engineering)

Abstract:
The increasing realism of AI-generated audio and video poses a growing threat to the authenticity of live video conferences, enabling impersonation, fraud, and the dissemination of manipulated information. While existing deepfake detection methods have demonstrated promise in offline settings, their applicability to live conferencing remains constrained by latency requirements, streaming variability, and the need to detect inconsistencies across audio and visual modalities in real time. In this paper, we investigate a real-time deepfake detection framework designed for live video conferencing, with an emphasis on identifying manipulated audiovisual content under practical streaming conditions. Our approach explores multimodal feature extraction and temporal analysis to capture inconsistencies between audio and video signals that may indicate synthetic or manipulated media. We evaluate the framework with respect to detection accuracy, computational efficiency, and inference latency, examining the trade-offs between reliable detection and the responsiveness required for interactive communication. By focusing on the constraints of live conferencing rather than offline media analysis alone, this work aims to advance practical deepfake detection systems capable of supporting trustworthy real-time communication.

Mentor(s):
Yung-Hsiang Lu (Engineering)

Other Acknowledgment(s):
Zihao Ye* (Engineering)

Poster Presentation Abstract Number: 1024
Presentation Time: Session 1: 9:00-10:00am

Lean Project Management applied to Coding Agents

STEM

Authors(s):
Sishir Chilakamarri† (Science|JMHC)

Abstract:
Artificial intelligence has changed how we code, and agentic AI tools such as Claude Code, which can write, run, and revise code on their own, are now being heavily utilized in the software development landscape. Recent work shows that an agent's planning phase, where agents break a task into steps before coding, can be restructured to change its results. Project management strategies used by corporate human teams may offer useful structures for this. This project tests Lean Project Management, a method focused on eliminating wasted effort, to see how it affects the way agentic AI plans small projects. The goal is to reduce prompt count, which lowers the agent's dependence on the user. We hypothesize a trade-off among prompt count, token usage, and target accuracy that favors Lean Project Management. Tokens are the small units of text an AI reads and writes, so token usage reflects the cost and computing effort of a task. Target accuracy measures how closely the final result matches what was requested. We expect token usage to rise slightly and accuracy to dip slightly, but the large drop in prompt count to justify using Lean Project Management. This research matters because it measures how independent AI can be from human input. If AI can manage a small project front-to-back, then as it improves, it could handle larger projects with far less human involvement.

Mentor(s):
Esra Tepeli (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1025
Presentation Time: Session 1: 9:00-10:00am

Performance Evaluation and MLIR-Based Graph Compilation for the Atalla AI Accelerator

STEM

Authors(s):
Vihaan Reddy Chinthakindi† (Engineering); Robert Yida Zhang† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Hassan Al-alawi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1026
Presentation Time: Session 1: 9:00-10:00am

A Parameterized IEEE 754-2019 Library and Loosely-Coupled Floating-Point Unit for SoCET

STEM

Authors(s):
Yun-Hsuan Chiu† (Engineering); Abid Hasan Khan† (Engineering); Gautham Paramasivam† (Engineering); Jai Anand Keskar† (Engineering); Matteo Giovanni Wahab† (Engineering); Yu-En Lee† (Engineering); Jhih-Chen Yang† (Engineering)

Abstract:
Floating-point arithmetic underpins scientific modeling, graphics processing, and general-purpose computing; to accelerate this, modern processors offload it to a floating-point unit (FPU). However, prior FPU designs from SoCET were not preserved, requiring future teams to redesign from scratch. To address this problem, we propose a parameterized library of IEEE 754 operations and a loosely coupled FPU built from it that can be integrated into different SoCET designs.

The key innovation is a modular architecture that separates floating-point computation from the host processor's pipeline. The library provides standalone SystemVerilog modules parametrized by floating-point format, covering all required and most recommended IEEE 754 operations. These modules are assembled into an FPU that communicates with the host processor through a tagged request/response interface, independent of its decode and commit logic. To accommodate operations with different execution latencies, the FPU supports out-of-order completion. A scoreboard manages data dependencies by holding operations until their operands are ready, while a reorder buffer returns results and exceptions in program order to preserve precise exceptions. Although the lack of tightly coupled memory access may reduce performance, we accept this trade-off for greater integration flexibility.

To verify correctness, we will use directed and constrained-random testbenches that check results against the Berkeley SoftFloat library, targeting bit-exact agreement. We will also evaluate performance by measuring per-operation latency, throughput, area, power, and maximum frequency. The design supports binary format only; decimal arithmetic is out of scope. Our goal is to deliver a documented, pipeline-independent

FPU and FP library with published post-synthesis metrics that future SoCET designs can adopt.

Mentor(s):
Mark Johnson (Engineering); Charles Spencer Bowles (Engineering); Zach Anthony Barna (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1027
Presentation Time: Session 1: 9:00-10:00am

Advanced Error Coding

STEM

Authors(s):
Andrew Thomas Choung† (Engineering); Michael K Lau† (Engineering)

Abstract:
Wireless digital communication technology has revolutionized the exchange of data, expediting message transfer over long distances. A key issue in communication theory is how to reliably transfer these messages through a noisy channel, as noise can distort and destroy bit information. Error coding theory emerged during the twentieth century as a means to redundantly define messages, allowing them to be resistant to bit corruption. Our research concerns two primary error correction methods, Bose–Chaudhuri–Hocquenghem (BCH) codes and polar codes, that have been used extensively in wireless communications systems. Our goal is to measure the effectiveness and reliability of different decoding schemes. Namely, for BCH codes, syndrome decoding, the Peterson-Gorenstein-Zierler (PGZ) algorithm, Berlekamp-Massey algorithm, and Chien search algorithm were all implemented. For polar coding, successive cancellation (SC) decoding, successive cancellation list (SCL) decoding, and belief propagation (BP) decoding algorithms were implemented and evaluated to determine their comparative performance. Ultimately, this comparative analysis aims to identify the optimal balance between computational complexity and error-correction capability for these encoding schemes in noisy channel environments.

Mentor(s):
Chih-Chun Wang (Engineering); Husheng Li (Engineering); David J Love (Engineering); James V Krogmeier (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1028
Presentation Time: Session 1: 9:00-10:00am

Promising Treatments for BOAS in Dogs

STEM

Authors(s):
Christina Moriah Collins† (HHS)

Abstract:
Brachycephalic obstructive airway syndrome (BOAS) is a respiratory condition that affects short-nosed dog breeds like French Bulldogs, English Bulldogs, and Pugs. Their facial features restrict airflow and negatively impact their quality of life. Many researchers have found different ways to diagnose and treat this condition (Riggs et al., Costa et al.).

My research project goes over promising ways to treat or manage BOAS in dogs. My exploratory literature review includes peer-reviewed veterinary research as well as clinical and case studies from veterinary sources considering surgical treatments, intervention strategies, exercise testing, and anesthesia risks in the dogs. I assess the benefits and limitations of each treatment and intervention.

Surgery can improve airflow by correcting inner facial problems, on the other hand lifestyle changes and early diagnosis can help manage symptoms. Also, exercise testing can help veterinarians find breathing problems that are not always clear during a simple routine examination. But, treatment effectiveness can change depending on each dog's condition and needs. My research highlights the benefits of combining the right treatment, early diagnosis, and continuous veterinary care to better respiratory health and quality of life for dogs affected by BOAS.

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1029
Presentation Time: Session 1: 9:00-10:00am

Using Power BI to Digitize Shop Floor Whiteboards at an MRO

Creative

Authors(s):
Henry Cooper† (Engineering|JMHC)

Abstract:
The purpose of this project was to improve the efficiency and effectiveness of the shop floor whiteboards using Microsoft Power BI. I worked on the project as part of an internship at Safran Nacelles, a Maintenance, Repair, and Overhaul (MRO) site in Plainfield, IN. Each area of the shop floor had a whiteboard that was manually updated once a day with repair job identification, status, current issues, and action items. The new system was to contain the same information, and more, update automatically, be viewable from any computer, and draw information from several sources. To accomplish the goals, the Power BI report was connected to three data sources: the company's Enterprise Resource Planning (ERP) system, Microsoft Planner, and Microsoft Excel. Certain services required an extra application to link the data, since they did not automatically export to Power BI. Additional work was required to enable automatic data exports from these applications. Additionally, the visual layout of the board was designed to be easy to understand, share all important information as simply as possible, and have a flight-information-screen-theme.

The functionality of the production board was completed as intended, except for the ability to publish and view the report from other devices. It was presented and well-received. The baseline report was configured and shared with other MRO locations. Near the end of the internship period, IT issues made publishing the report to a server, a necessity for viewable access from any device, a challenge. In the future, the project could be continued. Future efforts could focus on the setup of a report server. Other MRO locations or repair job-based workplaces could adapt the idea of the project to their workflow to improve efficiency and digitalization of their environment. This project was an example of how applications such as Power BI can be adapted for creative, atypical use cases to meet the needs of organizations.

Mentor(s):
Young Paik (Safran Nacelles Services Americas)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1030
Presentation Time: Session 1: 9:00-10:00am

Consumer Perception of Ultra-Processed Foods

Social Science

Authors(s):
Hope Illiana Cooper† (Agriculture)

Abstract:
Background: Consumers' understanding and perceptions of ultra-processed foods (UPFs) may influence their food choices and purchasing decisions.

Objective: The purpose of this study was to understand how consumers define and perceive UPFs.

Methods: A subset of data on consumer perceptions of ultra-processed foods from a national consumer survey on consumers' menu ordering decisions was analyzed. Descriptive analysis was conducted to analyze quantitative data, and thematic analysis was employed to analyze qualitative open-ended questions.

Results: A total of 1,100 U.S. consumers participated in the survey. Most consumers perceived diet soda (76%) and chicken nuggets (71%) as UPFs. However, products marketed or perceived as "healthy" tended to be less likely to be identified as UPFs, with only 44% identifying protein bars as UPFs. Consumers associated different ingredients with UPFs, including flavor enhancers (67%), artificial colors (66%), and artificial sweeteners (63%). The top three processing methods consumers associated with UPFs included the use of processing aids (68%), extrusion (59%), and hydrogenation (57%). Almost half of consumers (49%) believed that food with a long ingredient list is automatically ultra-processed. Qualitative analysis revealed varying consumers' definitions of UFPs, ranging from foods undergoing extensive industrial processing to foods that have been altered from their original state. Overall, these findings suggest that while consumers tend to know the basis of UPFs, their understanding may be influenced by the type of foods, perceived healthfulness, ingredients, and food processing techniques.

Significance: Findings from this study emphasize the need and direction for targeted consumer education to address misperceptions and support informed food choices.

Mentor(s):
Han Chen (Agriculture); Yaohua Feng (Agriculture); Anushka Jayesh Shah (Agriculture)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1031
Presentation Time: Session 1: 9:00-10:00am

Tumor Progression and Survival Following Anti-Neu Antibody Treatment in Genetically Diverse F1 NeuT Mice

STEM

Authors(s):
Carson Dennis Cornell† (HHS)

Abstract:
Genetic variation may influence the responses to antibody cancer treatments and contribute to differences in tumor progression and total survival. Previous research has identified quantitative trait loci (QTL) on chromosomes 2 and 17 associated with antibody responses to HER2 targeted cancer vaccines. Building on this research, this study investigates tumor progression and survival following anti Neu monoclonal antibody (mAb) treatment in genetically diverse (BALB × Diversity Outbred) F1 NeuT mice.

45 mice were analyzed to examine relationships between tumor onset age, remission duration, tumor growth rate, and survival following relapse. As, remission duration is defined as the period in which tumors were absent from the mice. Finally, Pearson and Spearman correlation analysis was used to identify relationships between the previously stated variables.

To start, tumor onset ages ranged from 61 to 160 days, while survival following tumor onset ranged from 33 to 95 days. Tumor growth rate showed a strong negative correlation with survival following relapse (Pearson r = −0.72; Spearman p = −0.79), indicating that tumors that grew faster were associated with shorter survival after relapse. Remission duration was positively correlated with survival following tumor onset (Pearson r = 0.68, Spearman p = 0.78), although remission duration contributes directly to total survival. In contrast, tumor onset age showed little correlation with total survival (Pearson r = 0.04).

These findings highlight differences in tumor progression and survival following mAb treatment in genetically diverse mice. Building on previous QTL findings, this research may help identify genetic factors that influence treatment responses and support the development of more effective HER2 targeted cancer therapies.

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1032
Presentation Time: Session 1: 9:00-10:00am

Predicting Movie Box Office Revenue: A Data-Driven Analysis of Film Characteristics

Business Case Study

Authors(s):
Khari Alyssa Dennis† (DSB); Nyree Camille Ruiz† (DSB|JMHC); Marco Andres Nunez† (DSB); Viviana Montealegre Pinto† (DSB)

Abstract:
How accurately can movie box office revenue be predicted using historical movie metadata, and which film characteristics are the strongest predictors of financial performance? The team's goal is to build a predictive model for movie box office revenue using data from the past 2 decades while identifying the factors that contribute most strongly to a film's financial performance. Accurate revenue prediction can help producers, studios, and other entertainment industry stakeholders make more informed decisions about production budgets and project selection.

We plan to compare Multiple Linear Regression, Random Forest, and Gradient Boosting regressions using RMSE, MAE, R^2, and Adjusted R^2 to evaluate model performance. Our preliminary exploratory analysis suggests that with an increasing budget, movies tend to generate more revenue, although revenue varies significantly among movies with similar budgets. With our findings, we can create a conclusion that most movies created tend to be in English rather than other languages. Also, it was clear that thrillers are the most common genre, and many movies have around 15 to 20 crew members. Additionally, the distribution of movie scores has a slight left skew.

Our project aims to determine which movie characteristics are most useful for predicting box office revenue. These findings can inform business practices because they can guide the entertainment market toward which genre will create the most revenue in the foreseeable future. This will help the market because, with our data, directors will know which genre will have a higher satisfaction rate, which causes more revenue.

Mentor(s):
Adrian Hoffert Wolanski (DSB)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1033
Presentation Time: Session 1: 9:00-10:00am

Extending the Dimension of Taste: Umami

STEM

Authors(s):
Kyler Dong† (Science)

Abstract:
Food taste profiles were long categorized into four “basic tastes”: sweet, salty, sour, and bitter. In recent decades, sensory scientists have expanded this foundation to incorporate additional basic tastes, most notably umami. First identified in 1908 by Japanese chemist Kikunae Ikeda in kelp broth, umami is characterized by a deep, lingering savory quality. Although it only achieved formal scientific recognition as a fifth basic taste in the late 1900s, Chinese culinary traditions have utilized umami flavor profiles for centuries through techniques such as fermentation, curing, and extended simmering. These methods allow for the development of the umami profile that is renowned in Chinese cooking through natural means.

Ongoing research continues to evaluate candidate taste modalities, including fat, calcium, kokumi (richness), and metallic sensations, that may further broaden our understanding of human gustatory perception. This evolving search underscores both the intricate nature of human taste and the fluid boundary between empirical sensory science and culinary art. By examining peer reviewed and credible articles, this paper traces the historical identification and chemical mechanisms of umami, explores its foundational role in regional Chinese cooking techniques, and considers how the institutional acceptance of umami offers a framework for evaluating potential new taste categories in gastronomy.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1034
Presentation Time: Session 1: 9:00-10:00am

Verifying AI Computation Hardware Systolic Array using UVM

STEM

Authors(s):
Athena Maria Adelina Maria Adelina Dourado† (Engineering); Jensen Y Feng† (Engineering); Leonard Dominic Buss† (Engineering)

Abstract:
Systolic arrays are a useful hardware structure that drastically improves the efficiency of multiplying two arrays together by eliminating the structural overhead of traditional architectures. Previous work developed a parameterizable matrix multiplication accelerator in SystemVerilog, which must be thoroughly verified to ensure it functions correctly when fabricated. In this project, Universal Verification Methodology (UVM) will abstract the testing of the systolic array into higher-level transactions and sequences. Instead of manual pin-by-pin assertions every clock cycle, fields are randomized to create a comprehensive combination of inputs to load into the design. To verify the outputs of the model, their values will be compared against a bit-accurate C reference model integrated into the environment using the SystemVerilog Direct Programming Interface for C (DPI-C). This reference model performs round-to-nearest-even (RNE) 32-bit to 16-bit floating-point reduction, while concurrently computing higher-precision, true values to characterize the numerical error inherent to the 16-bit floating-point design. Ultimately, this methodology verifies the design's functional correctness and guarantees silicon readiness by verifying pipeline flow control via SystemVerilog Assertions (SVA), achieving 100% functional and code coverage closure, excluding justified dead code, and ensuring all targeted corner cases, error scenarios, and regression test suites pass consistently across multiple random seeds.

Mentor(s):
Srilekha Jagarlamudi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1035
Presentation Time: Session 1: 9:00-10:00am

Investigating Spontaneous Emulsification Within Adsorbed Microdroplets

STEM

Authors(s):
Jocelyn Dumouchel† (Science); Olivia Carol Perkins† (Science); Hannah Dengler* (Science)

Abstract:
This study explores spontaneous emulsification at the liquid|liquid interface and investigates various factors to propose a mechanism for spontaneous emulsification. Researchers conducted experiments in custom-fabricated cells with a transparent front pane to allow imaging inside the cell. Researchers deposited an organic microdroplet into an aqueous bulk using an electronic microinjector. In experiments requiring electrochemical measurements, researchers used a robotic positioner to place an SECM ultramicroelectrode inside the droplet. Researchers gathered visual data for all experiments using a high-resolution camera, and optical imaging revealed microdroplet inclusions. Electrochemical data supports that microdroplets are water as opposed to air or particulates because these droplets electrochemically interact with the SECM tip in the stochastic manner characteristic of water. To investigate the underlying mechanism, the researchers investigated the effects of several parameters on emulsion formation. Emulsion formation is the most pronounced in systems with a small droplet size, high interfacial tension, and semi-miscible organic droplet. These observed relationships suggest that aqueous microdroplet nucleation in the organic phase is driven primarily by gradients of interfacial tension that trigger Marangoni convection. Computational models support this as the most prevalent mechanism as well. Emulsification is critical in fields such as pharmaceuticals, petroleum extraction, and food production. Conventional methods require energy input to form the emulsion, and surfactants, cosolvents, or other molecules to maintain the emulsion. Spontaneous emulsification could provide a lower cost and lower energy alternative for emulsion formation.

Mentor(s):
Savannah Mireille Hatch (Science); Jeffrey Edward Dick (Science)

Other Acknowledgment(s):
Ashutosh Rana* (Science); Thomas A Everett* (Engineering)

Poster Presentation Abstract Number: 1036
Presentation Time: Session 1: 9:00-10:00am

Sleep Disparities Among Latino/a Youth: The Role of Family, Home, and Social Contexts

Social Science

Authors(s):
Emily Duong† (HHS|JMHC); Hyuntae Ow† (HHS)

Abstract:
Latino/a youth experience sleep disparities influenced by economic, sociocultural, relational, and home environmental contexts (Blanco et al., 2023). Adequate sleep is critical for physical and mental health, development, and peer connection (Nguyen-Rodriguez et al., 2023; Palmer et al., 2021). Latino/a youth report shorter and lighter sleep than their White counterparts (Nguyen-Rodriguez et al., 2023). Positive familial relationships may facilitate healthy sleep and buffer against risks contributing to sleep disparities (Sasser et al., 2021; Jeon et al., 2021). This review examined how family relationships and the household sleep environment shape sleep health among Latino/a youth, and how discrimination and structural, institutional, socioeconomic, migration, neighborhood, and rural conditions shape sleep health. Articles using key words such as sleep disparity, home environment, and rural Latino/a youth were retrieved from Google Scholar, EBSCOhost, and Purdue Electronic Materials, identifying 34 articles. Findings were compiled using Zotero and Microsoft Word. Parent-enforced bedtimes added 24 minutes of nightly sleep and lowered obesity risk (Jeon et al., 2021; Jones et al., 2025). Parental support signaled safety, reducing nighttime awakenings under acute stress (Tsai et al., 2018). Caregiver depression and high workloads increased sleep schedule instability (Kalil et al., 2014; Schmeer et al., 2019). Perceived discrimination was negatively correlated with sleep duration and positively correlated with depression and anxiety symptoms (Zhang et al., 2025; Alegría et al., 2024). Same-day discrimination experiences were positively correlated with sleep disturbance and daytime dysfunction the following day (Alegría et al., 2024). Findings highlight the importance of family support and communication, alongside broader social and structural conditions, in shaping Latino/a youth sleep. Future research should expand to understudied rural Latino/a agricultural youth.

Mentor(s):
Yumary Ruiz (HHS); Genesis Santiago Burgos (HHS)

Other Acknowledgment(s):
Zoe Taylor* (HHS)

Poster Presentation Abstract Number: 1037
Presentation Time: Session 1: 9:00-10:00am

From Rags to Retail Success: A Customer Insight and Marketing Strategy

Business Case Study

Authors(s):
Christian Edwards† (DSB); Kennadie D Woods† (DSB); Chase Matthew Furchner† (DSB); Addison William Day† (DSB); Lucia Flores Mtanous† (DSB); Grant Matthew Holzwarth† (DSB)

Abstract:
Rags to Riches is a vintage clothing store located in Lafayette, Indiana. Our primary focus is to increase brand awareness, customer foot traffic, and sales, particularly among Purdue University students and the greater Lafayette community. Through surveys, customer insights, and an analysis of the store's current marketing strategy, we intend to strengthen Rags to Riches's visibility and customer engagement. The business currently relies heavily on social media and digital marketing along with word-of-mouth marketing. The findings that come out of this research project will allow us to make strategic marketing recommendations designed to increase awareness, attract new customers, and encourage increased visits to the store.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1038
Presentation Time: Session 1: 9:00-10:00am

Forecasting U.S. Recession Risk for Lenders and Portfolio Managers

Business Case Study

Authors(s):
Spencer William Erfmeier† (DSB); Abris Benedek Kellermayer† (DSB); Aalia Fernandes† (DSB)

Abstract:
How early can a bank or portfolio manager tell that a U.S. recession is coming, and how much should they trust that signal before acting on it? A lender that waits for defaults has already taken the loss; an investor who pulls back a year too early sits in cash while markets climb. They need a monthly probability that moves with the evidence, so they can tighten credit standards, stress test a loan book, or delay a big purchase in proportion to the risk. Our data come from FRED, and each observation is one month: 603 months from June 1976 to September 2026, 592 with a 12-month forward label. We use five predictors: the 10Y/2Y Treasury spread (T10Y2Y), the 3-month Treasury rate (TB3MS), the Sahm Rule indicator, the unemployment rate (UNRATE), and year-over-year CPI inflation. The target equals 1 when an NBER recession begins within 12 months. We average the daily spread to monthly, convert CPI to a yearly change, trim to the shared sample, and lag each predictor to when it was actually available. EDA changed our plan: only 12.2% of labeled months are positive, so accuracy is off the table; the spread was inverted in 54% of positive months versus 12% of others, so it is the strongest single signal but misses almost half of warning months; and the Sahm indicator crosses its threshold only after recessions begin. Because predictors overlap, we standardize inputs, start with logistic regression on the spread alone, add the other variables, and then compare Random Forest and XGBoost under expanding-window validation. Our primary metric is the Brier score, which rewards honest probabilities, matching how a bank acts on the probability level rather than a yes/no flag; log loss, ROC AUC, and calibration are secondary. If tree models do not clearly beat logistic regression, the simpler model wins, since a risk team can explain and trust it.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1039
Presentation Time: Session 1: 9:00-10:00am

Humanity's Capability of Planetary Defense

STEM

Authors(s):
Colton Luke Evans† (Science)

Abstract:
Asteroid collisions are an existential threat, capable of ending society as we know it or even leading humans to extinction. If an asteroid came barreling towards Earth, could humanity deflect it, and if so, what is the method that is most likely to succeed? This project aims to assess humanity's capacity for planetary defense against an asteroid impact. The research process started with combing through peer-reviewed journals, evaluating and comparing their contents to find humanity's best chance at avoiding an asteroid impact. The papers held theories, simulations, and experimental results regarding a multitude of deflection methods, including kinetic device impacts, intermediate asteroid collision, lasers, and X-ray bursts from nuclear explosives. At our current level of technology, I conclude a combination of kinetic impactors, as seen in NASA's Double Asteroid Redirection Test (DART), where NASA crashed a spacecraft into an asteroid, and nuclear explosives shows the most promise in altering the trajectory of an Earth-bound asteroid. Both methods have benefits and drawbacks, so using kinetic impact devices and nuclear bombs covers the weaknesses of each method.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1040
Presentation Time: Session 1: 9:00-10:00am

LLM assistance for causal discovery and estimation

STEM

Authors(s):
Yuehuan Fang† (Science)

Abstract:
Causal discovery and causal effect estimation are fundamental tasks in causal inference. Recent studies have explored using large language models (LLMs) to assist causal discovery, either by eliciting causal knowledge directly from LLMs or by incorporating LLM-derived knowledge into data-driven graph learning. In this project, we investigate how LLMs can further assist causal effect estimation.

We implement and compare two approaches. The first uses an LLM-assisted causal discovery method to construct a causal graph and then identifies adjustment variables for a specified cause-effect pair. The second starts directly with the cause-effect pair and uses an LLM to identify appropriate adjustment variables, particularly confounders and colliders. We evaluate both approaches using a causal benchmark dataset. Our current results reveal implementation and methodological limitations of both approaches rather than demonstrating the superiority of either method, highlighting challenges and opportunities for integrating LLM knowledge into causal effect estimation.

Mentor(s):
Jun Xie (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1041

Presentation Time: Session 1: 9:00-10:00am

SPC Characterization of RC and Inductor Wafers in Birck Nanotechnology Center

STEM

Authors(s):
Brandon Anthony Farber† (Engineering|JMHC); Kyle Zhen-Han Wang† (Engineering); Yuwen Song† (Engineering); Nikhil K Raman† (Engineering); Nolan Cai Tai† (Engineering); Xin Chen Lu† (Engineering)

Abstract:
This project focuses on the development and integration of passive electronic components through thin-film fabrication, process characterization, and statistical process control (SPC). The current work involves establishing SPC methods for resistor-capacitor (RC) wafers while independently developing inductor wafers, with the long-term objective of integrating both components into a unified fabrication process flow to produce integrated RLC circuits. Atomic force microscopy (AFM) is a primary characterization technique used to investigate surface topology and evaluate the physical characteristics of the physical vapor deposition (PVD) process. These measurements support process monitoring and provide insight into deposition consistency and its potential effects on device performance. Inductor development emphasizes key electrical parameters, including quality factor (Q), internal resistance, and parasitic capacitance, which influence overall performance and operating frequency. Several fabrication and characterization constraints have been identified, including limitations on metal deposition thickness imposed by the available deposition equipment, the inductor's resonant frequency, and the maximum frequency accessible through the available measurement instrumentation. Addressing these constraints is essential to optimizing inductor performance and establishing a reliable process for component integration. Ultimately, this work aims to develop a repeatable, statistically monitored fabrication process that enables the integration of RC and inductor structures into a functional RLC circuit while improving understanding of the relationships between thin-film process characteristics and electrical performance.

Mentor(s):
Ryan Prado Bailey (Engineering); Chengyu Chiu (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1042
Presentation Time: Session 1: 9:00-10:00am

A Custom Ultrasound Front End and PZT Probe Toward Wearable Ultrasound

STEM

Authors(s):
Zixuan Fei† (Engineering|JMHC)

Abstract:
Wearable ultrasound offers the potential for continuous, non-invasive monitoring of deep tissue and physiological motion, but practical implementation requires both compact electronic hardware and a reliable acoustic probe. This project develops a custom ultrasound system as a first step toward a wearable platform by combining printed circuit board (PCB) assembly with ultrasound probe fabrication.

The electronic platform integrates an analog front end (AFE), analog-to-digital conversion, and microcontroller-based control to support ultrasound excitation, echo reception, and signal acquisition. The AFE is designed to generate excitation pulses, interface with the transducer, receive echo signals, and provide signal conditioning before digitization. In parallel, a custom probe is being assembled using a commercially available PZT-5 piezoelectric element targeting an approximately 5 MHz resonant frequency. The backing, conductive bonding, interconnect, matching, and encapsulation components are being selected and assembled by the team based on materials commonly used in wearable ultrasound transducers.

System assembly is currently in progress, and experimental results are not yet available. Planned validation will use pulse-echo measurements to evaluate the PCB and probe together. Testing will examine the transmitted pulse, received echo waveform, signal timing, and noise in order to assess excitation and acquisition performance and identify potential issues in the electronics or probe assembly.

This work aims to establish a functional ultrasound prototype and provide a foundation for further miniaturization of the electronics and development of a flexible, skin-mounted ultrasound platform.

Mentor(s):
Robert Jose Ccorahua santo (Engineering); Wenzhuo Wu (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1043
Presentation Time: Session 1: 9:00-10:00am

Learning Through Play: Designing a Financial Literacy Game to Strengthen Critical Thinking and Teamwork

STEM

Authors(s):
David Edward Funkhouser† (Engineering); Elizabeth Anne Brochet† (Engineering); Emmanuel Jose Chevalier† (Engineering); Jenna Reed Boknecht† (DSB); Nicole Elizabeth Bunag† (Engineering); Koji Robert Dennis‡ (Engineering)

Abstract:
Financial literacy, critical thinking, and teamwork are essential skills that help young people make informed decisions in everyday life. However, students often have limited opportunities to apply financial concepts to realistic situations that require collaborative problem-solving. Educational games can provide an engaging environment where students explore financial decisions, evaluate alternatives, and learn from their choices.

This project aims to design and develop an interactive educational game for middle and high school students participating in Junior Achievement programs. The proposed game will introduce realistic financial and business scenarios that encourage students to work collaboratively, analyze information, and make informed decisions. For example, students may be challenged to manage a business budget, allocate limited resources, or respond to unexpected financial situations. Each challenge will require students to consider different options, discuss possible consequences, and justify their decisions as a team.

The proposed design process will involve identifying age-appropriate learning objectives, developing game mechanics and scenarios, creating prototypes, and gathering feedback from stakeholders. Iterative testing will focus on improving the game's usability, engagement, and suitability for different age groups.

The anticipated outcome is an educational game that Junior Achievement can use to complement its existing programming. By connecting financial concepts with collaborative decision-making, the project seeks to create meaningful learning opportunities while demonstrating how game-based activities can support the development of practical financial knowledge, critical thinking, and teamwork skills.

Mentor(s):
Aparajita Jaiswal (Engineering); Dikai Xu (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1044
Presentation Time: Session 1: 9:00-10:00am

Synthesis and Structural Characterization of Cobalt Tellurium Clusters using Mass Spectrometry

STEM

Authors(s):
Jakub Gasiorowski† (Science)

Abstract:
The synthesis of metal-chalcogen clusters, such as Co6Te8(PEt3)6, consisting of a transition metal and chalcogen core surrounded by an outer phosphine ligand shell, is of significant interest to materials science due to their distinct charge transfer, catalytic, magnetic, and chemical reactivity properties. Our group is studying the reactivity of these promising building blocks on surfaces by selectively removing ligands and exposing reactive sites in the gas phase and subsequently depositing mass-selected fragments. These studies have revealed promising reactivity of these species, including the selective formation of dimers and oligomers by reactions between undercoordinated clusters. This work focuses on the synthesis and stability of fully-ligated clusters to inform future studies of their undercoordinated counterparts. We report a consistent, time-sensitive synthetic protocol that yields appreciable quantities of Co6Te8(PEt3)6 alongside an under-coordinated derivative, Co6Te8(PEt3)4. This derivative is stable in the gas-phase, providing a controlled route for future functionalization and oligomerization studies. Furthermore, this synthetic framework establishes a foundation for a broader exploration of the effect of chalcogen substitutions (such as replacing telluride with sulfur or selenium) and ligand substitutions using both mono- and diphosphines, to tune cluster stability and reactivity in upcoming deposition experiments.

Mentor(s):
Joshua Taylor Koval (Science); Julia Laskin (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1045
Presentation Time: Session 1: 9:00-10:00am

Finite Element Analysis of Non Uniform Tessellations

STEM

Authors(s):
Tanish Ghai† (Engineering); Benjamin Jay Weile‡ (Engineering|JMHC)

Abstract:
Tessellated structures, which are composed of repeating geometric tiles, are used across engineering applications ranging from panels to heat shield assemblies, since they include modularity and complete coverage of an area. Most designs rely on uniform tessellations, in which a single tile shape is repeated across the entire structure. Non-uniform tessellations, which vary size, shape, or arrangement, may offer advantages in stiffness, stress distribution, and resistance to cracking; however, their mechanical behavior and stress response is less well characterized. This project compares the response of non-uniform tessellations against uniform tessellations of equivalent overall dimensions under lateral loading. Models were designed in MATLAB and exported as STEP files, establishing a repeatable workflow for transferring detailed geometry into Abaqus for finite element analysis, allowing for infinite scalability. Each configuration was modelled as a 2D planar object, then included into an assembly of objects. They were then subjected to identical boundary conditions and lateral loads so that differences in response could be attributed to tile arrangement alone, being loading on one side and zero displacement or rotation on the other side. Key outputs include displacement, peak stress concentrations, lateral deflection, and Von Mises stress. Results are compared to determine whether non-uniform tile arrangements redistribute lateral load more effectively, reduce localized stress concentrations, or shift failure-prone regions relative to their uniform counterparts. This work aims to inform design guidelines for tessellated structures in applications where weight, durability, and manufacturability are critical, and more efficent processes can be used.

Mentor(s):
Thomas H Siegmund (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1046
Presentation Time: Session 1: 9:00-10:00am

Development and Characterization of a Photoresist Lithography "Soft Mask" Process for Through-Silicon Via Applications

STEM

Authors(s):
Bobby Gu† (Engineering); Leo Jeffrey Janert† (Engineering); Adithya Anand† (Engineering|JMHC); Aditya H Joshi† (Engineering); Arush R Katrekar† (Engineering); Gechun Guo† (Science)

Abstract:
This project focuses on developing a repeatable photoresist lithography process for through-silicon via (TSV) applications in advanced packaging and heterogeneous integration. TSVs enable vertical electrical interconnections that support increased integration density in 2.5D and 3D devices, which is important for creating more highly capable and compact microelectronics. The lithography process involves spin-coating photoresist onto silicon substrates, exposing the desired patterns, and developing the resist to define via openings.

Process development emphasizes controlling photoresist thickness, exposure conditions, and development parameters to improve pattern fidelity and uniformity. Characterization aims to assess opening dimensions, resist coverage, and pattern defects across repeated fabrication runs.

The study seeks to establish a reliable soft-mask recipe and produce consistently patterned samples for subsequent fabrication stages such as etching and deposition. This work supports a standardized lithography process that improves reproducibility and provides a foundation for coordinated TSV process integration. This TSV process integration will in turn support further advanced 3D packaging capabilities to inform future research and industry needs.

Mentor(s):
Peter Bermel (Engineering); Saeed Mohammadi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1047
Presentation Time: Session 1: 9:00-10:00am

The Effects of AI Teaching Science and Math

STEM

Authors(s):
Purujit Gujral† (Science)

Abstract:
Many students struggle with learning college level content and may resort to getting answers from AI. AI has a bad stigma for doing schoolwork for students which hinders students' ability to learn. But what if AI can help students with their schoolwork while also helping students understand the material? Can AI tailor made to tutor students be beneficial for learning content in science and math courses? In this research project I will examine if AI tutors can help students understand college level material better in science and math and why or why not. I want to know if some form of AI can be a good alternative for lectures and office hours. My review of the literature will examine AI tutors in multiple science and math courses to understand their performance and what makes them more or less effective than lectures. I will see whether AI can provide a strong learning experience in science and math. The findings of my research could help promote a new and accessible tool for students to use for a better understanding of science and math.

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1048
Presentation Time: Session 1: 9:00-10:00am

High Voltage Dust Removal for Solar Panels

STEM

Authors(s):
Yonathan Gur† (Engineering); Rudra Sarker Das† (Engineering)

Abstract:
Solar panels in dry dusty areas often accumulate dust particles on their surface. These particles block access to light for the panel and can greatly reduce the power generation by as much as 70% in desert regions near the equator. Although there are multiple ways to alleviate this, many of these methods have drawbacks including water usage, labor costs, and mechanical deterioration.

By using a transparent electrode on top of and above the solar panels and creating a large potential difference between them, a large electric field can be generated. This polarizes the particles and creates an electrostatic force on the particles which when combined with the tilt angle of the panel, will remove the dust and allow for efficient power production without the use of manual labor and water.

The goal of this research is to attempt to replicate the effects of previously conducted electrostatic dust removal studies using supplies that are more easily accessible than those used in the original study. This includes the use of simple plastic enclosures, a more affordable high voltage DC power supply, and more easily accessible ITO glass than the AZO glass used in existing studies. For a fully soiled solar panel, 95% of power is expected to be recovered through this technique, which can help increase deployment of photovoltaics in dry and dusty climates without depleting limited resources such as water.

Mentor(s):
Peter Bermel (Engineering); Muhammad A Alam (Engineering)

Other Acknowledgment(s):
Angshuman Deka* (Centers & Institutes)

Poster Presentation Abstract Number: 1049
Presentation Time: Session 1: 9:00-10:00am

Evaluation of a 22-Gene Genomic Classifier to Predict Biochemical Recurrence Following Radical Prostatectomy

STEM

Authors(s):
Ryan Yaw Gyasi-Nimako† (Science|JMHC); Aarav Mathur† (HHS)

Abstract:
Introduction: Pre-treatment prostate-specific antigen (PSA) has limited ability to predict biochemical recurrence (BCR) in prostate cancer (PCa) patients, leaving a critical gap in identifying candidates for intensified therapy.

Objective: To evaluate the predictive performance of pre-treatment serum PSA versus a 22-gene genomic classifier (Decipher) and its underlying biosignatures in predicting BCR post-radical prostatectomy (RP).

Methods: A retrospective secondary analysis evaluated 50 PCa patients undergoing RP under IRB #26266. Pre-treatment biopsy samples were analyzed using the Decipher assay. Patients were stratified into BCR (22%, n=11) and non-BCR (78%, n=39) cohorts over a 36-month follow-up. Statistical comparisons of pre-treatment PSA, composite Decipher score, and individual gene sub-scores were performed.

Results: Among the 50 patients evaluated, 11 (22%) experienced biochemical recurrence (BCR) within 36 months following radical prostatectomy, while 39 (78%) did not. Pre-treatment serum PSA was significantly higher in patients who developed BCR compared to those who remained recurrence-free (12.04 ± 7.70 ng/mL vs. 6.88 ± 3.01 ng/mL, p = 0.005). Similarly, the composite Decipher overall score was significantly elevated in the BCR group compared to the non-BCR group (0.787 ± 0.20 vs. 0.523 ± 0.24, p = 0.002). When analyzing individual Decipher gene sub-scores, patients in the BCR cohort exhibited higher mean expression levels across several key biomarkers compared to non-BCR cases, including PSMA (57.36 ±33.59 vs. 50.15 ± 20.23), AR (44.91 ± 26.88 vs. 29.85 ± 19.07), P53 (38.18 ± 21.67 vs. 25.69 ±20.40), PTEN (0.57 ± 0.29 vs. 0.39 ± 0.23), and ERG (0.57 ± 0.49 vs. 0.39 ± 0.48).

Conclusion: Both pre-treatment serum PSA and the composite Decipher score significantly stratify the risk of BCR following RP. While individual

gene sub-scores trended higher in BCR cases, the overall Decipher score provides strong predictive value for disease recurrence.

Mentor(s):
Oluwaseyi Michael Oderinde (HHS)

Other Acknowledgment(s):
Carly M Reynolds* (Science)

Poster Presentation Abstract Number: 1050
Presentation Time: Session 1: 9:00-10:00am

Dipping Out: Why Customers Bypass the Hummus Republic App

Business Case Study

Authors(s):
Olivia Rose Hasenkamp† (DSB|JMHC); Alexis Nicole Coberg† (DSB); William Henry Donahue† (DSB); Anisha Nanda† (DSB|JMHC); Andrea Pellizzari‡ (DSB|JMHC); Samantha Bailey Byrnes‡ (DSB|Liberal Arts|JMHC)

Abstract:
The Hummus Republic is a fast casual Mediterranean franchise that offers a mobile app and points based loyalty program. However, the current CEO reports that customers are rarely using the app to order, and often turning to third parties like DoorDash and Uber Eats. This directly impacts the businesses ability to profile its customers and retain loyalty. Our team partnered with Hummus Republic to answer the following research question: where in the customer journey does the loyalty program break down and what changes would cause customers to increase adoption and order directly? Our objectives are to determine if customers know whether or not the app exists, find out if customers are aware of it, why they aren't using it, and develop a clearer understanding of the Hummus Republic customer. We apply consumer behavior frameworks of motivation, and consumer involvement to analyze the problem. Our methods include a review of the existing program and app, external secondary data, and internal point of sale data. This work will result in strategic recommendations for improving the loyalty program or app, which we will present directly to the Hummus Republic. Beyond this single business, the project offers insights into other franchises seeking a similar solution with issues of third party app use.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1051
Presentation Time: Session 1: 9:00-10:00am

PeteChat: AI for Education

STEM

Authors(s):
Gaetano Antonio Iannotta† (Engineering); Jason Jaeho Song† (Liberal Arts|Science); Bharath Anand† (Engineering); Tyler Daniel Grabowski† (Engineering); Henry Patrick Breen† (Science); Boyang Wu‡ (Engineering); Zhenghao Xu‡ (Engineering); Anay Misra‡ (Scie

Abstract:
[Abstract Redacted]

Mentor(s):
Qiang Qiu (Engineering); Wei Zakharov (Libraries); Colby Acton (Engineering); Wei Chen (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1052
Presentation Time: Session 1: 9:00-10:00am

Social Engineering Prevention Strategies for University Students

STEM

Authors(s):
Nikhita Iyer† (Liberal Arts|Polytechnic)

Abstract:
Every day, whether in work or school, we use technology and digital communication. A particular threat that we encounter frequently is social engineering, the exploitation of human psychology to gain unauthorized access to sensitive information and computer systems. In a university setting, one of the most common forms of social engineering students encounter is phishing: emails, text messages, or phone calls that attempt to trick or pressure students into disclosing sensitive information. This can lead to data breaches and account compromises that threaten the digital safety of the university. The purpose of this research is to find which solutions are most effective in preventing social engineering related compromises in a university context. Previous research has established methods of spreading awareness and preventing attacks, and this research will focus on comparing effectiveness between different methods in a university setting. They will be evaluated using a combination of existing research on the effectiveness of these methods and surveys of university students' perceptions of their effectiveness. By comparing solutions using existing research and student perceptions, this research may help determine which solutions to implement to prevent students from interacting with phishing emails or other forms of social engineering and ultimately protect the digital safety of the university.

Keywords: Cybersecurity, social engineering, phishing, cyberpsychology, phishing awareness

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1053
Presentation Time: Session 1: 9:00-10:00am

Application of Shear-Wave Elastography to Differentiate Dystrophic and Healthy Skeletal Muscle in a Murine Model of DMD

STEM

Authors(s):
Ayush A Kabirpara† (Engineering|JMHC)

Abstract:
Duchenne muscular dystrophy (DMD) is a progressive X-linked genetic disorder characterized by skeletal muscle weakness, degradation, and replacement of muscle tissue with fat and connective tissue [1]. There is a need for noninvasive methods that can provide meaningful information about changes in affected skeletal muscle in longitudinal preclinical studies to capture progression. Ultrasound shear-wave elastography (SWE) is an emerging imaging technology that quantitatively assesses tissue stiffness and may characterize mechanical changes in dystrophic muscle [2]. Here we explore the application of SWE to skeletal muscle in a murine model of DMD. The vastus lateralis (VL) muscle was selected as a target muscle, and SWE measurements were performed on the left legs to evaluate the ability to distinguish between healthy and dystrophic muscle. SWE measurements were acquired in 29-week-old D2.mdx (DMD model) and DBA/2J control male mice (n=5, both groups, Jackson Laboratories). D2.mdx mice demonstrated substantially higher mean VL muscle stiffness than DBA/2J controls, with average SWE measurements of 14.8 +/- 3.9 kPa for the D2.mdx mice and 5.0 +/- 2.3 kPa for the DBA/2J control mice. This difference was statistically significant ($p < 0.01$), indicating that SWE was able to distinguish between dystrophic and healthy muscle. This work demonstrates that SWE can provide meaningful insight into skeletal muscle changes associated with DMD. Future work will focus on consistency studies, evaluating multiple time points to determine whether SWE-derived stiffness measures can track disease progression, and ultimately investigating the utility of SWE for assessing skeletal muscle changes in response to therapeutic interventions.

[1] A. B. B. Angulski et al., “Duchenne muscular dystrophy,” Frontiers in Physiology Jun. 2023, doi: 10.3389/fphys.2023.1183101. Available: https://pmc.ncbi.nlm.nih.gov/art

[2] L. Lacourpaille et al.,“Effects of Duchenne muscular dystrophy on muscle"

Mentor(s):
Benjamin Zeidler (Engineering); Craig Goergen (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1054
Presentation Time: Session 1: 9:00-10:00am

Reintroduction Programs: Are They Worth It?

STEM

Authors(s):
Emma Jayne Karber† (Vet Med|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1055
Presentation Time: Session 1: 9:00-10:00am

Predicting Hotel Booking Cancellations to Support Operational Decision Making

Business Case Study

Authors(s):
Roneet Khattar† (DSB); Krish Bansal† (DSB); Ryan Scott Petranek† (DSB)

Abstract:
How can hotels better anticipate reservation cancellations to improve staffing, room availability, and overbooking decisions? This project aims to develop a classification model using information available at booking to estimate cancellation risk and reduce uncertainty in hotel operations. The Hotel Booking Demand dataset contains 119,390 reservations from a resort hotel in the Algarve and a city hotel in Lisbon between 2015 and 2017. It includes 32 variables, consisting of 31 potential predictors and the cancellation outcome. Key variables include lead time, room type, daily rate, customer characteristics, and booking channel. Preliminary analysis shows a 37.0% cancellation rate. Canceled bookings averaged 144.8 days of lead time, compared with 80.0 days for honored bookings, suggesting lead time may help predict cancellations. Data preprocessing will address missing values, duplicates, inconsistent data types, and potential leakage through scaling, one hot encoding, and feature engineering. Logistic regression will serve as an interpretable baseline model. Decision trees and random forests will also be evaluated because they can capture nonlinear relationships and interactions between booking characteristics. F1 score will be the primary evaluation metric because balancing missed cancellations and false alarms is important for operational decisions. Five fold cross validation will assess model performance and consistency. The models are expected to identify reservations with elevated cancellation risk. More importantly, these predictions could help managers anticipate occupancy fluctuations, adjust staffing and room availability, and make informed overbooking decisions. By estimating cancellation probabilities early, hotels could better allocate resources, reduce operational uncertainty, and limit financial losses from inaccurate occupancy forecasts.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1056
Presentation Time: Session 1: 9:00-10:00am

SOCET GPU Team Non-Senior Design: Vertex Stage for Fixed-Function GPU

STEM

Authors(s):
Jihee Kim† (Engineering); Noah Zhu† (Engineering); Zhicheng Benjamin Li† (Engineering)

Abstract:
The Birdy Graphics Processing Unit (GPU) is a subproject within the SoCET GPU team. It is a small, fixed-function GPU that aims to run basic graphics workloads, teach students about the basics of graphics processing and serve as a launching point for future projects. Many specifics of existing GPUs are industry secrets so the majority of our references come from open graphics libraries like OpenGL, however this only gives direction on the outcomes but gives no information on the actual hardware implementation. So this implementation is almost completely custom. The outcome of the Birdy GPU will be an FPGA emulation rendering a rotating fish with 480p resolution @60 frames per second with a clock speed of 125 MHZ fitting on a spartan 7 50t FPGA(pretty small area).

Within the Birdy GPU project, this team will create the Vertex stage, which is the first stage of the graphics pipeline. Taking triangles from a 3d world space and transforming them to a 2d space on the screen while maintaining all the correct scaling and positions through matrix multiplication and other operations.

This team is not the bottleneck in the GPU so the focus will be on saving resources for later stages to use. As such most of our operations will not be happening in parallel but instead focus on fast sequential computation with minimized time waste between computations. This increases the complexity of the control logic to orchestrate the whole stage but drastically reduces the resource utilization aligning with the focus. After the initial Birdy implementation is complete, future possibilities include added lighting support in hardware or making the stage wider to accommodate more throughput.

Mentor(s):
Charles Spencer Bowles (Engineering); Zach Anthony Barna (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1057

Presentation Time: Session 1: 9:00-10:00am

Novel Therapeutic Advancements Against Enterococcal Infection

STEM

Authors(s):
Olivia Lucille Kimmick† (Science); Alessia Lin Heiser† (Science)

Abstract:
A major challenge in modern medicine is hospital-acquired bacterial infections that are becoming increasingly resistant to antibiotic treatment. The rise of the ESKAPE pathogens (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, and Pseudomonas aeruginosa) has made this issue even more difficult to combat. Vancomycin-resistant Enterococcus faecium (VRE), is a clinically significant pathogen associated with hospitalization. Antibiotic treatment of VRE is limited by both the intrinsic and acquired resistance harbored by the bacterium. New effective treatments are needed to help combat VRE antimicrobial resistance. Circular antimicrobial peptides (AMPs) are emerging as one such treatment due to their broad spectrum of possible targets as well as their stability. In this study, novel AMPs were obtained and screened against the VRE strain Enterococcus faecium HM-952. In vitro, antimicrobial susceptibility was tested by assessing the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). The results showed that numerous AMPs have strong inhibitory activity against Enterococcus faecium HM-952 and warrant further testing. A time-kill assay was performed to determine the impact of the AMPs on bacterial growth over time. Multiple AMPs showed a decrease in growth compared to untreated bacteria. Toxicity screenings showed that the screened AMPs did not decrease the viability of Caco-2 cells. These strong candidates are planned to undergo additional in vitro tests to examine their mechanisms of action and pinpoint their targets, while also testing more strains and concentrations to obtain a broader panel of results. The goal of these experiments is to advance these compounds towards in vivo testing in mouse infection models. Ultimately, we hope to provide a promising therapeutic solution against the continuously evolving enterococcal infections.

Mentor(s):
Ahmed Abdelkhale Hassan (Vet Med)

Other Acknowledgment(s):
Mahmoud Adel Mohamed Sayed Ahmed* (Vet Med); Ahmed Abdelaleem Abdelhafeez Mohammed* (Vet Med)

Poster Presentation Abstract Number: 1058
Presentation Time: Session 1: 9:00-10:00am

Parametric Study of Vanadium Produced Via Laser Powder Bed Fusion

STEM

Authors(s):
Kyle Klaas† (Engineering|JMHC)

Abstract:
Vanadium is widely recognized for its high strength-to-weight radio, high melting point, and low neutron absorbance cross-section. Consequently, vanadium is a highly promising alternative to traditional tungsten monoblocks, which suffer from parasitic energy loss due to their higher neutron absorption. Despite this potential, studies on vanadium prepared by laser powder bed fusion (LPBF) remain scarce. This poster will discuss the printability of V through a systematic printing parameter study. By correlating the processing window with optical microscopy, SEM and EBSD characterization, we will discuss how LPBF parameters dictate the resulting microstructural evaluation and mechanical properties of V.

Mentor(s):
Xinghang Zhang (Engineering)

Other Acknowledgment(s):
Tanner O McElroy* (Engineering); Patrick Zhang Tong Hearne* (Engineering)

Poster Presentation Abstract Number: 1059
Presentation Time: Session 1: 9:00-10:00am

Detection of Unknown N-Nitrosamines in Cosmetic Products via HPLC/MS/MS

STEM

Authors(s):
Abigail Koons† (Science)

Abstract:
[Abstract Redacted]

Mentor(s):
Hilkka Kenttamaa (Science); Razieh Zamani (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1060
Presentation Time: Session 1: 9:00-10:00am

A Population Study of the Physical Parameters of Type-I Superluminous Supernovae

STEM

Authors(s):
Vihitha Kumar† (Science); Gabriella Smith† (Science|JMHC); Preston Jacob Scott† (Science); Mathias Logan Allen† (Science)

Abstract:
Superluminous supernovae (SLSNe) are a rare class of supernovae classified by their high peak luminosities that are at least an order of magnitude greater than those observed from standard supernovae. Some of the approximately thirty SLSNe that are detected each year are type-I superluminous supernovae (SLSNe-I), characterized by their lack of prominent hydrogen features in their emission spectra. The high luminosities of SLSNe require an additional source of energy beyond radioactive decay. A favored interpretation is the presence of a central engine, in the form of a magnetar or pulsar, that continually deposits energy into the system. To better understand the progenitor system and the explosion mechanism powering SLSNe-I, tighter constraints on their physical properties are needed. As of October 2026, the ZTF Bright Transient Survey has classified over 100 SLSN-I events. We will model multiband light curves of a sample of these events utilizing magnetar models implemented by the Bayesian inference package Redback. By doing this, we will be able to infer physical parameters such as rotational period, ejecta mass, ejecta velocity, magnetic field strength, and corresponding uncertainties of the SLSN-I population. We will present the distribution of inferred physical parameters calculated from our models of over 100 SLSN-I events ranging from 2018 to 2026.

Mentor(s):
Andy Jung (Science); Danny Milisavljevic (Science); Lauren Grace Murphy (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1061
Presentation Time: Session 1: 9:00-10:00am

Design and Verification of a SystemVerilog Triangle Rasterizer for a fixed-function GPU

STEM

Authors(s):
Connor Matthew Lai† (Engineering); Jack Mangas† (Engineering|JMHC); Minseok Kim† (Engineering)

Abstract:
Rendering a three-dimensional scene requires processing large amounts of geometric data, which can be computationally expensive for a general-purpose central processing unit (CPU). Graphics processing units (GPUs) address this challenge through specialized hardware organized into a graphics pipeline, a sequence of stages that transforms geometric data into pixels on a screen. One stage, rasterization, identifies the screen locations covered by triangles and generates fragments containing information needed to render them. Although established rasterization algorithms efficiently determine triangle coverage, implementing them in hardware requires balancing processing speed, accuracy, and resource usage. This project builds on these findings by developing and evaluating a SystemVerilog rasterizer for Birdy, SoCET's fixed-function GPU, using bounding-box traversal as a baseline for future architectural improvements. The rasterizer receives three triangle vertices, constructs a bounding box, and examines candidate pixels within it. Using Juan Pineda's edge-function algorithm, it identifies covered locations and applies affine interpolation to calculate depth and texture coordinates. The design targets evaluating one candidate pixel per clock cycle. We will evaluate coverage correctness against expected results, fragment throughput, processing latency, and hardware resource usage. Because the design checks pixels sequentially, cycles may be spent on locations outside the triangle; affine interpolation also cannot provide perspective-correct attributes. Future work includes parallel evaluation, more efficient traversal, and integration with the remaining GPU stages to enable complete image rendering and provide a reusable platform for evaluating graphics performance and hardware complexity.

Mentor(s):
Charles Spencer Bowles (Engineering); Zach Anthony Barna (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1062
Presentation Time: Session 1: 9:00-10:00am

Spice It Up! Gaining Loyalty in Local Restaurant Business Marketing Strategy

Business Case Study

Authors(s):
Cameran Mai Lancaster† (DSB|JMHC); Sydney M Eckert† (DSB|Liberal Arts|JMHC); Zoe Carpenter† (DSB); Gabriella Anne Thorn† (DSB); Armani Bearden† (DSB|Liberal Arts); Ava Marie Yu† (DSB)

Abstract:
This project examines what prevents customers from spending more money during their dining experience at Salt of the Earth Bistro in Lake Placid, New York. The research uses survey data from a consumer base as well as internal business data and publicly available data. Our data sets include the public's dining experience preferences and overall restaurant attendance and specific menu purchase patterns. Through this internal data, we will dive deep into day-of-the-week patterns, attendance fluctuation, and customer behavior.

The results will identify what drives increased spending per guest at the Salt of the Earth Bistro, as well as provide new strategic opportunities for attracting new loyal customers through in house experience and online presence. We will provide actionable insights towards marketing strategy. The desired outcome is to increase repeat visits, increase spending by existing customers, and attract new customers.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1063
Presentation Time: Session 1: 9:00-10:00am

Development of an Interchangeable End Effector for Heavy Loads - Humanoid Robot Club

STEM

Authors(s):
Matthew Lau† (Engineering)

Abstract:
Purdue's Humanoid Robot Club is designing and developing a humanoid robot capable of performing complex tasks in space that would otherwise require human astronauts. To achieve this goal, we must develop individual systems that let the robot operate tools, adapt to different tasks, and lift heavy loads. Our team is working toward creating an interchangeable end effector that will improve the robot's ability to balance and lift heavier objects.

This project focuses on the overall design and feasibility of an interchangeable end-effector system that would improve the load-handling capabilities and versatility of the club's humanoid robot. Our main objective is to determine which mechanical designs are best suited to withstand heavy loads while maintaining secure and interchangeable attachments.

Some of our initial design concepts include five-fingered and three-fingered grippers, along with the possibility of coupling both robotic arms together to distribute heavier loads. Additional considerations include actuator selection, force transmission, and developing a quick-connect mechanism that allows the end effector to be easily exchanged. Potential attachment methods include twist-lock mechanisms, magnetic alignment, and other mechanical locking systems capable of maintaining a secure connection under heavy loads. We plan to primarily use CAD modeling and structural analysis to evaluate the different designs, identify areas of high stress, and determine which configurations would be most suitable for our goals.

Through researching existing designs and evaluating our proposed configurations, we aim to develop an end-effector system that can lift heavy loads while maintaining structural reliability and modularity. Overall, this project will contribute to the club's broader mission of developing adaptable humanoid robotic systems capable of assisting with future space exploration.

Mentor(s):
Jaeeun Kim (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1064
Presentation Time: Session 1: 9:00-10:00am

Adapting CLEAN for Enzyme Annotation Using Reaction Templates

STEM

Authors(s):
Burhanuddin Sajidbhai Laxmidhar† (Science)

Abstract:
Accurate enzyme annotation is essential for understanding biological processes and identifying useful catalysts. However, assigning functions to understudied enzymes and enzymes with multiple catalytic activities remains challenging. This project investigates whether reaction templates, which describe patterns of chemical transformation, can support accurate prediction of enzyme function from protein sequences.

We adapted Contrastive Learning-enabled Enzyme ANnotation (CLEAN), a framework originally designed to predict Enzyme Commission (EC) numbers, to predict reaction-template labels. Our approach combines ESM-1b protein sequence embeddings with Rhea-derived reaction-template annotations linked to Swiss-Prot proteins. The preprocessed dataset contains 173,626 proteins, 11,832 reaction templates, and 485,993 protein-template associations. We modified the data processing, training and prediction pipeline to use reaction templates while retaining CLEAN's core learning framework and support for proteins associated with multiple labels.

The resulting pipeline enables training and inference using reaction-template annotations. We are currently evaluating models trained under different configurations on enzyme sequences excluded from training to assess prediction accuracy and generalization. These experiments examine how effectively the adapted framework recovers known reaction-template annotations for previously unseen sequences.

By connecting protein sequence representations with reaction chemistry, this work evaluates reaction-template prediction as an alternative approach to sequence-based enzyme annotation, with potential applications in characterizing understudied enzymes.

Mentor(s):
Karthik Sankaranarayanan (Agriculture|Engineering); Joel Jenson Kuriakose (Agriculture|Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1065
Presentation Time: Session 1: 9:00-10:00am

The Impact of Canadian Wildfires on Midwest Air Quality

STEM

Authors(s):
Avryn Glynis Leary† (HHS); Joshua Furst† (HHS); Kenna Lyn Wollard† (HHS); Morgan Brianna Hirschhorn† (HHS|JMHC); Cassidy Rose Nevitt† (HHS)

Abstract:
Background: Over the past few years there has been a marked increase in the occurrence and severity of Canadian wildfires. The smoke generated from these wildfires is capable of reaching midwestern areas and negatively impacting the air quality.

Methods: This study is a literature review focusing on existing data regarding the trends of occurrence and severity of Canadian wildfires as well as the impacts of particulate matter.

Results: A study analyzing Canadian wildfires from 1959-2025 found that the area burned by the wildfires from 2017-2025 was 3 million hectares greater from the entire 1959-2016 period. 2023 and 2024 were the worst and second worst years where 6000 fires burned 15 million hectares, and 5581 fires burned 5.3 million hectares, respectively (Tymstra & Flannigan, 2025).

As for the impact of these fires on air quality, in the 2023-2025 period, the carbon emissions were 574, 243, and 308 teragrams of carbon per year. These are the highest values in the previous two decades (Chen et al., 2026).

Beyond carbon emissions, Canadian boreal wildfires also released substantial amounts of reactive nitrogen. Satellite-based estimates indicate that wildfire-related ammonia (NH_3) emissions in northern Canada averaged 0.86 Tg N per month during the 2023 fire season (Chen et al., 2025). These emissions may contribute to secondary particulate matter formation, highlighting an additional pathway through which wildfires can affect air quality.

Regarding PM2.5 exposure, the annual mean for the Midwest in 2023 increased by 3.13 µg m-3 (Zhang et al., 2025).

Conclusions: Overall, the severity of Canadian wildfires has increased in recent decades in the number of wildfires and areas burned as a result. Due to these fires, the carbon emissions increased, as well as general PM2.5 emissions. These emissions can contribute to poor air qualities indices for areas in the Midwest (Bingham, 2024).

Mentor(s):
Mark Wilson (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1066
Presentation Time: Session 1: 9:00-10:00am

The Climate Cost of Putting Patients to Sleep

STEM

Authors(s):
Cheyi Lee† (Science)

Abstract:
Every year, millions of surgical patients receive general anesthesia as inhaled gases, which they later exhale largely unchanged into the atmosphere. Several of these gases are strong greenhouse gases. Desflurane and nitrous oxide used for anesthesia trap more heat than carbon dioxide from exhaust fumes, and nitrous oxide also damages the ozone layer. Consequencely, anesthesia contributes a surprisingly large portion of hospitals' carbon footprint. This project asks how the chemical structures of common inhaled anesthetics determine their climate impact, and whether lower-impact alternatives can provide equally safe patient care. To answer this question, I will collect published research from chemistry, environmental science, and clinical medicine. I will compare the atmospheric lifetimes and warming potentials of chemicals used for anesthesia: desflurane, sevoflurane, isoflurane, and nitrous oxide. Then, I will review clinical outcomes of alternatives such as gas-capture technology. I also plan to interview a practicing anesthesia provider about how impactful a doctor's decision in the operating room to our environment. The goal of this research is to show general audiences how molecular chemistry connects everyday medical decisions to global climate change.

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1067

Presentation Time: Session 1: 9:00-10:00am

Autonomous Tenth-Scale Purdue Grand Prix Car

STEM

Authors(s):
Alejandro Jose Lima† (Engineering); Aadya Abhyankar† (Engineering); Adir Shtalryd† (Engineering); Pearl Wadhwa† (Engineering); Arahan Amit Shah† (Engineering)

Abstract:
Autonomous vehicles rely on the integration of complex hardware, software, and theoretical models to independently navigate and interact with the environment. Translating these algorithms into physical systems introduces significant challenges, including sensor noise, communication delays, and computational constraints. This project investigates the transition from a simulated environment to physical hardware through the development of a 1/10-scale autonomous car using the HOUND and F1TENTH platforms as technical foundations. Rather than maximizing speed or constructing novel algorithms, the project emphasizes practical applications of control theory, robotic software, and embedded hardware, with the goal of reliably completing an autonomous lap on the Purdue Grand Prix track. The system architecture defines perception, localization and state estimation, path planning, control, and actuation as the building blocks for the vehicle. LiDAR and RGB-D cameras will supply environmental measurements, GPS and inertial sensors will estimate the pose of the car, and a single-board computer will serve as the computing platform connecting sensor outputs to high-level algorithms and a microcontroller for low-level actuation. This architecture allows individual subsystems to be developed and validated before full integration. Prior to hardware implementation, the localization, mapping, and control algorithms will be evaluated in a software-in-the-loop (SIL) simulation environment integrated with the Robot Operating System (ROS). Throughout the simulation phase, various control algorithms such as Pure Pursuit, proportional-integral-derivative (PID), and model predictive path integral (MPPI) control will be studied and compared. Further development will evaluate path-tracking accuracy, sensor and algorithm reliability, and characterize the differences in performance between simulated and real environments.

Mentor(s):
Andres Felipe Hoyos Moreno (Engineering); Reed Joseph Freer (Engineering); Samuel Labi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1068
Presentation Time: Session 1: 9:00-10:00am

Designing Hand-Tracking Interaction for Virtual Yoke and Cockpit Controls in VR Flight Simulation

STEM

Authors(s):
Yu-Hsien Liu† (Engineering|Science)

Abstract:
Virtual reality flight simulation can provide an immersive cockpit experience, but many setups still depend on physical yokes, buttons, or handheld controllers. This project explores a hand-tracking interface that replaces selected physical cockpit controls with virtual interactions. A virtual yoke will use tracked hand position and rotation to control aircraft pitch and roll, while secondary cockpit functions such as landing gear, flaps, autopilot, lights, and trim will be controlled through symbolic gestures and hand motions. The project focuses on designing suitable interaction methods for both continuous controls, such as the yoke, and discrete or multi-state cockpit controls. The prototype will be integrated with Microsoft Flight Simulator in a virtual reality environment. The system will be evaluated using measures such as recognition accuracy, response time, and unintended activation rate. The goal is to identify a practical gesture-mapping approach that can provide reliable and intuitive control in a virtual cockpit while reducing dependence on dedicated physical hardware.

Mentor(s):
Steven R Dunlop (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1069
Presentation Time: Session 1: 9:00-10:00am

NSWC AIMM ICC Autonomous Boating Challenge

STEM

Authors(s):
Jacob Charles Long† (Engineering); Sean Peter Steinmetz† (Engineering); Zheng Yang Stephen Lim† (Engineering); Benjamin Charles McTarsney† (Engineering); Margulan Mukhametkarim† (Engineering)

Abstract:
RoBoat: Development of an Autonomous Low-Profile Surface Vessel

This project is about cleaning up the wiring and designing a math model on "RoBoat," a

self-driving boat built for the Crane Naval Surface Warfare Center's AI Maritime Maneuver

Indiana Collegiate Challenge (a student competition). Right now, the boat's wiring is messy and

hard to maintain resulting in electrical noise that disrupts the sensors. To fix this, a full wiring

schematic will be designed and utilized. Ultimately, power should flow through breakers, fuses,

and relays (electrically controlled switches) so that the wires carrying heavy motor current are

kept separate from the sensitive sensors the boat uses to navigate on its own.

Simultaneously, a math model of the boat's movement (12.5 ft x 3.5 ft x 2 ft) is being built. The

boat will be treated as a single point with all its weight in one spot. The model will then calculate

how the boat speeds up or slows down in each direction (x, y, and z). The model will account for

forces including (but not limited to) the push from the motors, wind, water, gravity, and buoyancy

(the upward force of water).

The electrical schematic will aid in analyzing several electrical factors including current draw in

the different systems of the boat and thermal management of the ESCs (Electronic speed

controllers) that drive the motors of the boat. A math model detailing accurate weight distribution

and motor control will enable the simulation of the boat's performance with different path finding

algorithms. The model also allows for the tuning of the boat's differential drive system without

the risk of damaging parts in real life. Together, the cleaner wiring and the motion model will

create a reliable base for driving the boat and efficiently completing the competition tasks

autonomously.

Mentor(s):
Andres Felipe Hoyos Moreno (Engineering); Reed Joseph Freer (Engineering); Richard Ajagu (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1070
Presentation Time: Session 1: 9:00-10:00am

The Effects of Mobile Phone Use in Adolescents

Social Science

Authors(s):
Ronni Lozano† (Polytechnic)

Abstract:
Close to 90% of United States of America's adolescent population own or have access to mobile phones and use them frequently. This research paper aims to explore the positive and negative effects on adolescents aged 12-17-years-old when they have these phones. This paper will draw from peer-reviewed articles focusing on mental health, physical health, and attention span in school. What are the changes in health, changes in attention span, and the correlation to education with phones? What is considered too early for a child to have access to a mobile phone? What age is the best to give a phone to preserve some mental health? A study in 2022 found that 83% of children in the UK 12-15-years-old own a smartphone and 64% have 3-or-more devices of their own. It was found suggestive but limited evidence that greater use of say social media may have been associated with poorer mental health in adolescents. A study in 2026 investigated whether 15-17-year-olds who got their first mobile phones between 1-15-years-old have an association with psychosocial functions. They found that the first device is typically received before the age of 11 or 12, and daily use was started by the age of 13. Estimated approximately half of mental disorders begin before the age of 18, and prevalence of major depressive episodes have increased in recent years, affecting approximately 16% in the United States.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1071
Presentation Time: Session 1: 9:00-10:00am

Testing undercut anchors in cracked concrete for seismic applications.

STEM

Authors(s):
Ivan Daniel Marquez Julio† (Engineering)

Abstract:
Post-installed anchors are metal elements set in holes drilled into hardened concrete. For undercut anchors, the bottom of the hole is enlarged, creating a mechanical interlock with the concrete. When a structure is subjected to seismic loading, the concrete may crack. These cracks open and close during the earthquake while the anchor remains under tension load. This crack cycling can reduce the anchor's capacity; therefore, qualification standards such as EOTA TR 049 require anchors to be tested under these conditions before use in seismically active regions. This project evaluates the tensile performance of undercut anchors under crack cycling using computer-controlled actuators, with data recorded by a data acquisition (DAQ) system. First, a hairline crack passing through the anchor borehole is induced. Next the anchor is installed in the test specimen with its fixture; the installation torque is applied and held for 10 minutes, then released and reapplied at 50% to simulate preload loss over time. The specimen is then mounted in the test setup, where the crack is fully closed, and crack opening and closing cycles begin while a sustained tensile load is applied to the anchor. Load cells measure the loads, a potentiometer measures anchor displacement, and two LVDTs measure the crack opening and closing. I assisted with specimen preparation and testing, installed the anchors, LVDTs, and potentiometers, and summarized the EOTA TR 049 test procedures. This work presents the experimental process and the main challenges of this development phase.

Mentor(s):
Akanshu Sharma (Engineering); Luis David Fernandez Vasquez (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1072
Presentation Time: Session 1: 9:00-10:00am

Student Dining Behavior and Retail Food Service Optimization at Purdue Memorial Union

Business Case Study

Authors(s):
Anokhi Matta† (Science|JMHC); Caleb R Grayer† (Agriculture); Zoe Isabella Hu† (Liberal Arts|Polytechnic|JMHC); Devi S Raparthi† (Science|JMHC); Karli Faith Wojtach† (HHS)

Abstract:
[Abstract Redacted]

Mentor(s):
James Tanoos (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1073
Presentation Time: Session 1: 9:00-10:00am

Marketing Strategy for Pawradise Hotel

Business Case Study

Authors(s):
Rebecca Grace Matthieu† (DSB|JMHC); Margaret Anne Boysen† (DSB); Stella Grace Seymour† (DSB); Lauren Elizabeth Embs† (DSB|JMHC); Genevieve Marie Morrissey† (DSB); Anna Grace Walatka† (DSB|JMHC)

Abstract:
Pawradise Hotel is a recently opened luxury dog boarding facility in Lafayette, IN, offering premium care for $75 per day. Since opening, the owner has identified two main challenges: low brand awareness and customer hesitation around the higher price compared to traditional boarding facilities. Our research aims to develop a marketing plan that increases awareness while better communicating the value of Pawradise's luxury experience.

We recommend a strategy focused on increasing visibility, communicating value, and positioning Pawradise as a premium hotel experience rather than a traditional kennel. Based on consumer research, recommendations include digital marketing and local outreach, loyalty programs, and word-of-mouth marketing.

These strategies aim to build awareness, trust, and customer loyalty while highlighting Pawradise's personalized care, comfort, and premium experience. Ultimately, the goal is to create a foundation for consistent marketing and long-term customer relationships as the business grows.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1074
Presentation Time: Session 1: 9:00-10:00am

Tunable Cooper-Pair Tunneling in Multi-Branch Josephson Devices

STEM

Authors(s):
Noah O Meroueh† (Engineering|Science); Kyle s Ohlin‡ (Science)

Abstract:
Josephson elements with energies that vary as cos(dφ) enable the tunneling of Cooper pairs in groups of d, carrying charge 2de rather than 2e normally associated with single Cooper pairs. These elements are components of proposed hardware-protected superconducting qubit designs. For example, a d = 2 element produces a two-fold ground degeneracy that is protected by Cooper-pair parity. The generalization of these elements to an arbitrary d produces qudits of d-fold symmetry protection and dimension d. Such devices have only been demonstrated up to d = 2. We present the design of multi-branch SQUIDs intended to realize charge 6e, 8e, and 12e Josephson elements. Each branch consists of two gate-tunable Josephson junctions in series. When the Josephson energies of the junctions are matched, they supply the higher harmonics that a single tunnel junction lacks. This arrangement resembles a single junction of near-unit transparency. We place d branches in parallel with flux Φ_0/d threading each equal-area loop. This cancels every harmonic except multiples of d by interference and generates a current-phase relationship (CPR) dominated by sin(dφ). We will determine the CPR by a switching current interference against a reference loop. As the field is swept, charge-2de transport divides the field oscillation period by d. Observation of Cooper-pair transport at d > 2 will establish these multi-loop SQUID devices as a potential route to protected qudits.

Mentor(s):
Michael James Manfra (Engineering|Science)

Other Acknowledgment(s):
Wyatt Rhys Gibbons* (Science); Kevin Alexander Barrow* (Science); Rojila Ghimire* (Science); Tyler Lindemann* (Science)

Poster Presentation Abstract Number: 1075
Presentation Time: Session 1: 9:00-10:00am

The Effects of Temperature on the Morphology, Abundance, and Viability of Batrachochytrium dendrobatidis In Vitro

STEM

Authors(s):
Emilio Alejandro Meza Viera† (Science)

Abstract:
Batrachochytrium dendrobatidis (Bd) is a lethal fungal pathogen that causes chytridiomycosis in amphibians worldwide. Bd kills its hosts by disrupting osmoregulation and respiration across the skin, leading to electrolyte imbalance and cardiac arrest. Because of its wide distribution and high virulence, Bd poses a significant threat to many amphibian species. Bd grows best at relatively cool temperatures (17–25 °C), yet little is known about how temperatures within and above this range affect its zoospores, the infective stage, in the absence of a host. In the present study, we will test whether moderately elevating the ambient temperature to 30°C can inhibit Bd in vitro. To characterize the response of Bd to temperature, we will measure its morphology (zoospore and flagellum length), estimate cell abundance, and assess viability using Trypan blue staining. We hypothesize that temperatures further from the optimal range for Bd will reduce cell abundance and viability and alter zoospore and flagellum size. By characterizing how temperature affects Bd structure and survival in the absence of a host, this study aims to clarify how infection risk may change under different thermal conditions, including climate warming scenarios.

Mentor(s):
Catherine L Searle (Science); Shahed Uddin Ahmed Shazib (Science); David Rabern Simmons (Agriculture)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1076
Presentation Time: Session 1: 9:00-10:00am

Data Center Network Accelerator RTL Verification and HAPS-100 Integration

STEM

Authors(s):
Amelia Franciszka Mietus† (Engineering); Eliezer Jasper Rudolph-Harris† (Engineering); Anna Z Dalton† (Engineering); Iris Tsai† (Engineering); Philip Louis-Karl Zautke† (Engineering); Garima Thapliyal† (Engineering); Isabelle Lucie Regnault† (Engineering)

Abstract:
High-performance ASIC Prototyping System (HAPS) is a line of FPGA-based hardware and software prototyping solutions developed by Synopsys. The HAPS system the team is using cannot test RTL designs with standard SystemVerilog testbenches because input and output control depends on Synopsys Transactors, making it difficult to observe and validate design behavior during testing. To address this limitation, this project aims to develop a generic verification framework that can drive inputs and capture outputs for any design on the HAPS verifying that data packets are streamed correctly.

The verification framework uses a dedicated FPGA kernel to buffer testbench inputs and outputs, allowing designs to run at hardware speed. To connect the kernel to the host, a Python-based emulator enables host-to-HAPS communication over Ethernet, packaging messages in the format the RTL expects while handling reliable transport. A DPI-C script will log the testbench inputs and expected outputs for replay on the HAPS.

These design changes will improve how HAPS users monitor inputs and outputs, but they will not increase the design's execution speed. Its performance is limited by core modules of the design such as the read kernel, write kernel, and memory access controller. The team will compare HAPS outputs against simulation results to verify correctness and benchmark the DNA RTL to measure its performance. The intended outcome is to create a reusable verification framework, a fully verified DNA RTL plus emulator, and performance benchmarks for future improvements.

Mentor(s):
Brady Philhower (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1077
Presentation Time: Session 1: 9:00-10:00am

Data Management For Data Science for Smart Cities

STEM

Authors(s):
Sahil Mitra† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Nikkhil Vijaya Sankar (Engineering); Mohammad Reza Jahanshahi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1078
Presentation Time: Session 1: 9:00-10:00am

A Miniature Embedded Iontophoresis Board for On-Demand Wearable Sweat Sensing

STEM

Authors(s):
Cooper Mohr† (DSB|Engineering|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Robert Jose Ccorahua santo (Engineering); Wenzhuo Wu (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1079
Presentation Time: Session 1: 9:00-10:00am

Refactoring Singletons into Sessions in NEMO5

STEM

Authors(s):
Jhojan Alejandro Montana Ahumada† (Engineering)

Abstract:
This presentation examines singleton mitigation as a complex software design task and investigates refactoring strategies for NEMO5, a large scientific codebase for nanodevices and semiconductors. Originally designed to run a single simulation per execution, NEMO5 now faces a growing problem as it evolves: the overuse of singletons, classes that allow only one globally accessible instance. As a result, attempts to run independent simulations within the same process cause their data to be overwritten, preventing NEMO5's use as a re-entrant library. We are developing a session-based architecture in which the states that were previously held in singletons, such as simulation data and material data, are encapsulated in independent session objects. Such an approach involves identifying existing singletons, refactoring per-simulation state into sessions, and preserving a legacy mode. The refactoring will be validated by confirming that legacy results remain unchanged and that concurrent sessions run without interfering with each other's data. Future work will evaluate whether these session changes address the correct requirements for transforming NEMO5 into a Quantum Computing Library (QCL). Next steps include integrating the session architecture into the main NEMO5 repository, synchronizing it with ongoing development, and demonstrating QCL behavior in a practical workflow. This effort aims to make NEMO5 usable as an embeddable library and may serve as a model for modernizing other legacy scientific codebases.

Mentor(s):
Tillmann C Kubis (Engineering)

Other Acknowledgment(s):
Daniel A Lemus* (Engineering); Robert A Campbell* (PWL)

Poster Presentation Abstract Number: 1080
Presentation Time: Session 1: 9:00-10:00am

First-Principles Mapping of the MXene and MAX-Phase Chemical and Structural Landscape

STEM

Authors(s):
Sahana Mukund† (Science); Samiya Balu‡ (Engineering)

Abstract:
MXenes, a newly developed two-dimensional material known for its tunable properties through interchangeable elemental stacking sequences, show high potential to be used in nanomaterials and semiconductors, electronic components critical to national interests. However, while these materials show great potential, the vast configurational space available creates uncertainty in the stability of the structures once synthesized. For this reason, high-throughput predictive tools are necessary to help screen the vast configuration space for more target experimental efforts. We aim to screen this space using ab-initio molecular dynamics (AIMD) based on density functional theory (DFT) and through the development of scalable machine-learning interatomic potentials.

Mentor(s):
Alejandro H Strachan (Engineering)

Other Acknowledgment(s):
Aidan Damian Pantoya* (Engineering); Rushik Desai* (Engineering)

Poster Presentation Abstract Number: 1081
Presentation Time: Session 1: 9:00-10:00am

The Strategic Shift: Burlington Promotions

Business Case Study

Authors(s):
Evelyn Jane Nielsen† (DSB); Ella Jane Robinson† (DSB); Emma Kate Ahern† (DSB); Ella Nicole Riordan† (DSB); Luke Robert Storer‡ (DSB); Giavanna Noelle Buscarini‡ (DSB); Abigail Marie Carroll‡ (DSB)

Abstract:
Burlington Promotions recently expanded from a wedding decor shop into a corporate gifting and promotional partner, while staying true to its local, family-owned roots. To grow in this new market, the business must overcome three major consumer behavior hurdles: corporate buyers default out of habit to massive online catalogs to save time; they stick with familiar giants like 4Imprint or VistaPrint to avoid risking company budgets; and it is hard to show the true, tactile quality of custom products through a screen. To address this, this study will investigate corporate decision-makers, what holds them back from using boutique companies, and what trust signals can change their routines. Specifically, we will examine how a boutique brand can balance its warm, local charm with the dependable reliability of a professional B2B partner. Through competitor analysis and buyer research, we will explore whether personal service and high quality can beat the convenience of big online sites. Ultimately, we expect to find that by blending local roots with professional polish, niche brands can successfully position themselves as a trusted, high-value alternative to anonymous national suppliers. Outcome will include several strategic recommendations with included tactics and execution plans.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1082

Presentation Time: Session 1: 9:00-10:00am

Beyond tumor burden: investigating gut microbial changes in cancer cachexia

STEM

Authors(s):
Charles Porter Olson† (Engineering); Nina O'Tain* (Agriculture); Sierra J Kingsford* (Agriculture)

Abstract:
Cancer cachexia is a multifactorial metabolic syndrome characterized by progressive skeletal muscle wasting, body weight loss, and impaired physical function. Cachexia symptoms are prevalent in many late-stage cancer diseases, and its onset is an indicator of poor outcomes for patients. Despite the severity of cancer cachexia, its origins and pathology remain poorly understood. Emerging evidence has linked alterations in the gut microbiota to the development of cancer cachexia, though it remains unclear if these changes are directly connected to cancer-induced muscle wasting or represent broader responses to tumor development. In this study, we established three experimental groups of BALB/c mice: mice bearing cachexia-inducing C26 tumors, mice bearing non-cachexia-inducing CT26 tumors, and non-tumor-bearing controls. Body weight, skeletal muscle mass and function, and spleen weight were evaluated to characterize physiological responses. Gut microbial communities were characterized using 16S rRNA gene sequencing, while culture-based method were used to enumerate total aerobic and anaerobic bacteria and selected bacterial populations, including coliforms. At 24 days post-tumor injection, C26 tumor-bearing mice showed significantly greater skeletal muscle loss and impaired muscle function compared with non-cachectic groups ($P < 0.05$). Gut microbiome analysis revealed alterations in microbial community composition, including increased relative abundances of Ligilactobacillus and Escherichia/Shigella, along with depletion of Muribaculaceae in C26 mice. Culture-based analysis demonstrated an expansion of culturable coliform populations in C26 mice. Future analyses will explore potential relationships between microbial alterations and indicators of muscle dysfunction. Overall, our results suggest that cancer cachexia is characterized by a distinct gut environment, with shifts in microbial community composition that may extend beyond the effects of tumor presence alone.

Mentor(s):
Tingting Ju (Agriculture)

Other Acknowledgment(s):
James Frederick Markworth* (Agriculture); Xinyue Lu* (HHS)

Poster Presentation Abstract Number: 1083
Presentation Time: Session 1: 9:00-10:00am

Characterizing Gastrointestinal Development in Weaned Piglets to Inform Smart Capsule Design

STEM

Authors(s):
Nina O'Tain† (Agriculture); Charles Porter Olson* (Engineering); Dylan Thomas Day* (Agriculture)

Abstract:
The gastrointestinal (GI) tract of young piglets undergoes substantial anatomical and physiological changes following weaning. Although GI development has been widely studied, detailed information on age-related variation in GI dimensions and regional luminal pH remains limited. This study aimed to characterize these changes during the early post-weaning period to provide baseline measurements for future smart capsule development. A total of nine crossbred piglets (Duroc × Landrace × Yorkshire) were sampled at 3, 4, and 5 weeks of age (n = 3 per age group). GI measurements included total small intestinal length, external diameters and circumferences of selected GI segments (esophagus, stomach, small intestine, cecum, and colon), pyloric outlet dimensions, and regional luminal pH. Data were analyzed using one-way analysis of variance, followed by Tukey's post hoc tests for pairwise comparisons, with significance set at $P < 0.05$. GI dimensions generally increased with age, accompanied by region-specific changes in luminal pH. Mean total small intestinal length increased from 3.48 m at 3 weeks to 4.80 m at 4 weeks and 6.92 m at 5 weeks of age ($P < 0.001$). Similarly, distal small intestinal diameter increased from 5.64 to 7.71 and 13.47 mm, respectively ($P < 0.001$). In addition to these anatomical changes, luminal pH exhibited region-specific changes with age. Cecal pH decreased from 6.67 at 3 weeks to 5.86 and 5.47 at 4 and 5 weeks, respectively ($P = 0.002$). These findings demonstrate age-associated differences in GI dimensions and luminal pH during the first two weeks following weaning. These preliminary measurements may inform future smart capsule design, particularly capsule dimensions and pH-based approaches for intestinal localization and sampling.

Mentor(s):
Tingting Ju (Agriculture)

Other Acknowledgment(s):
Jose Carlos Cabezas Alvarez* (Agriculture); Jinyoung Lee* (Agriculture); Jinsu Hong* (Agriculture); Brian T Richert* (Agriculture)

Poster Presentation Abstract Number: 1084
Presentation Time: Session 1: 9:00-10:00am

CODO's for the HHS college

Business Case Study

Authors(s):
Nicholas Karl Ozolins† (DSB); Jonathan James Burritt† (DSB); Noah Yahng Pieters† (DSB); Silas Cameron Bowman† (DSB); Evan Benjamin Ballou† (DSB)

Abstract:
Choosing a college major is an important decision, but students sometimes realize that their first choice does not match their interests or goals. This research project looks at how Purdue University's College of Health and Human Sciences (HHS) can better reach and support students who are thinking about changing their major through the CODO process. Our goal is to help students learn about other options without pressuring them to change majors.

Our research using a mixed method approach will focus on first-year and sophomore students who may be questioning their current major. Through student surveys and other research, we hope to better understand why students change majors, what concerns they have, and what they want from the CODO process.

Using our findings, we will recommend ways HHS can better communicate with students, including which messages and communication methods work best. We will also look at how academic advisors can further improve the CODO's process. Ultimately, we want students to understand that changing their major is not a setback, but an opportunity to find a path that better fits their interests and future goals.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1085
Presentation Time: Session 1: 9:00-10:00am

Optimizing Membrane-Based Separation for Perchlorate Recovery and Energetics Production

STEM

Authors(s):
Tejas Pandit† (Engineering); Sahda Mohammadu Haroon* (Engineering)

Abstract:
Establishing a sustained human presence on Mars will require in-situ resource utilization (ISRU) technologies that enable the production of essential materials from present resources and materials. One application is the production of energetic materials such as fuel or explosives, for which perchlorate separation is a critical step. This study investigates membrane-based separation methods to obtain high-purity perchlorate salts from solutions containing various ions.

A Python-based nanofiltration model was used to conduct a sensitivity study of three membrane parameters affecting permeability and selectivity: active-layer thickness, pore size, and charge. A valid range for each of these parameters was then designated, with equally spaced values being placed within each range. The model, which takes in ions, concentrations, and these three parameters among other variables, was then run on each possible combination of the three parameters. The feed solution contained Na^+, Ca^{2+}, Mg^{2+}, K^+, HCO_3^-, ClO_4^-, and Cl^-. Ion fluxes were analyzed to determine separation of each pair of ions, with particular emphasis on separating perchlorate (ClO_4^-) from bicarbonate (HCO_3^-) and chloride (Cl^-) as perchlorate salts are the basis of energetics production.

The results indicated that nanofiltration alone was insufficient to achieve high perchlorate purity. Hence, a hybrid process utilizing an electrodialysis step to separate ions by charge followed by nanofiltration of the resulting positive and negative solutions was investigated. A second sensitivity study on the resulting positive and negative solutions identified membrane parameter combinations capable of improving perchlorate separation and achieving higher purity.

This work provides a basis for selecting membrane parameters for perchlorate recovery. The findings support further investigation of membrane technologies for ISRU applications and the production of materials needed to sustain future Mars missions.

Mentor(s):
Xavier I Morgan-Lange (Engineering); Clark Lay (Engineering); David Warsinger (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1086
Presentation Time: Session 1: 9:00-10:00am

From Simulation to Control: Training and Deploying a Quadruped Robot Using PPO

STEM

Authors(s):
Rohan Pardeshi† (Science)

Abstract:
[Abstract Redacted]

Mentor(s):
Jaeeun Kim (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1087
Presentation Time: Session 1: 9:00-10:00am

Automation Methods in Gamma Ray Spectroscopy and Data Analysis

STEM

Authors(s):
Truman Carl Parrish† (Engineering); Nicholas B Flowers† (Engineering); Leo Sun† (Engineering)

Abstract:
Gamma-ray spectroscopy is a important tool for studying nuclear structure, offering insight into the excited states and decay pathways of atomic nuclei that give rise to nuclear isomers. These transitions are organized into nuclear level schemes, typically reconstructed from two-dimensional gamma-gamma coincidence matrices through non-ML analysis. This process is slow and difficult to scale when matrices contain detector background, Compton scattering, finite energy resolution, and overlapping or ambiguous peak structures. As datasets grow larger, these challenges motivate automated methods leveraging AI/ML that can distinguish true transition relationships from background and scattering artifacts. This project explores machine learning methods for data analysis using simulated matrices generated from toy Monte Carlo models, providing large training datasets with known ground truth for comparison against model predictions. The approach frames level scheme reconstruction as an image-to-graph problem, using a two-stage Graph Attention Network (GAT) pipeline. The first stage classifies each candidate coincidence as real or scatter, and the second groups the surviving transitions into cascade bands. The attention mechanism learns which relationships most strongly reflect real nuclear transitions rather than background or scattering, letting the model prioritize the most physically meaningful connections when reconstructing a level scheme. By combining simulation, preprocessing, and graph attention-based machine learning, this work contributes to a scalable pipeline for gamma-ray spectroscopy analysis. The long-term goal is to reduce reliance on manual interpretation, improve reproducibility, and accelerate nuclear isomer discovery and level scheme reconstruction.

Mentor(s):
Andy Jung (Science); Ace Rounds (Science)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1088
Presentation Time: Session 1: 9:00-10:00am

Beat the Heat: Health Risks and Workplace Factors in Heat-Exposed Workers

STEM

Authors(s):
Neha Paruchuri† (HHS|JMHC); Paige Elisabeth Hazelrigg† (HHS); Hannah Celine Wade† (HHS|JMHC); Daniella Prisca Galvez† (HHS); Autumn L Onken† (HHS)

Abstract:
The purpose of this project was to investigate how heat stress and related illnesses are increasing with the rising global temperature, specifically with a focus on prescription medication. We conducted a literature review and looked at multiple reputable studies and sources to evaluate our research question: what are the physiological effects of working in a hot environment and how are those effects impacted by working conditions and behaviors? Global temperatures are averaging 1.45ºC above pre-industrial levels (World Health Organization, 2025). Exposure to heat, particularly those working in extreme conditions, can result in numerous physical and mental health issues (Journal of Climate Change and Health, 2023). Predictive rising temperatures require changes in occupational standards and practices to keep workers safe. Informing both employers and workers on the effects of heat and how to avoid extreme effects is crucial.

Additionally, more research in diverse populations is necessary when evaluating how prescription medication impacts heat-related illness. Specifically, there exists a correlation between anticholinergic drug use and core temperature and sweat regulation (Hospers et al., n.p.). Anticholinergic drugs encompass hundreds of medications that control the nervous system by blocking the neurotransmitter acetylcholine (“Anticholinergic Drugs”, n.p.). However, in most of these studies only younger men are tested needing more studies on women, minorities, and older adults.

Mentor(s):
Mark Wilson (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1089
Presentation Time: Session 1: 9:00-10:00am

Design for Test Architecture on SoCET's AFTx08 65nm Tapeout

STEM

Authors(s):
Cameron Thomas Patt† (Engineering)

Abstract:
Modern semiconductors are massively complicated devices that are prone to microscopic defects during manufacturing. These defects can cause a chip's internal gates and signal paths to behave incorrectly, making them difficult to identify without dedicated test architecture. Scan chains address this challenge by connecting a system on chip's internal registers into shift registers, allowing known test vectors to be loaded into the design and the outputs to be observed. This project aims to implement scan architecture on the TSMC65 tapeout of SoCET's AFTx08 chip to ensure that the silicon received is free of manufacturing defects. The effectiveness of scan chains are measured through their fault coverage, which is the percentage of computer-simulated faults that are detected by the scan logic. Improving fault coverage requires applying additional test patterns to the design, increasing the capital necessary to ensure each unit is correctly manufactured. Additionally, an on-chip clock controller must be included in the design to facilitate accurate modeling of transition faults. This project is a continuation of last semester's TSMC180 tapeout scan implementation, and aims to further improve fault coverage metrics through pattern compression and ATPG optimization while operating on a smaller process node.

Mentor(s):
Niels van Ritbergen (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1090
Presentation Time: Session 1: 9:00-10:00am

Femtosecond Laser Annealing of Hafnium Zirconium Oxide (HZO)

STEM

Authors(s):
Nikolai Perebeinos† (Engineering); Vaishnnavi Purram* (Engineering|JMHC)

Abstract:
Hafnium Zirconium Oxide (HZO) is a promising material for next-generation nonvolatile ferroelectric memory and ferroelectric field-effect due to its ferroelectric properties in a polar orthorhombic crystal structure. However, crystallization of thin-film HZO into a polar orthorhombic structure requires rapid thermal annealing at high temperatures, which exceeds the thermal budget of back-end-of-line (BEOL) integration. This creates a need for localized annealing methods that can induce the ferroelectric polar orthorhombic phase of the HZO layer, without impacting the underlying layers. This work utilizes a femtosecond laser annealing system to crystallize the 10 nm amorphous HZO deposited via Atomic Layer Deposition. Necessary tungsten layers are also deposited before and/or after the HZO deposition. To ensure uniformity of the annealed area, the optical path incorporates a Pi-shaper and a Digital Micromirror Device (DMD) to transform the Gaussian beam into a uniform, flat-top square profile. Pulse fluence and pulse count then serve as independent parameters to control the laser annealing. Following the parameter sweep, large-area annealing is performed to fabricate sufficient crystalline material for ellipsometry. Ferroelectric switching was observed using polarization-electric-field measurements, with the largest measured switchable polarization, 28.8 μC/cm2 at 76.4 mJ/cm2 and 6250 pulses, exceeding values reported to date for laser-annealed HZO. A coupled optical and thermal model, built from transfer matrix laser energy absorption calculations and a two-temperature model, predicts that each pulse briefly raises the HZO to temperatures required for crystallization while the silicon substrate is heated to approximately 80K, below the 400 \degc BEOL limit. Spectroscopy reveals a spectral response in the annealed regions consistent with crystallization into the ferroelectric orthorhombic phase.

Mentor(s):
Xianfan Xu (Engineering)

Other Acknowledgment(s):
Anwarul Islam Akash* (Engineering); Luke Calen Johnson* (Engineering); Thomas Edwin Beechem* (Engineering); Fernando Josue Vega* (Engineering); Haesung Kim* (Engineering); Junwoo Jang* (Engineering)

Poster Presentation Abstract Number: 1091
Presentation Time: Session 1: 9:00-10:00am

Cataloging Algerian Artifacts in US Collections

Humanities

Authors(s):
Reva Arlene Pettigrew† (Engineering|JMHC); Nitya Kalidas Patel† (HHS|JMHC); Hope A Wittmeyer† (Science|JMHC); Darsh M Nair† (Liberal Arts|Polytechnic|JMHC)

Abstract:
In partnership with the US Embassy in Algiers, Algeria and Purdue University's Urban Matters Lab, this project aims to comprehensively catalog Algerian cultural objects and archival materials across US collections. A bilateral agreement between Algeria and the United States renders possessing undocumented Algerian antiquities illegal, necessitating provenance audits. Our team has systematically parsed publicly accessible databases—spanning national museums, university archives, auction houses, and digital secondary markets. We extracted metadata, including acquisition methods and donor histories, to document artifacts from the Paleolithic to the modern era. This research analyzes patterns in artifact acquisition and documentation—highlighting inconsistencies in existing public records. The resulting master catalog and analysis will equip Algerian and US authorities with a framework to track undocumented artifacts, enforce cultural heritage protections, and facilitate future repatriation efforts.

Mentor(s):
Ashima Krishna (JMHC)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1092
Presentation Time: Session 1: 9:00-10:00am

The Ethical Balance in Data Collection, Privacy, and Government Regulation

Social Science

Authors(s):
Sanjana Prasanna† (Exploratory Studies)

Abstract:
As technology grows and becomes more prominent in everyday life, the collection of personal data has become increasingly common. Companies collect information through websites, mobile apps, social media, online shopping, and other digital services. This information can be useful for companies to help them personalize user experiences, improve products, and help businesses gain a better understanding of their customers. At the same time, the growing amount of personal data being collected also creates significant ethical concerns. Many customers may not fully understand what information they are sharing, how it is being used, or who has access to it. This raises the question of to what extent it is ethical for companies to collect and use consumers' personal data, and what responsibilities should companies have to protect that information?

This research will examine the ethical issues surrounding the collection and use of consumer data, particularly location data or browsing/search history. Focusing on privacy, consent, transparency, and targeted advertising, it will explore the balance between the benefits companies get from collecting data and the risks that consumers face when their personal information is stored or shared. This paper will examine articles focusing on the responsibility companies have to protect consumer information and whether current privacy laws provide enough protection. By looking at different perspectives from the consumer and business sides, this research aims to better understand whether the ethical boundaries of data collection are met and to identify ways companies can collect and use personal information more responsibly and transparently.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1093
Presentation Time: Session 1: 9:00-10:00am

Modelling Nitrogen Ice Sintering on Triton

STEM

Authors(s):
Suhani Rana† (Science)

Abstract:
Triton, Neptune's largest moon, shows evidence of active surface activity, including nitrogen rich plumes and possible cryovolcanic activity where volatile or icy material can move beneath or through the surface. Understanding how nitrogen ice changes in strength, density, and pore structure over time can help provide context for these processes. This research investigates how nitrogen ice grains sinter over time under Triton's environmental conditions. Sintering is a process where neighboring ice grains bond together, pores shrink, and the material becomes denser over time. We adapted a sintering model to use material properties of nitrogen and track changes in neck radius, pore radius, and relative density during different stages of sintering. The model includes several mass transport mechanisms, including surface, lattice, grain boundary diffusion, and vapor transport. We first evaluated nitrogen ice sintering at a constant temperature to see how temperature and grain size affect sintering times. Then we incorporated a time varying Triton surface temperature file to reproduce seasonal temperature variation. The simulations showed that sintering is strongly dependent on temperature and grain size, with warmer conditions accelerating grain evolution and larger grains taking longer to sinter. At 37 K, Stage 3 sintering took about 8 years for 10 μm grains and about 259 years for 50 μm grains. At 45 K, those same grain sizes took about 0.02 years and 0.47 years. Triton's changing temperatures also affected sintering time compared with a constant 37 K, showing why it is important to represent Triton's changing thermal environment when estimating long term nitrogen ice evolution. This work provides a framework for connecting sintering simulations to how Triton's nitrogen rich surface changes over time.

Mentor(s):
Perianne Elizabeth Johnson (Science); Ali Bramson (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1094
Presentation Time: Session 1: 9:00-10:00am

Utilizing Low-Intensity Pulsed Ultrasound (LIPUS) to Treat ACL Injury

STEM

Authors(s):
Amrita Rani Raparti† (Science)

Abstract:
[Abstract Redacted]

Mentor(s):
Deva Chan (Engineering); Ryan Michael Meister (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1095
Presentation Time: Session 1: 9:00-10:00am

The Elephant in the Room: Indianapolis Zoo and AZA Accreditation

Business Case Study

Authors(s):
Jess Reder† (DSB); Isabella Truly Holloway† (DSB|JMHC); Ella Rose Brummet† (DSB); Rachel Hope Campbell† (DSB); Soren Micheal Price† (DSB); Seth Roger Fuhrman† (DSB)

Abstract:
The Indianapolis Zoo has recently, as of September 30th, lost their AZA accreditation, which will impact the amount of people who visit the zoo. Through a survey of Purdue college students, as well as secondary research, we are working to determine if the loss of AZA effects consumer behavior. We intend to be able to provide a holistic presentation that is both factually and statistically backed as well as providing direct consumer quotes. Our aim is to be able to create strategies to keep consumers engaged with the animals and other benefits of the zoo, while working towards becoming re-certified. We see this as an important study to understand how consumers are guided by morals and ethics when making decisions.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1096
Presentation Time: Session 1: 9:00-10:00am

Evaluating Low-GWP Refrigerants for Vehicle Air Conditioning Systems

STEM

Authors(s):
Colton Rockers† (Engineering)

Abstract:
This research evaluates novel low-global warming potential (GWP) mixtures for military vehicle air conditioning systems. The transition to sustainable refrigerants is currently hindered because existing low-GWP options are either incompatible as drop-in replacements with current infrastructure, or excessively flammable, the latter being especially relevant to this project given the military applications. The primary purpose of this study is to validate safe, direct replacements by evaluating tertiary low-GWP blends of R-134a, identified in collaboration with NIST. The methodology encompasses developing a comprehensive system to screen fluids and predict flammability and performance metrics, experimentally verifying flammability behaviors under varied ignition conditions, and performing experimental analyses on the system-level performance of selected blends. At the current stage, extended property measurements for viable blends are under testing at NIST, and experimental results from the testing stand will be used to validate the accuracy of the screening software. Additionally, blast chamber testing of various refrigerants has updated ASTM testing protocols, yielding direct impacts to ASHRAE standards. These findings establish a pathway to evaluating performance metrics of low-flammability, low-GWP refrigerants without requiring extensive physical testing.

Mentor(s):
Davide Ziviani (Engineering); Listier Apella Otieno (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1097
Presentation Time: Session 1: 9:00-10:00am

High-throughput desorption electrospray ionization mass spectrometry driven discovery and optimization of SULT2B1b inhibitors

STEM

Authors(s):
Alejandro Rodas Montoya† (Purdue University)

Abstract:
[Abstract Redacted]

Mentor(s):
Nicolas Mauricio Morato Gutierrez (Centers & Institutes)

Other Acknowledgment(s):
Beinan Yang* (Agriculture); Saurabh Gireesan* (Science); Andrew D Mesecar* (Centers & Institutes); Robert Graham Cooks* (Science); Yunfei Feng* (Science); Shiva Ataei* (Science)

Poster Presentation Abstract Number: 1098
Presentation Time: Session 1: 9:00-10:00am

Unraveling resistance mechanisms of SARS-CoV-2 main protease V186G clinical variants to FDA-approved drugs

STEM

Authors(s):
McKenzie Russell† (Science)

Abstract:
The World Health Organization (WHO) estimates 7.12 million people have died from COVID-19 caused by the SARS-CoV-2 virus. Two mainstream clinically approved drugs, nirmatrelvir and ensitrelvir, for treatment of COVID-19 target SARS-CoV-2 3C-like protease (3CLpro) which is also called main protease. Since the emergence of SARS-CoV-2, numerous clinical variants of SARS-CoV-2 with mutations in 3CLpro have been identified and reported to confer drug resistance to nirmatrelvir. One variant, V186G, was recently shown by our group to be 116-fold more resistant to nirmatrelvir. SARS-CoV-2 3CLpro variants with additional mutations to the V186G variant have also been identified including a V186G triple mutant. In this study, we utilized steady-state kinetic assays and determined that the enzymatic activity of the V186G triple variant was significantly (20-fold) lower than the wild-type (WT) and V186G single variant 3CL proteases. Thermal stability studies further revealed that the V186G triple variant was significantly less stable than the WT and V186G, suggesting that the additional mutations disrupt both enzymatic activity and 3CLpro stability. The X-ray structure of the V186G triple variant in complex with inhibitor GRL-051-22 was determined to 2.4 Å to provide a foundation for future structure-based drug design efforts against this variant. Unraveling the mechanisms of resistance of newly emerging clinical variants of 3CLpro is essential for identifying and developing new FDA approved compounds to combat drug resistance.

Mentor(s):
Sydney Nicole Bogan (Agriculture); Misa S Meadows (Agriculture)

Other Acknowledgment(s):
Arun K Ghosh* (Pharmacy|Science); Andrew D Mesecar* (Centers & Institutes)

Poster Presentation Abstract Number: 1099
Presentation Time: Session 1: 9:00-10:00am

Amide Bond Synthesis in Microdroplets

STEM

Authors(s):
Diana Christine Sarle† (Science|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Mousumi Saha (Science); Robert Graham Cooks (Science)

Other Acknowledgment(s):
Manish Jana* (Science); Evandro Piccin* (PWL)

Poster Presentation Abstract Number: 1100
Presentation Time: Session 1: 9:00-10:00am

Multimodal Tweet Classification Using Machine Learning and Large Language Models for Natural Disaster Damage Impact

STEM

Authors(s):
Maren Elizabeth Selle† (Engineering); Aahana Yadav† (Science); Erin KaiChi Too† (Science); Jake Joseph Kuper† (DSB)

Abstract:
During natural disasters, timely allocation of emergency relief depends on rapid, accurate assessment of infrastructure damage and humanitarian needs. Although modern technology has allowed us to see the damage to infrastructure, humanitarian needs, and the overall severity of the storm, we are only able to get so much information due to the time it takes to gather the information and analyze it. While social media platforms such as X (formally Twitter) provide real time crowdsourced reports, the sheer volume of unstructured, heterogeneous data overwhelms conventional triage methods. This project develops a multimodal machine learning framework to automatically filter and categorize disaster related posts using the benchmark CrisisMMD dataset. The CrisisMMD dataset looks at 7 different natural disasters from around the world with posts that include text and images. The system implements a two stream classification pipeline, a transformer based language model implemented by PyTorch for semantic text processing, paired with a fine tuned ResNet-50 convolution neural network for visual feature extraction.The model will utilize the labels provided by the CrisisMMD dataset for several disaster-related categories, including damage severity, infrastructure damage, and humanitarian effects. At this stage, we are training and developing the models to prepare them to classify the data we provide to it. This will establish a solid foundation for future integration as well as more diverse use for future natural disasters. The primary goal of this project is to develop a model to classify multimodal posts regarding disasters through data preprocessing, model development, and evaluation. Future work will look to combine the models to allow for use by first responders and others to quickly evaluate disaster damage in real time.

Mentor(s):
Soudabeh Taghian Dinani (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1101
Presentation Time: Session 1: 9:00-10:00am

Machine Learning Applications for Automating Photoluminescence Material Analysis Workflows

STEM

Authors(s):
Benjamin James Seo† (Engineering|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Jainil Dharmil Shah (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1102
Presentation Time: Session 1: 9:00-10:00am

"Let's Talk About Sex": Contextual experiences of sex communication among rural Latino/a youth and parents

Social Science

Authors(s):
Hridya Shah† (Pharmacy|JMHC)

Abstract:
Background: Open communication between parents and adolescents about sex is associated with later sexual debut (first entry into sexual activity) and better contraceptive use. This demonstrates the importance of parent-youth communication for adolescent health. However, the frequency and content of these conversations vary by race and ethnicity, and parents and youth often have different perceptions of these conversations. There is a gap in understanding of how rural migrant youth perceive and experience sex conversations with their parents and how they evolve. This study examined how rural Latino/a youth's accounts of parent-child communication about sex changed over one year.

Methods: Bilingual researchers conducted semi-structured interviews with 47 rural Latino/a youth ages 10-15 as part of the Purdue Puentes Project, a larger longitudinal study of 307 families in the Midwest U.S. We used two waves of data with youth (N=33; Mage=12.28, 56% U.S. born) including 13 girls, 19 boys, and 1 non-binary youth. Following cross-sectional thematic analysis of each wave, longitudinal qualitative analysis of paired cases is underway in NVivo 15.

Preliminary Results: At Wave 1, 20 of 33 youth (60.6%) reported at least one conversation with a parent about sex; at Wave 2, 18 (54.5%) did. These similar totals masked substantial change: 13 youth (39.4%) gave a different account a year later. Six youth newly reported a conversation, while 7 who had described "the talk" at Wave 1 reported no communication at Wave 2, 6 of them boys. Analysis of how youth explain these changes is ongoing.

Conclusion: Preliminary findings suggest that parent-child communication about sex in rural Latino/a families is an ongoing, fluid process: nearly 4 in 10 youth described it differently within one year of early adolescence. Understanding these changes can inform well-timed,

culturally tailored parent-child communication interventions to reduce sexual health disparities among rural Latino/a youth.

Mentor(s):
Yumary Ruiz (HHS); Phuc Tran Hong Nguyen (HHS); Zoe Taylor (HHS)

Other Acknowledgment(s):
Daniel Arturo Guerrero* (HHS); Kendall Ann Kiel* (HHS)

Poster Presentation Abstract Number: 1103
Presentation Time: Session 1: 9:00-10:00am

Eye-Tracking Analysis of 2D Tellurene Synthesis and Flake Preparation: Targeting Steps for AI Guidance[

STEM

Authors(s):
Kashvi Shahi† (Engineering); Suyash Dash* (Polytechnic|JMHC); Alessia Chiesara galiasso* (Engineering)

Abstract:
More than 70% of researchers have failed to reproduce another lab's experiment, partly because h[RCS3.1]ands-on lab procedures rely on judgment, habit, and visual cues that written protocols do not capture. As a result, it is often unclear where time is lost or where errors creep in. Wearable eye tracking can close this gap by recording each step from a first-person view while showing where an observer's attention falls.

We tested this approach in a study of a 2D-materials workflow.[RCS4.1] While two student researchers made tellurene flakes, deposited them onto silicon substrates, and located and measured them under an optical microscope, a third student observed them wearing Pupil Labs eye-tracking glasses. Three recorded sessions covering four samples produced synchronized observer-perspective video and gaze data. The clearest early finding is time loss: sample preparation took 70.7%[RCS5.1]-80.8% of each session, so it is the first step we will target.

We are also redesigning the Pupil Labs recording interface[RCS6.1] so researchers can record and review sessions more quickly. By improving the tools used for direct observation, this work offers a practical method for finding bottlenecks in materials lab procedures and guiding improvements to experimental workflows.

Mentor(s):
Robert Jose Ccorahua santo (Engineering); Wenzhuo Wu (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1104
Presentation Time: Session 1: 9:00-10:00am

Effects of Direct Morphological Awareness Instruction on Early Language and Literacy Development in Preschool-Aged Children

STEM

Authors(s):
Lynna Gail Shanor† (HHS|JMHC)

Abstract:
Morphological awareness (MA), the ability to recognize and manipulate units of meaning within words, is a foundational skill that supports early language and literacy development. While previous research has highlighted a relationship between MA and later reading outcomes, the effectiveness of direct MA instruction in pre-literate children remains an area of ongoing investigation, thus leaving opportunities for exploration in how direct MA instruction may support emerging literacy skills. This study examines the effectiveness of direct MA instruction in preschool-aged children and its impact on pre-literacy abilities and overall outcomes following participation in a direct MA intervention.

As part of the WordBuilders project, 22 preschool-aged children completed assessments of MA and foundational language and literacy skills at two time points approximately six weeks apart. Between assessments, 12 children received the WordBuilders intervention, while 10 participated in a delayed control group.

Morphological skills were assessed using the Early Lexical Morphology Measure (ELMM) and the Wug Test. The ELMM assesses children's ability to identify and produce constituent morphemes from familiar multimorphemic words by completing sentences with related word forms. The Wug Test evaluates children's ability to apply inflectional and derivational morphological rules to novel words using sentence completion prompts. Together, these measures assess morphological analysis of familiar words and application of morphological rules to unfamiliar words.

On average, the immediate intervention group demonstrated larger gains in lexical morphology and morphosyntax than the delayed control group; however, differences were small and not statistically significant. These preliminary findings contribute to ongoing investigations of direct MA

instruction in preschoolers and highlight the need for further research into its potential role in early literacy education.

Mentor(s):
Rebecca Marks (HHS); Kelsey Elizabeth Davison (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1105

Presentation Time: Session 1: 9:00-10:00am

Optimizing the Structure-Activity Relationship of a Modified microRNA-34a for the Treatment of Triple-Negative Breast Cancer

STEM

Authors(s):
Aindri Abhishek Singh† (Science)

Abstract:
Triple-negative breast cancer (TNBC) is aggressive, with limited targeted treatment options. Its lack of estrogen receptor, progesterone receptor, and HER2 expression limits receptor-targeted therapies. MicroRNAs (miRs) are small non-coding RNAs that regulate genes at the post-transcriptional level. Tumor-suppressive miRs are often downregulated in cancer, making their restoration a therapeutic strategy. MiR-34a is a tumor-suppressive miR that regulates genes involved in cell proliferation, apoptosis, and survival. Restoring miR-34a is therefore a promising strategy for reactivating tumor-suppressive pathways in TNBC. However, poor stability of miRs in biological fluids has limited their clinical application. This project assesses the structure-activity relationship of modified miR-34a (FM-miR-34a), with alternating 2′-O-methyl and 2′-fluoro modifications, to enhance stability and biological activity. We systematically varied phosphorothioate (PS) linkages in the antisense strand and sense strand length, parameters known to influence nuclease resistance, duplex stability, and Argonaute (Ago) loading. We synthesized antisense strands with 3′ PS linkages, ranging from 1 to 7. Constructs with at least 4 PS linkages (≥4PS) showed improved serum stability while maintaining high biological activity. Since increased PS content leads to increased non-specific protein binding and immune activation, we selected 4PS for further optimization. Next, we varied sense strand length from 12 to 21 nucleotides, making 10 constructs. As we increased sense strand length, we observed an increase in stability, but a decrease in activity, consistent with a decrease in net Ago loading. Thus, selecting the optimal sense strand length required balancing stability and activity. Together, our findings identify lead FM-miR-34a candidates with enhanced stability and biological activity, providing a framework for the development of effective RNA interference (RNAi) therapeutics against TNBC.

Mentor(s):
Shreyas Ganesan Iyer (Science); Andrea L Kasinski (Science)

Other Acknowledgment(s):
Alejandra Romero Alzate* (Science); Digambar Kumar Waiker* (Science)

Poster Presentation Abstract Number: 1106
Presentation Time: Session 1: 9:00-10:00am

LLM-Assisted Loop Invariant Generation for Memory-Safety Verification in C Programs

STEM

Authors(s):
Ayush Singh† (Science); Abhi Theo Hakhu† (Engineering); Lohit Jagarlamudi† (Science); Vickram Chennupati‡ (Science)

Abstract:
Memory-safety vulnerabilities remain a significant challenge in C and C++ software. Memory-safety bugs account for approximately 70% of severe vulnerabilities in large C/C++ codebases [1], highlighting the importance of improving software verification. Formal verification can help identify such vulnerabilities, but verifying complex programs often requires substantial human effort to specify program properties and reason about memory operations. This project investigates the use of large language models (LLMs) to generate loop invariants that support memory-safety verification in C programs.

The proposed system will use an LLM to generate candidate loop invariants and evaluate them using formal verification tools. When verification fails, verifier feedback will be explored as a means of improving subsequent generation attempts. The project will also investigate a hybrid retrieval-and-generation approach that retrieves relevant examples of verified invariants for common programming patterns before generating new candidates. The system will be evaluated on representative C programs using verification success rate, invariant validity, and computational cost, with comparisons between baseline generation and the proposed enhancements.

This research aims to assess whether combining LLM generation, verifier-guided refinement, and retrieval of verified examples can improve the effectiveness of memory-safety verification while reducing manual effort. The findings may inform the development of more practical and scalable verification workflows for existing C codebases.

References

[1] Secure by Design: Google’s Perspective on Memory Safety. Available: https://storage.googleapis.com/gweb-research2023-media/pubtools/7665.pdf

Mentor(s):
James C Davis (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1107
Presentation Time: Session 1: 9:00-10:00am

Farming Robotics Challenge Abstract

STEM

Authors(s):
Rushan Mahammad Sipai† (Engineering); Nathan Lee† (Engineering); Codrut Theodore Pintea White† (Engineering)

Abstract:
Growing up, my father regularly worked alongside his siblings and roughly ten cousins to manually remove corn tassels on my grandfather's farm. Through this project, I am working to automate the same task, bringing that family experience full circle. Our team is developing a drone capable of detecting and removing corn tassels to reduce manual labor and prevent unwanted pollination in hybrid seed production. This semester's work focuses on assembling the drone with new motors, developing a computer-aided design for an underside cutting mechanism, and improving a tassel detection model using Roboflow. The flight system uses a Pixhawk flight controller, GPS, and telemetry, with initial operation controlled manually. The detection model has achieved a highest reported mean average precision (mAP) of 56.9%, with additional training and evaluation planned. Drone assembly and cutter design remain in progress, and integrated detasseling performance has not yet been demonstrated. Next steps include completing assembly, fabricating and integrating the cutter, and testing flight endurance and tassel removal. The long-term goal is autonomous flight, detection, and detasseling.

Mentor(s):
James Michael Goppert (Engineering); Alexander Kmetko (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1108
Presentation Time: Session 1: 9:00-10:00am

Estimating Stabilizer Rényi-2 Magic on Quantum Hardware and Comparison with Classical Simulation.

STEM

Authors(s):
Connor Siurek† (Science|JMHC); Jordan Kyle Gracey Srinivasan† (Science); Kylen Winslett† (Polytechnic); Sicheng Zhang† (Science)

Abstract:
Quantum magic, or nonstabilizerness, quantifies a resource associated with quantum computations beyond classically simulable stabilizer operations. The stabilizer Rényi-2 entropy (M2) provides a measure to this resource, but estimating it on real processors is more challenging than calculating it from ideal simulated statevectors. Previous research demonstrates the measurement of quantum magic on physical quantum processors using randomized local Clifford measurements, while more recent computational work has employed exact statevector based magic calculations to investigate parameterized quantum circuits. Extending these measures to physical quantum hardware introduces challenges with finite resource measurements, uncertainty, and hardware noise, motivating further comparison between simulation and experimentally derived magic.

The project aims to adapt an existing simulation based calculation framework for measurement based estimation on quantum hardware. Building upon established randomized measurement methods, we intend to compare hardware estimated magic against exact simulated predictions for a selected range of quantum circuits. We will replicate known results on quantum hardware and juxtapose the differences between simulation and reality. Through these comparisons, we seek to assess the accuracy, requirements and practical limitations of evaluating non-stabilizer resources on real quantum processors.

The study is in the theoretical and preliminary implementation stages. It’s intended to investigate and evaluate a route from ideal magic calculations to experimental estimations of it.

Mentor(s):
Andy Jung (Science); Noah Charles Singer (Science)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1109

Presentation Time: Session 1: 9:00-10:00am

Modeling and Implementing Beyond 5G Wireless Systems with SDR and NYUSIM

STEM

Authors(s):
Paul Shannon Slack† (Engineering|JMHC); Daniel Ivan Lopez† (Engineering|JMHC); Aleksander Colby Witt† (Engineering); Joseph Timothy Kritenbrink† (Engineering); Michael K Lau‡ (Engineering)

Abstract:
Modern wireless communication systems have redefined the 21st century, enabling key technologies such as Wi-Fi, satellite communications, Bluetooth, and a fully connected Internet of Things (IoT). As demand grows for faster and more reliable connections, networks beyond 5G will need communication schemes that are both efficient and robust in real-world conditions. The Beyond 5G team aims to model, simulate, and implement advanced communication systems using GNU Radio, software-defined radios (SDRs), and the NYUSIM channel simulator. Our work begins with the fundamentals of digital communication, including symbol mapping, pulse shaping, sampling, and modulation schemes such as QAM, which we study and verify through MATLAB simulations. Building on this foundation, our main efforts will split into an SDR implementation of common modulation schemes and channel simulation within NYUSIM. Our SDR effort will focus on the implementation of Gaussian minimum shift keying (GMSK) on a USRP SDR. GMSK is a modulation scheme used in GSM cellular networks and many satellite links. It smooths the transmitted signal with a Gaussian filter, which keeps the signal's bandwidth narrow and its amplitude constant, making it well suited for efficient hardware. We will first build and test the transmitter and receiver in GNU Radio simulation. We will then transmit over the air with the USRP and evaluate performance using metrics such as bit error rate. In parallel, we will use NYUSIM to model how electromagnetic waves propagate in realistic environments, capturing effects such as path loss and multipath. These channel models will let us predict how our communication schemes would perform outside of ideal conditions. Together, these methods will give the team a complete path from theory to simulation to hardware, and a platform for future work in ultra-reliable low-latency communication and integrated sensing and communication.

Mentor(s):
Chih-Chun Wang (Engineering); Husheng Li (Engineering); David J Love (Engineering); James V Krogmeier (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1110

Presentation Time: Session 1: 9:00-10:00am

Evaluating the Ergonomic Design of Purdue University Study Spaces

STEM

Authors(s):
Jacob Mirgon Smetana† (HHS)

Abstract:
The purpose of this research project is to determine whether or not Purdue students would benefit from further investment in ergonomically designed study spaces. Research will be gathered by assessing study locations across Purdue's campus, the costs and potential benefits of ergonomic investment, and the need for ergonomically designed study spaces across college campuses. Primary research will also be completed through a survey of Purdue students and interviews with health science and ergonomics professionals. The findings will be used to determine whether additional investment is needed to improve study spaces across Purdue's campus, and suggestions will be made on how to improve spaces and implement new resources.

Mentor(s):
Catherine Jean Shukle (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1111
Presentation Time: Session 1: 9:00-10:00am

Interactive Mapping of Grid Hosting Capacity and Operational Flexibility

STEM

Authors(s):
Sudarshan Sridhar† (Engineering)

Abstract:
This project develops an interactive visualization platform for exploring where the electric grid may accommodate additional generation or electricity demand and how operational flexibility can affect that capacity. The platform connects NextGW hosting capacity outputs with geographic information through an interactive map, location search, interconnection filters, and information panels for selected regions. It is designed to help researchers explore results under different flexible operating strategies and modeling assumptions across the Eastern, Western, and Texas interconnections. The current prototype includes map visualization, search functionality, and filtering controls, establishing a foundation for these comparisons. Ongoing development focuses on improving data integration and application performance, checking displayed values against source records, and documenting assumptions and limitations. Planned layers, including electricity pricing, hourly data, and financial and site information, will provide additional context for interpreting hosting capacity results. By making geographic patterns and the effects of operating assumptions easier to examine, this work aims to support research into how existing grid infrastructure can accommodate evolving generation and demand.

Mentor(s):
Junjie Qin (Engineering); Gu (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1112
Presentation Time: Session 1: 9:00-10:00am

Self-Sensing Materials in Unmanned Aerial Vehicles

STEM

Authors(s):
Margaret Anna May Stamm† (Engineering); Antonia Vlahos† (Engineering); Enze Chen† (Engineering); Brady Mitchel Buie† (Engineering); Alexander Strelnikov† (Science); William Antonio Keyes† (Engineering|JMHC); Po-Han Yang† (Engineering); Esther Wu† (Enginee

Abstract:
Unmanned aerial vehicles (UAVs) such as quadcopter drones are increasingly being explored for use cases such as product delivery (e.g., consumer goods, medicine, etc.), infrastructure inspection (e.g., inspecting bridges, wind turbines, etc. via drones), agriculture and crop assessment, land surveying, and among many other examples, military applications. Because of the low-cost and high-volume nature of UAVs, it is not desirable to use traditional nondestructive evaluation techniques on them. That is, UAVs in these applications are far too numerous to cost effectively inspect one-by-one for damage, signs of failure, suitability for continued service, etc. Embedded self-sensing has potential to alleviate this problem by enabling continuous and on-board assessment. Self-sensing refers to materials that exhibit coupling between their mechanical condition and their electrical state. Thus, non-invasive electrical measurements embedded into the UAV can be used to determine if the UAV is still fit for service by detecting overloads, cracks, or other precursors of failure. In this work, we explore the use of a representative self-sensing material: carbon nanofiller-modified polylactic acid (PLA). Conductive PLA is used because it can readily be integrated into a 3D printer to rapidly produce bespoke UAV components on demand. This poster will summarize our VIP team's research on self-sensing materials and methods in aeronautics, printing of drone components, wireless in-flight resistance measurements, and the self-sensing response of the due to landing.

Mentor(s):
Tyler N Tallman (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1113
Presentation Time: Session 1: 9:00-10:00am

Class Scheduling in Higher Education: Purdue University as a Case Study

Business Case Study

Authors(s):
Samantha B Stutler† (Engineering|JMHC)

Abstract:
How do class scheduling patterns vary across academic units within a university, and how are these differences associated with course characteristics? This observational study addresses these questions using Purdue University's West Lafayette campus as a case study. Drawing on administrative course-section records from the UniTime scheduling system across multiple academic terms, the analysis compares scheduling patterns across colleges and subject areas. Records without published meeting times, travel-time entries, duplicate sections, and sections with no enrollment are excluded. For each academic unit, the study calculates the proportions of sections beginning before 9 a.m., after 5 p.m., together with the mean start time. Additional comparisons examine how these patterns vary by course level, meeting duration, enrollment, section capacity, and instructional format, while comparisons across terms assess the consistency of observed patterns. Preliminary observations of early-starting clinical sections illustrate the importance of considering instructional format when interpreting differences between academic units. Rather than estimating effects on student performance or interpreting scheduling differences alone as evidence of inequity, the study characterizes the distribution of class times and identifies patterns that warrant further investigation. The case study provides an empirical foundation for discussions of scheduling equity and resource allocation, while offering a replicable framework for comparative research across higher education institutions.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1114

Presentation Time: Session 1: 9:00-10:00am

Early Identification of At-Risk Individuals for Diabetes Using Survey Data

Business Case Study

Authors(s):

Luke James Sullivan† (DSB); Elliot Woo† (DSB); Krish Aggarwal† (DSB); Arthi Venkataramanan† (DSB)

Abstract:

Which health indicators can best predict diabetes risk, and how can they help healthcare providers identify at-risk individuals earlier? Nearly one in seven U.S adults in our data report diabetes. Delayed detection increases treatment costs and the risk of life changing complications. We use the CDC's 2015 Behavioral Risk Factor Surveillance System, a national health survey of 253,680 adults with 21 predictors and a binary diabetes outcome (13.9% positive). Exploratory analysis shows self-rated general health (r=0.29), high blood pressure (r=0.26), BMI (r=0.22), as the strongest predictors. These findings suggest that perceived health status and cardiovascular risk factors could provide stronger signals than traditional demographic data, guiding further feature importance analysis and model comparison. Preprocessing includes handling missing responses, encoding categorical variables, standardization, assessment of multicollinearity, and class weighting. We will develop a logistic regression baseline and compare it against decision trees, random forests, and gradient boosting models. Logistic regression provides an interpretable baseline that aligns with screening applications, while tree-based models can capture nonlinear relationships and interactions between health, lifestyle, and demographic factors that could potentially influence diabetes risk. Recall is the primary evaluation metric, because the goal of the model is to identify as many at risk individuals as possible. Missing a case could delay preventive intervention, increase costs, and lead to avoidable complications. ROC-AUC is a secondary metric. Ultimately, we aim to identify the most predictive diabetes risk factors and develop a cross-validated screening model using only short questionnaire responses, without requiring medical tests. This could support low cost screening, earlier intervention, and reduced diabetes related healthcare costs.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1115
Presentation Time: Session 1: 9:00-10:00am

Brake PCB: Measuring Pedal Angle and Hydraulic Pressure for Race Strategy and Simulation for Purdue Solar Racing's "Artemis"

STEM

Authors(s):
Joshua Andy Theng† (Engineering)

Abstract:
Quantifying driver braking inputs and the resulting hydraulic response can support more accurate vehicle simulations, particularly on sloped surfaces. Purdue Solar Racing's "Artemis" currently uses a mechanical braking system where the hydraulic brake pressure is activated solely by a limit switch, and gives no quantitative data. This R&D project aims to build a compact signal-conditioning PCB that measures the angle the brake pedal is pressed and hydraulic line pressure and transmits the measurements to the vehicle's telemetry system.

A potentiometer mounted on the pedal shaft tracks the pedal's 25 degree range of motion, while 2 pressure transducers, one on the front brake line and one for the rear measure pressure across the brake system's 0-700 psi operating range. The PCB itself filters electrical noise, processes raw analog data, converts that data to digital data, and uses onboard firmware to convert the digital data into useful PSI and angle values. A RJ45 jack cable connects the PCB to the power distribution board, ground, and CAN telemetry network. The PCB's mounting location is being worked out with the mechanical team, with short shielded cables to the sensors to ensure this addition isn't a hindrance to other mechanical components.

Comparing pedal angle against hydraulic pressure shows when and how quickly a driver begins braking and how responsive the brake system reacts. The measurements collected could be useful as a basis to make changes to brake sensitivity resulting in reduced lockups, support more accurate vehicle simulations for braking on uphill and downhill slopes, and evaluate the balance between mechanical and regenerative braking. Parts selection and schematic design are complete, and firmware development is in progress ahead of the direct assembly and validation on the Artemis vehicle.

Mentor(s):
Cyndi Lynch (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1116
Presentation Time: Session 1: 9:00-10:00am

Application of Citric Acid for Critical Metal Leaching from Waste Printed Circuit Boards

STEM

Authors(s):
Abby L Thompson† (Science|JMHC); Hannah Margeurite Kitts‡ (Engineering|JMHC); Sadie Catherine van der Spuy‡ (Engineering)

Abstract:
Electronic waste is a growing global problem, yet it is also a valuable source of critical metals that should not be simply discarded. However, conventional methods use harsh chemicals to extract these substances, which are environmentally damaging and pose risk to the planet. The use of green chemistry offers organic, biodegradable, and environmentally friendly reagents that have shown some prior success. One promising example is citric acid, a low-toxicity organic acid found naturally in citrus fruits and produced industrially by fermentation.

This research focuses on citric acid as an organic agent for the recovery of valuable metals from printed circuit board plates. The purpose of this study is to evaluate citric acid leaching as a safer, efficient, and greener alternative to conventional strong-acid extraction. USB drives were used as the source for printed circuit boards because they are small, commonly used, and the matrices are uniform, keeping a necessary variable constant.

After prepping and placing PCBs into an aqueous solution of Type 1 water, citric acid was dosed into the solution to achieve pH of 1.5. The solution was heated on a hot plate at a constant temperature of approximately 90℃ and reactions were run over varying reaction times of 15 minutes to 5 hours. Preliminary results suggest that citric acid is a sufficient leaching agent to extract such metals as Ca, Sn, Cu, and Ni. The data also shows that the extraction yield with citric acid increases over time. The efficiency is evaluated by analyzing the composition of the filtrates with ICP-OES to calculate elemental yield. Further experiments treating leached PCBs with hydrogen peroxide will be performed to determine an oxidant's effect on the efficiency of metal extraction. This research supports the use of organic acids and green chemistry as an effective and safer alternative for recovering critical metals from electronic waste.

Mentor(s):
Nadezhda N Zyaykina (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1117
Presentation Time: Session 1: 9:00-10:00am

Programming a Six-Axis Robotic Manipulator for Automated Object Handling and Sorting

STEM

Authors(s):
Karlin To† (Engineering)

Abstract:
As surgical procedures become more advanced and operating spaces more constrained, precision and collision avoidance are increasingly important. This study explores the potential benefits of integrating a laser-induced graphene electrode sensor with a camera on a robotic arm for surgical applications. Traditional open-loop control systems lack environmental awareness, while cameras provide limited information about hidden surface features. A LIG sensor could enable robots to detect subtle surface variations through touch. Similar to how an octopus uses its chemotactile abilities to explore its surroundings, a robot equipped with LIG electrodes could gather information about both physical and surrounding chemical microenvironment. This capability could provide opportunities for in-vivo measurements, identifying chemical changes associated with biological conditions such as tumors. This portion of the project focuses on developing the programming framework for the Elephant Robotics myCobot 320 M5, a six-axis robotic arm capable of automated handling and sorting tasks using the LIG sensor. The sensor provides information about an object, which the robot uses to autonomously execute movements and move the object to a designated location. The project consists of four stages: simulating robot movements and object manipulation in PyBullet, testing the physical robot without a gripper and connecting it to simulation scripts, integrating a gripper for object handling, and incorporating the LIG system to create a functional prototype. Results are ongoing, and the presentation will show progress made during the first three months of the year-long project, discuss technical challenges found, and outline future steps. In the long term, this technology could contribute to the development of surgical robotic systems that complement visual information with sensing, potentially elevating a robot's ability to interact with delicate structures and navigate anatomical spaces.

Mentor(s):
Pedro Henrique de Souza Barbosa (Engineering); Wenzhuo Wu (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1118
Presentation Time: Session 1: 9:00-10:00am

Investigating the Role of PKL and ARP6 in H2A.Z Deposition and H3K27me3 Homeostasis in Arabidopsis Thaliana

STEM

Authors(s):
Brooke Annabelle Tran† (Agriculture|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Joe Ogas (Agriculture); Jiaxin Long (Agriculture)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1119
Presentation Time: Session 1: 9:00-10:00am

Rich Boards or Winning Teams: What Drives Success in International Cricket?

Social Science

Authors(s):
Ishita Trivedi† (DSB|JMHC)

Abstract:
When I was eight years old, I often wondered why some cricket nations continued to improve while others struggled to catch up. Money seemed like the obvious explanation. Wealthier cricket boards could invest in better coaching, facilities and player development. But I kept coming back to another question: could the opportunity to regularly compete against stronger teams matter just as much?

That question now drives my research into whether financial resources or access to stronger competition is more closely linked to improvement in men's international cricket. My study examines countries that held International Cricket Council (ICC) Full Member status between 2014 and 2025, covering 138 eligible board years. Using audited financial reports and international match records, I am measuring each board's operating revenue and how frequently its team faced higher rated opponents. I will examine how both factors relate to later changes in performance across cricket formats, comparing each board over time while accounting for trends shared across years. Early research has revealed a challenge: while match records are widely available, financial reports differ in currencies, accounting periods and revenue definitions. Some are also unavailable. I am documenting these gaps to ensure the findings reflect these limitations. The expectation is that this study helps answer a question that extends beyond cricket: is financial support enough to help developing teams succeed, or does progress also depend on who gets the chance to compete?

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1120

Presentation Time: Session 1: 9:00-10:00am

AI Driven ASIC Design: Study of a Two Channel SPI RF Controller

STEM

Authors(s):

Brendan Henry Uhlinger† (Engineering); Justin Tan† (Engineering)

Abstract:

Artificial Intelligence has been rapidly advancing and has the capabilities to heavily assist engineers throughout the ASIC development process, all the way from specification to physical design. However, AI-generated responses still need to be assessed for correct functionality, timing, and physical feasibility. This project evaluates the limitations and capabilities of AI applications in development from spec to tapeout using the NEX AI harness. The specific design focuses on a SystemVerilog controller for a two-channel RF front-end configuration, with data sent over an SPI interface for 24-bit register configuration. The controller is able to accept commands to configure registers with attenuation, transmit modes, and a CORDIC block for angle calculations for two antenna channels. The data is then stored until the controller is ready to send out the information to the outside RF front end. AI tools are utilized to assist with requirements, RTL generation, testbench development, and module debugging, followed by synthesis, placement, and routing. To understand and measure the impact of AI tools in ASIC development, we quantify metrics like estimated hours saved, testbench pass rates, debugging iterations of the AI, and token usage. Using the data collected, we are able to observe where AI speeds up the workflow and where human verification is still required. Our case study into AI-integrated design only includes one design, and thus the results may not be fully applicable to more complex designs. The documentation will be imperative to understanding where AI stands in the future of ASIC design.

Mentor(s):

Pranav Sangam (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1121
Presentation Time: Session 1: 9:00-10:00am

Understanding Student Dining Preferences to Improve Food Sales at the Purdue Memorial Union

Business Case Study

Authors(s):
Justin Trent Vargas† (Engineering); Zackary Thomas Render† (Polytechnic); Pablo Gomez† (Polytechnic); Ryan Tyler Cameron† (Polytechnic); Jiya Kalra† (Science); Mia Angela Abragan† (Polytechnic)

Abstract:
Aramark, the primary food distributor on campus, is seeking to better understand the dining preferences and behaviors of Purdue undergraduate students to identify opportunities to increase food sales at the Purdue Memorial Union (PMU), particularly during weekday lunch hours. According to data provided by Aramark, only 28% of PMU visitors purchase food, suggesting a significant opportunity to increase dining participation among existing visitors. This research study examines the factors influencing students' decisions to dine at the PMU and explores potential changes and/or new food options that could increase their likelihood of dining there. To investigate these questions, our team developed and distributed a Qualtrics survey to Purdue undergraduate students to collect information on their current dining habits, preferences, satisfaction, and interest in potential improvements. Survey responses will be analyzed alongside Aramark's historical visitor and sales data to identify trends and develop recommendations for improving the PMU dining experience. Ultimately, this research aims to help Aramark make data-driven decisions that increase student satisfaction, convert more PMU visitors into dining customers, and improve food sales during weekday lunch hours.

Mentor(s):
James Tanoos (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1122
Presentation Time: Session 1: 9:00-10:00am

Bridging Community Science and Policy

Social Science

Authors(s):
Emilio Vega Salcedo† (HHS)

Abstract:
The purpose of this research project is to determine whether public health and regulatory environmental agencies should integrate citizen led science data into official environmental health surveillance and enforcement. Research will be gathered by a literature review of the accuracy and calibration of cheap air and water quality sensors, the Environmental Protection Agency's policy frameworks for community science, and case studies where data from crowds helped influence public health interventions. Primary research will be completed through interviews with environmental health researchers and public health officials to understand the technical and legal barriers of utilizing non-traditional data. These findings will work to propose a balanced framework that uses community science for early hazard detection while maintaining the necessary standards for checking data and implementing new policies.

Mentor(s):
Catherine Jean Shukle (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1123
Presentation Time: Session 1: 9:00-10:00am

Predicting Five-Year Earnings by College Major to Improve Career Planning

Business Case Study

Authors(s):
Riya Vinodkumar† (DSB); Vidhi J Thakkar† (DSB); Ananya Banerjee† (DSB); Sydney B Menino† (DSB)

Abstract:
Can a college major's 5-year median earnings be reliably predicted to help students make informed higher education investment decisions amid rising tuition and student debt? We use the College Majors 2026 dataset from Kaggle (about 228,000 observations and 72 variables from five U.S. federal data files). The unit of observation is one academic program at a specific institution. The target is 5-year median earnings; the main predictors are 1-year median earnings, program type, credential level, and median debt. We remove target-derived columns and split by institution to prevent leakage. Exploratory analysis shows a 0.8722 correlation between one-year and five-year earnings, which means one-year earnings explain about 76% of the variance in five-year earnings, so early-career pay will likely dominate predictions. Our key question is whether program characteristics add value beyond it, which we test by comparing models with and without this predictor. Multiple linear regression will be used as an interpretable baseline; ridge regression handles correlated predictors such as earnings and debt; decision trees, random forests, and gradient boosting capture nonlinear effects and interactions, such as field differences across credential levels. Models are compared with institution-grouped cross-validation. Our primary metric is mean absolute error (MAE), with RMSE and R^2 as secondary. MAE is in dollars, so a student comparing programs can read it as the typical prediction miss, and it is less distorted by a few very high-earning programs. The results are expected to identify factors associated with 5-year earnings and estimate how accurately future earnings can be predicted. These findings may help students compare programs based on expected earnings and debt, while helping institutions better understand financial outcomes. However, predictions will indicate associations rather than prove causation, and individual earnings may vary.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1124
Presentation Time: Session 1: 9:00-10:00am

A Methodology for the Study of La Crosse Virus Nucleoprotein-Lipid Interactions

STEM

Authors(s):
Diya Vishwakarma† (HHS)

Abstract:
La Crosse Virus (LACV) is a mosquito-borne Orthobunyavirus which is one of the most common causes of pediatric encephalitis in the United States. Infections can lead to chronic seizures, motor delay, or other lifelong neurological complications. Despite the disease burden, there is little known on how LACV assembles in human cells to form new virus particles. LACV assembles in the Golgi apparatus in infected cells, where the viral nucleoprotein (N) encapsidates the viral genome producing ribonucleoprotein (RNP) complexes. It is unknown how the RNP complex interacts with other viral proteins to form and incorporate into the viral particle. Additionally, we have preliminary data from our lab that demonstrates interactions between the N protein and specific host cell lipids. In order to analyze these N-lipid interactions, we are developing a two pronged approach, focusing on biochemical techniques and cellular interactions. Biochemically, we are developing a methodology including affinity tag protein purification followed by surface plasmon resonance (SPR) with lipids resembling the Golgi lipid makeup in order to determine the origins of N protein and lipid binding. Simultaneously, we are developing a virus-like particle system to use as a model to identify the interactions within cells between RNP complexes and the lipids identified in the biochemical analyses. Together, these experiments will help us understand the role of N protein and lipids in LACV assembly. This study will help us establish methodologies to further investigate these types of interactions in other Orthobunyavirus providing a platform to answer questions about Orthobunyavirus assembly.

Mentor(s):
Robert V Stahelin (Pharmacy); Kyra Ann Forsyth (Pharmacy)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1125
Presentation Time: Session 1: 9:00-10:00am

Targeting α-Synuclein Proteostasis: c-Abl Inhibition and Hsp70-Mediated Suppression of Aggregation

STEM

Authors(s):
Theoni Christina Vlachos† (Science|JMHC); Wing Man Stacie Chan† (Pharmacy|JMHC)

Abstract:
Parkinson disease (PD) is characterized by progressive dopaminergic neurodegeneration and the accumulation and prion-like propagation of misfolded alpha-synuclein (aSyn) aggregates. Disruptions in proteostasis, the cellular processes responsible for protein folding and degradation, contribute to this pathology. Two proteins involved in these processes are c-Abl, a non-receptor tyrosine kinase, and heat shock protein 70 kDa (Hsp70), a molecular chaperone. Under physiological conditions, c-Abl regulates cellular processes including cytoskeletal organization, cell signaling, and responses to cellular stress. However, aberrant c-Abl activation has been implicated in impaired autophagy initiation and flux, potentially reducing the clearance of misfolded aSyn. Hsp70 maintains proteostasis by assisting protein folding, preventing aggregation, and facilitating protein degradation. Additionally, Hsp70 exhibits an ATP-independent "holdase" function that can directly inhibit aSyn aggregation. This project investigates these distinct mechanisms by examining the effects of c-Abl inhibition on autophagic clearance and evaluating Hsp70-mediated suppression of aSyn aggregation through viral-mediated overexpression. Together, these studies highlight how multiple proteostasis pathways contribute to aSyn pathology and may provide distinct strategies for targeting disrupted proteostasis in PD.

Mentor(s):
Brady Michael Woods (Pharmacy); Jean-christophe Rochet (Pharmacy)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1126
Presentation Time: Session 1: 9:00-10:00am

Understanding Recombination Efficiency in Interspecific Yeast Hybrids

STEM

Authors(s):
Gabrielle Vonder Embse† (Science); Phoenix Moore† (Science|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Aparna Desai (Science); Brian Metzger (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1127
Presentation Time: Session 1: 9:00-10:00am

The Optimization and Application of Compliant Grippers for Assistive Robotic Manipulation

STEM

Authors(s):
Alyssa Wan† (Engineering); Adikesh S Nathan† (Science)

Abstract:
Many individuals with upper limb disabilities (ULD) require robotic manipulators for everyday tasks. These assistive systems often utilize rigid grippers, which are effective for tasks involving known objects but can struggle to manipulate delicate or irregular-shaped objects, such as food items. Prior usability testing conducted by the lab supports that compliant grippers yield better and easier manipulation of these object types. However, there are still no ways to optimize or personalize grippers for target tasks or objects and rely on user trial-and-error to improve. Incorporating compliant grippers and optimizing them for different objects can expand the range of performable tasks and increase users' independence in activities of daily living (ADLs).

This research aims to optimize compliant gripper designs by investigating how internal infill geometry and density influence gripper force output and transfer capabilities Based on past work in the lab, we are developing an optimal infill generator tool using finite element analysis (FEA), enabling rapid comparison of different infill configurations and ranks their performance based on material properties, gripper geometry, and desired force-compliance balance. By combining computational design, 3D printing, and physical prototyping, this approach enables efficient iteration and more comprehensive testing of gripper designs.

Future work will focus on validating the infill generator experimentally and characterizing the produced composite grip score to optimize gripper performance across target objects. Additionally, the optimized designs are being integrated into a variety of assistive robotic systems, including the lab's developing RoboGripper powered and tenodesis wearables as well as the in-market Robotiq and Kinova systems. Ultimately, we aim to optimize the design of compliant grippers while developing autonomous systems capable of performing ADL tasks to further improve usability for individuals with UD

Mentor(s):
Shaiv Mehra (Engineering); Bradley S Duerstock (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1128
Presentation Time: Session 1: 9:00-10:00am

Demand-Driven Procedural City Simulation and Generation

STEM

Authors(s):
Taozhe Wang† (Polytechnic)

Abstract:
[Abstract Redacted]

Mentor(s):
Daniel P Triplett (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1129
Presentation Time: Session 1: 9:00-10:00am

Creatine and Cognitive Health in Neurodegeneration

Social Science

Authors(s):
Jake Wang† (HHS)

Abstract:
This research project investigates the cognitive effects of creatine use and its potential benefits for people with early neurodegenerative disorders. A literature review will be conducted to gather metrics from previous studies on creatine and brain function, cognitive before-and-after data, and the neuroscience behind creatine's effects in the body. Primary research will also be conducted through interviews with professors and researchers specializing in cognition and neuroscience at Purdue. This project will use the results to determine creatine's effectiveness and whether it is an advantageous supplement for overall cognitive health.

Mentor(s):
Catherine Jean Shukle (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1130
Presentation Time: Session 1: 9:00-10:00am

SkinFit: Building Smarter, Personalized Skincare Recommendations

STEM

Authors(s):
Shaivi B Wankhede† (DSB)

Abstract:
Skin Fit is a project to help people with skin conditions find makeup and skincare products that will not irritate their skin. Product labels often do not reflect how ingredients affect specific skin concerns, which leaves consumers to rely on trial and error. To address this, we are designing an optimization algorithm and an interactive front end. Through the front end, users enter their skin concerns and receive a personalized product routine. Using ingredient data and published dermatological research, the algorithm first filters products containing ingredients linked to irritation for each concern, then selects the fewest products that cover all of the user's needs. Skin Fit is expected to produce smaller, safer routines than browsing products on one's own. This work could help people with skin conditions avoid costly trial and error and help retailers and dermatologists give more personalized product guidance.

Mentor(s):
Prateek Jaiswal (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1131
Presentation Time: Session 1: 9:00-10:00am

Driving Customer Loyalty and Retention at CircleCity Indoor Golf

Business Case Study

Authors(s):
Henry Grant Westrick† (DSB); Caroline Elizabeth Frost† (DSB); Camila Mercado Baldivieso† (DSB|Liberal Arts); Justina Li Gu† (DSB); Sara Negishi† (DSB|JMHC)

Abstract:
Our project examines CircleCity Indoor Golf, an indoor golf entertainment facility in Broad Ripple, IN. We are investigating how Circle City can attract new customers, encourage repeat visits, and convert loyal customers into members, by analyzing consumer preferences, motivations, and barriers to returning. Through secondary research, competitor analysis, and primary data directly from CircleCity, our team will identify opportunities to increase bay utilization and strengthen customer loyalty. Ultimately, our project plans to provide CircleCity Indoor Golf with a strategic marketing plan that includes 5 key factors to attract and retain customers during high and low traffic seasons.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1132
Presentation Time: Session 1: 9:00-10:00am

Protecting the Play: The Reform for Age Limits in Youth Tackle Football

Humanities

Authors(s):
Addison Nicole Wieser† (HHS)

Abstract:
Repeated cranial blunt-force trauma in youth tackle football has raised many concerns regarding long-term neurological health and Chronic Traumatic Encephalopathy (CTE). In my research project, I shed light on the long-term health impacts and policy justifications for restricting tackle football in youth athletics until adolescents turn 12 years old. To investigate this issue, I conducted empirical research on neurological CTE studies, sport interviews, and youth athletic policy rules and mandates. Scientifically acclaimed neuroimaging has revealed brain atrophy in former football players in regions associated with CTE. According to an ESPN report, "Recent medical investigations reveal that at least 25% of former professional football players demonstrate clinical markers of CTE, sparking intense debates among active players, parents, and medical experts regarding early contact exposure" (Seifert and Holder). Because CTE currently can only be diagnosed via autopsy after death, these findings underscore the importance of mitigating cumulative head impacts during adolescent development. Additionally, other researchers stress the physical vulnerabilities children 12 and younger face, revealing that delaying full contact reduces head injuries without slowing down skill development. To preserve football's athletic, social, and psychological benefits, this project suggests flag football as a better alternative because of the safer environment it fosters. Ultimately, this research underscores the need for USA Football and youth athletic administrations to implement standardized age restrictions for children under 12 and to adopt flag football programs to protect the heads of juvenile athletes.

Mentor(s):
Jessica M Mercado (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1133
Presentation Time: Session 1: 9:00-10:00am

Reducing Missed Diagnoses: A Data-Driven Approach to Prioritizing Heart Disease Screening

Business Case Study

Authors(s):
Cole Witmer† (DSB); Mishka Parashar† (DSB); Dane Alexander Kniola† (DSB)

Abstract:
Can clinics identify which patients are most likely to have heart disease so that limited testing resources go to those who need them first? Every missed high-risk patient means delayed treatment and worse outcomes, while every unnecessary follow-up test strains scarce staff time and diagnostic capacity. We aim to predict whether a patient has heart disease so clinics can decide who gets additional testing first. We use the Cleveland subset of the UCI Heart Disease dataset, which contains 303 patient records and 13 predictors covering demographics, symptoms, clinical measurements, and cardiac test results. Heart disease is present in 139 patients (45.9%) and absent in 164 (54.1%), a balanced mix that resembles the screening decisions clinics face. Chest-pain type and maximum heart rate differ noticeably between the two groups, suggesting that information clinics already collect during routine visits may help flag higher-risk patients. We will impute missing values, encode categorical variables, and standardize continuous variables, fitting all steps on training data only to prevent leakage. Logistic regression will serve as an interpretable baseline. A decision tree will provide understandable decision rules based on combinations of symptoms and clinical measurements, while a random forest will combine multiple trees to improve predictive stability and capture relationships that a linear model may miss. Because missing a patient with heart disease is the costliest error, we will compare models primarily by recall through cross-validation, which directly measures how many at-risk patients we catch. If successful, this approach could give clinics a consistent, low-cost way to prioritize patients for testing, helping at-risk patients receive treatment sooner and reducing unnecessary testing costs. Given the small, historical dataset, results are exploratory rather than a clinical tool.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1134
Presentation Time: Session 1: 9:00-10:00am

How do Habitat Characteristics and Prey Activity Influence Wolf Presence and Activity Across Comparable U.S. National Parks?

STEM

Authors(s):
Makayla Marie Woodward† (Agriculture|JMHC); Carissa Aiello† (Engineering|Liberal Arts|JMHC)

Abstract:
Grey wolves are apex predators that help maintain ecological balance by regulating prey and intermediate predator populations, producing cascading effects throughout ecosystems. Historically, eradication programs, habitat loss, hunting, and geographic isolation have severely reduced wolf populations and limited their recovery. Previous research identifies prey availability, vegetation, water access, and human activity as important influences on wolf habitat suitability, but how these factors interact across geographically distinct yet ecologically comparable sites remains unclear.

Voyageurs National Park in Minnesota supports an established wolf population, whereas Acadia National Park in Maine, despite evidence of historical wolf presence and potentially suitable habitat, has no resident wolves. This contrast offers an opportunity to examine ecological conditions and human disturbance associated with wolf presence.

We compared four sites in each park with similar natural resources. Acoustic recording units (ARUs) and camera traps collected noninvasive observations of soundscapes, wildlife activity, and potential human disturbance. Each site was sampled for 1 minute of every hour (Site-Acadia: 9/23-9/25/2026, Site-Voyageurs: 9/23-9/25/2025. Combining acoustic and camera-trap data allows us to evaluate habitat characteristics, prey-community activity, and disturbance across the two parks.

We hypothesize that greater ecological disturbance, particularly human activity, in Acadia is associated with reduced habitat suitability for wolves despite otherwise favorable conditions. This research may inform habitat connectivity, reintroduction assessments, conservation strategies, and human–wildlife coexistence.

Mentor(s):
Kristen Marie Bellisario (JMHC)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1135
Presentation Time: Session 1: 9:00-10:00am

Feline Ovariohysterectomy at Eight Weeks: Owner Aversions and Veterinarian Opinions

Social Science

Authors(s):
Vaishnavi Yalla† (Science)

Abstract:
The subject of juvenile feline ovariohysterectomy, or kitten spay, has been debated amongst veterinary healthcare professionals and pet owners for years, with recommended guidelines frequently changing. There is no consensus in the industry; however, with initiatives such as FFF (Feline Fix by Five) by the United Spay Alliance and modern cancer research, there are few counterpoints against spaying as early as possible. Large-volume spay and neuter clinics tend to approve spay procedures for eight-week-old kittens weighing at least three pounds. Yet many pet owners express aversion and some hospitals refuse the service, recommending waiting until after first heat or six months of age. Using a survey, I will collect answers from pet owners detailing their opinions on the practice. The survey will include their working definition of ‘spay’, opinions on when to spay, where those thoughts may stem from, and if they have owned kittens. This data will be used to average respondents into two different groups: averse and non-averse, which I intend to assess for common denominators influencing aversions. That data will be forwarded to multiple veterinarians, some specialized in spay and neuter, to offer solutions and debunk false ideas. These statements will be cross-referenced with peer-reviewed studies to craft methods of spreading updated recommendations for spay age with specific benefits and risks. New, informed guidelines can aid in preventing the emotional reasons for delaying ovariohysterectomy from compromising kitten health and longevity.

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1136
Presentation Time: Session 1: 9:00-10:00am

Associations of MIND Diet Components and Cardiorespiratory Fitness With Working Memory Across Menstrual Cycle

Social Science

Authors(s):
Kaitlin L Yang† (HHS|JMHC)

Abstract:
BACKGROUND AND SIGNIFICANCE: Women during their luteal phase report declined cognitive function due to elevated progesterone. MIND diet research has been linked to lower inflammation and oxidative stress, which can enhance cognition. Additionally, cardiovascular fitness (CRF) is positively associated with executive function and memory potentially through increased cerebral blood flow and neurotrophic factors. Determining if MIND diet and CRF can mitigate cognitive deficits during the luteal phase is significant as it helps identify potential interventions to stabilize cognitive function throughout the menstrual cycle. RESEARCH QUESTION: Does higher MIND diet adherence or higher CRF protect against deficits in working memory during the luteal phase when progesterone is elevated compared to the follicular phase? PROPOSED METHODS: Sixty women aged 18-35 will be recruited to complete three visits. On the first day, participants will familiarize with a computerized Sternberg task requiring varying memory load to assess working memory, complete a treadmill-based graded exercise test to assess V̇O2max as a CRF measure, and later detail their typical diet to identify MIND diet components. On each of the follicular/luteal days, done in counterbalanced order, participants will complete the Sternberg task and provide a 25 ml blood sample to verify their progesterone and estradiol levels. Between-phase difference in working memory will be first verified using a 2 (Phase: follicular, luteal) x 2 (Load: low, high) ANOVA. The relationship between individual MIND diet components and working memory scores in high versus low fit adult women will be assessed to determine the correlation. PROJECTED LIMITATIONS AND OBSTACLES: Since diet is self-reported, collected MIND diet component levels may be under/overestimated. Because the luteal phase was used to contrast with the follicular phase, the associations of MIND diet and CRF with working memory in other phases will not be captured.

Mentor(s):
Shih-chun Kao (HHS); Brandon M Kistler (HHS); Manuela Cortes Ospina (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1137
Presentation Time: Session 1: 9:00-10:00am

Repurposed drug efficacy against different strains of Acanthamoeba species in vitro

STEM

Authors(s):
Annika Ybarra† (Science)

Abstract:
Acanthamoeba spp. is a genus of pathogenic, free-living amoebas that can cause corneal disease, systemic infections, and central nervous system (CNS) infections by entering through the skin or nasal passages. They can cause diseases such as acanthamoebiasis, a systemic infection; Granulomatous Amoebic Encephalitis (GAE), which occurs when the blood-brain barrier breaks down and the amoeba infects brain tissue; or Acanthamoeba Keratitis (AK), which is mainly caused by contact lens contamination through exposure to freshwater sources from showering or swimming, which can lead to corneal infection and blindness. The overall case mortality rates for acanthamoebiasis are ~70%, and >90% for GAE. No standardized protocol exists for treating Acanthamoeba infections, so we need to discover and develop new drugs. In this project, we tested various Acanthamoeba strains for their sensitivity to disinfectants, antifungals, antibiotics, and antiprotozoals. We used 96-well plates incubated at 27°C for 72 hours to determine the optimal trophozoite seeding density and used the CellTiter-Glo 2.0 trophocidal assay to calculate the half-maximal inhibitory concentration (IC_{50}) for each drug. For both the V006 and 07-076 strains in Ac6 media, flucytosine showed good biological efficacy (IC_{50}= 0.02-2 µg/mL). Some drugs, like azithromycin and chlorhexidine, only showed good biological efficacy for the V006 strain, and alexidine and voriconazole showed good efficacy for the 07-076 strain only. These results show the need for standardizing research methods in drug development and discovery against Acanthamoeba to assess and compare drug efficacy, and for standardizing treatment regimens, potentially reducing these mortality rates.

Mentor(s):
Christopher Aaron Rice (Vet Med); Kamana Thapa (Vet Med); Chayan Sharma (Vet Med)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1138
Presentation Time: Session 1: 9:00-10:00am

AIDA3 Research Autonomous Tail-Sitter

STEM

Authors(s):
Jaiveer Zaveri† (DSB); Adam Stanley Jurewicz† (DSB); Luca T Miloscia† (Engineering); Ryan Zhao† (Engineering)

Abstract:
Vertical takeoff and landing (VTOL) aircraft operate without runways, but most trade away the speed and efficiency of conventional airplanes. Our team is designing, building, and testing an autonomous fixed-wing aircraft that strives to overcome this. The aircraft will undergo a vertical take-off then transition into horizontal flight. Referred to as a “tail-sitter,” the aircraft’s significance lies in its ability to merge the vertical agility and hovering capabilities of a helicopter with the high speed, extended range, and aerodynamic efficiency of a conventional airplane, reducing the weight and usual requirements for extensive runway space. To turn this concept into reality, our team is executing a systems engineering framework structured around the V-model, ensuring that every design choice is traceable from top-level requirements down to component verification. Turning stakeholder needs into technical requirements, establishing functional baselines, and developing 3D-CAD models in OnShape alongside dynamic aerodynamic simulations are among the many parts of this project. The team will test the vehicle's onboard vision and sensor-based navigation in PURT – a specialized unmanned robotics facility along with wind tunnel testing to test the models' flight controls for stability. It is the goal to demonstrate stable transitions between hover and forward flight and navigation of a designated zone without a human pilot through modeling and real testing. By combining modern automation with historic VTOL concepts, this project focuses on overcoming past limitations in pilot visibility and landing precision, yielding a high-performance, and efficient autonomous aerial vehicle. Throughout the engineering design process, using verification and validation, this hands-on research allows first-year students to gain both practical and technical knowledge to design meaningful solutions to key problems.

Mentor(s):
Richard Ajagu (Engineering); Sabine Brunswicker (Polytechnic); Christopher Rashidian (Polytechnic); Alexander Kmetko (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1139
Presentation Time: Session 1: 9:00-10:00am

Vid2Grasp: Autonomous Grasping for Wheelchair-Mounted Robotic Arms from a Single Smartphone Video

STEM

Authors(s):
Jacob Junjie Zhang† (Engineering)

Abstract:
Wheelchair-mounted robotic arms (WMRAs) are assistive robotic manipulators that aid people with upper limb disabilities in performing activities of daily living (ADLs), everyday self-care tasks such as eating, grooming, and household cleaning. However, manual control methods for WMRAs, such as joysticks, eye tracking, and brain-computer interfaces, can cause cognitive fatigue, may require significant training, and may not be viable for people with severe upper limb impairments. Autonomous robotic grasping pipelines can address these limitations by allowing WMRAs to grasp objects with minimal user input, but many require specific camera configurations, depth sensors, or task-specific training data, which are costly and difficult to obtain or set up on wheelchairs. In addition, some pipelines rely on partial views of an object, which can hurt grasp performance. We present an autonomous grasping pipeline that requires only a smartphone video that a caregiver can easily record by sweeping the phone 360° around an object. The pipeline uses 3D reconstruction to generate a 3D model of the object from the video and the grasp generation framework GraspGen to predict grasp poses. We are evaluating the pipeline through real-world experiments on a Kinova Gen3 robotic arm with various ADL objects and comparing it against other common methods. Our evaluation centers on two key metrics: grasp success rate, defined as the percentage of pick-and-place trials completed without dropping or damaging the object, and inference latency, defined as the computation time required to determine an optimal grasp pose. Future work will focus on reducing the pipeline's latency and improving grasp reliability across more complex ADL tasks. Ultimately, by removing the need for specialized sensors or task-specific training, we hope that our pipeline can make autonomous grasping more accessible to users and caregivers, supporting greater independence for WMRA users in their daily lives.

Mentor(s):
Shaiv Mehra (Engineering); Maxwell Ryan Kawada (Engineering); Bradley S Duerstock (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1140

Presentation Time: Session 1: 9:00-10:00am

Design and Performance Characterization of a 2nd Order Continuous-Time Delta Sigma Modulator for Wireless Communications

STEM

Authors(s):
Amanda Zheng† (Engineering); Ethan C Peyton† (Engineering|JMHC)

Abstract:
Modern day communication systems require signal conversion that can provide high resolution, low noise, whilst performing at relatively high sampling rates. In the case of wireless communications environments, this becomes especially quintessential, as these environments include abundant signal interference and noise, as well as weak radar echoes. For signal converters to distinguish the weak radar signals from others in the environment, high resolution and low noise processing is essential. In addition, traditional ADC's require anti-aliasing filters, consuming large amounts of power. In comparison, the low noise, high resolution and built in anti-aliasing characteristics of a CT DSM makes it an attractive choice for communication applications. Typical CT DSM uses analog summing amplifiers before the quantizer to compensate for excess loop delay (ELD), requiring high power consumption, high unity gain bandwidth, and difficulty in layout. This proposed design utilizes ELD compensation to eliminate the analog summing amplifier and instead performs the summation of the loop filter output and DAC signal directly inside the comparator. The proposed design is of a 2nd order continuous time delta sigma modulator utilizing a 3-bit quantizer, OSR of 16, and is designed for BWs of 40MHz, reaching a peak SNDR of 60dB. Prior work falls short in balancing noise shaping with stability and counteracting ELD without adding in an extra unwanted pole in high-speed applications. The completed design may be subject to heavy kickback noise, which may severely degrade the signal and proves itself to be a heavy circuit design challenge.. The completed Delta Sigma Modulator establishes a validated analog front end for full Delta Sigma ADC realization, with ongoing work focused on transistor level design, layout implementation, and post-layout verification within the Purdue System-on-Chip Extension Technologies Analog-Mixed Signal sub team.

Mentor(s):
Seyedehmarzieh Rouhani (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1141
Presentation Time: Session 1: 9:00-10:00am

Trustworthy Machine Learning - Dockerization Agentic Tools

STEM

Authors(s):
Julius Zhou† (Science); Minh Huy Pham† (Science); Kabyn Patrick Allen Peterson† (Science); Chibin Hwee Loo† (Science); Saachika Yadav† (Engineering)

Abstract:
Real-world machine learning systems often need to satisfy multiple guarantees at once, such as privacy, robustness, and fairness. However, defenses that provide these guarantees are usually designed and evaluated in isolation, and little is known about how they interact when combined. Landseer is a framework for studying these interactions empirically by evaluating defenses from trustworthy machine learning (TML) research together under a shared set of benchmarks and models.

This requires onboarding existing TML tools into Landseer, which is not an easy task. Published code repositories rely on varied software dependencies, hardware configurations, and undocumented environment assumptions, and reconstructing these environments by hand is slow and error-prone. To make onboarding scalable, we are automating it with an agentic framework in which AI agents set up, run, and validate each repository.

Our team focuses on one part of this framework: a toolchain that automatically packages a repository into a reproducible container. It has four components: repository inspection, iterative Dockerfile generation and repair, container lifecycle management, and a command execution interface. Informed by our manual reproduction of a published robustness method, the pipeline builds Docker containers first and then converts them to Apptainer for use on Purdue's research computing clusters.

We have completed the repository inspection stage, which analyzes a repository's structure, dependencies, documentation, and environment requirements, such as Python, CUDA, and deep learning framework versions. We are now building the remaining components in parallel and will then merge them into one end-to-end pipeline. Once complete, the toolchain will reduce the manual effort of onboarding TML tools and allow Landseer to study defense interactions at scale.

Mentor(s):
Zahra Ghodsi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1200
Presentation Time: Session 2: 10:30-11:30am

Enhancing Retention Rate: A Data-Driven Approach to Student Success

Business Case Study

Authors(s):
Adyan Saleh Al-Shamri† (DSB); Serene Joseph† (DSB); Sonakshi Thakuria† (DSB)

Abstract:
Can we predict if a student will drop out, stay enrolled, or graduate based on their academic, socioeconomic, and demographic characteristics to help universities identify at-risk students and improve retention strategies? Student dropout affects student success, retention rates, and the allocation of university resources, and identifying higher-risk students early lets universities target support such as advising, tutoring, or financial assistance. Using the Predict Students' Dropout and Academic Success dataset from the UCI Machine Learning Repository, with 4,424 student records and 36 academic, admission, socioeconomic, and demographic features, we classify each student as dropout, enrolled, or graduate. Our EDA shows a class imbalance: 49.92% of students graduate, 32.14% drop out, and 17.94% stay enrolled. We also compare first-semester performance, approved course units, scholarships, and tuition payment status across outcomes. We will check for missing values and duplicates, encode categorical variables, scale numerical features, and use a 60/20/20 split to avoid data leakage. Logistic regression is our simple, interpretable baseline; random forest and gradient boosting capture nonlinear relationships and interactions, since the link between academic performance and dropout risk may depend on financial situation or scholarship status. Models are evaluated with stratified k-fold cross-validation and macro F1, which balances precision and recall across the three imbalanced classes. Missing an at-risk student means missed support, while a false alarm wastes advising resources, so we also examine dropout-specific precision and recall. The model cannot identify causes of dropout or guarantee higher retention, but it can help universities prioritize students for early intervention and allocate support resources more effectively.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1201
Presentation Time: Session 2: 10:30-11:30am

Codon Optimization of the Human Alpha-Synuclein Gene for Improved Protein Production in Escherichia coli

STEM

Authors(s):
Diya Ambat† (Science|JMHC)

Abstract:
Parkinson disease is characterized by the aggregation of the neuronal protein alpha-synuclein (aSyn). Studying the process of aggregation in vitro and in vivo requires large quantities of purified protein, which are typically expressed recombinantly in Escherichia coli (E. coli). One challenge in recombinant protein expression is that the human gene for alpha-synuclein uses codons that are rare in bacteria, which can slow down protein production and lower protein yield. This project assesses the effect of expressing aSyn with codons optimized for expression in E. coli. Only the codons were changed, so the protein sequence itself stays the same. To build the new construct, the pT7 plasmid was isolated by miniprep, and the plasmid backbone was amplified by PCR so that the codon-optimized alpha-synuclein sequence can be inserted in place of the original one. PCR products were run on an agarose gel to confirm the backbone was amplified at the expected size. The assembled construct was then transformed into E. coli, and protein production will be induced under the same conditions for the redesigned and original versions. The amount of protein produced will be determined through protein purification and SDS-PAGE. Higher protein yield resulting from utilizing codon-optimized coding sequences will make it easier for labs to produce alpha-synuclein in large quantities.

Mentor(s):
Jean-christophe Rochet (Pharmacy); Bryce Colon (Pharmacy); Andrew Edward Sayers (Pharmacy)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1202
Presentation Time: Session 2: 10:30-11:30am

Flock Cameras and What They Mean to the United States.

Creative

Authors(s):
Obichukwu Patrick Anyanwu† (Polytechnic)

Abstract:
Automated car tracking is at an all-time high, Flock Cameras being installed in abundance across the United States. With safety as the main driver, governments are funding these high-tech cameras with the capability of using AI to recognize patterns between license plates and vehicle features to provide near-instantaneous updates for law enforcement to potentially prevent or stop crimes. While Flock has claimed that these tracking instances are encrypted, logged, and completely private for government use to maintain safety, many speculate about the ethics and trust that they are willing to put into these peering cameras. Many feel that it is wrong that the government should be able to continually track them in whatever they are doing. They also argue about how this tracking information will be used. Things like the severity of crime, placement of Flock cameras, and potential misuse of tracking information are potential factors that can determine whether these cameras are installed and planned to be used as intended.

Mentor(s):
Karrie Hamilton (PFW)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1203

Presentation Time: Session 2: 10:30-11:30am

Bifunctional antibody-recruiting molecules for renal cancer immunotherapy

STEM

Authors(s):

Payton Scott Baker† (Science); Beatrice V Dyas† (Science); Laurel Frances Tayloe† (Science); Noah Miller† (Science|JMHC)

Abstract:

An estimated 80,000 people in the United States will be diagnosed with kidney cancer in 2026. Renal cell carcinoma makes up about nine in ten kidney cancers, and for patients with metastases, fewer than one in five survive five years.

Antibody-recruiting molecules (ARMs) are an emerging approach to cancer immunotherapy. They redirect a patient's own antibodies to cancer cells, where antibodies engage the immune system to destroy the target, without the need for a manufactured therapeutic antibody. Existing ARMs use haptens, small molecules recognized only by specific antibodies, which limits recruitment to a small part of each patient's antibody pool. Our approach targets the Fc region, the constant tail shared by immunoglobulin G (IgG) antibodies, so the patient's entire antibody repertoire is available for recruitment.

We developed a bifunctional conjugate composed of a ligand for human IgG and a ligand for carbonic anhydrase IX (CAIX), a protein found on renal cancer cells. The CAIX ligand anchors the conjugate to the tumor cell, where the IgG ligand captures circulating antibodies. Surface plasmon resonance (SPR) binding studies showed strong binding of the IgG ligand to human IgG, with fast association and slow dissociation. In an antibody-dependent cellular cytotoxicity (ADCC) assay, the conjugate activated the Fc receptor that triggers ADCC on effector cells with high potency. In vivo studies are in progress to evaluate antitumor efficacy. These results demonstrate a modular platform for directing a patient’s own antibodies against cancer.

Mentor(s):

Pranav Ballaney (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1204
Presentation Time: Session 2: 10:30-11:30am

Phospholipase Cε (PLCε) Regulation by the Y-box

STEM

Authors(s):
Courtlyn V Bales-Hall† (Science|JMHC); Christian D Guess* (Science|JMHC)

Abstract:
Phospholipase Cε (PLCε) is a key modulator in heart health by hydrolyzing phosphatidyl-inositol phosphate species into second messengers to promote maximal cardiac contractility and downstream cell signaling. Dysregulation of PLCε is implicated in cardiovascular disease which is the leading cause of death in the United States and worldwide. In order to develop safer, more selective therapeutics, how this enzyme is regulated must be better understood. Unlike other PLC isoforms, PLCε contains a 70-residue insertion in the catalytic core known as the Y-box. Maximal activation of PLCε requires the Y-box, but it is unclear why. This project aims to understand the role of the Y-box in PLCε regulation. To date, the Y-box and fragments within it have been deleted from the DNA sequence using site-directed mutagenesis for activity assays. Insect cell cultures have been inoculated and incubated with selected deletion constructs to express and purify proteins for structural studies. Cell-based, radio-labeled assays have been performed to observe changes in lipase activity with these different deletions. These steps provide the foundation for focusing on the role of the Y-box region in the next phase of research. By understanding how the Y-box regulates PLCε, the results of this work will support further study of cardiovascular health and the treatment of cardiovascular disease by making therapeutics selective to PLCε by targeting the Y-box.

Mentor(s):
Faith Duryea McCauley (Science); Angeline M Lyon (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1205
Presentation Time: Session 2: 10:30-11:30am

How Much Data Is Too Much? Balancing Machine Learning Fraud Detection and Consumer Privacy

Social Science

Authors(s):
Dishita Ashok Bansal† (DSB|HHS)

Abstract:
As financial institutions increasingly rely on machine learning to detect identity theft and payment fraud, an important question emerges: how much consumer information should banks be allowed to collect in the name of security? Machine learning algorithms can identify suspicious transactions by analyzing spending habits, transaction histories, geographic activity, and other behavioral patterns. However, the same information that makes these systems effective also raises concerns about consumer privacy, transparency, and the potential misuse of personal data.

This exploratory research examines the relationship between machine learning-based fraud detection and consumer privacy through a review of scholarly research and industry publications. I investigate how financial institutions use behavioral data to identify fraudulent transactions, the limitations of existing detection methods, and emerging approaches such as explainable AI and privacy-preserving machine learning. Particular attention is given to whether improving fraud detection necessarily requires collecting more personal information or whether more effective use of existing data could produce similar benefits.

By evaluating the advantages and limitations of these technologies, this research aims to identify how financial institutions can balance fraud prevention with responsible data collection. Ultimately, it considers whether stronger financial security and consumer privacy must be competing priorities or whether machine learning can help institutions achieve both.

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1206
Presentation Time: Session 2: 10:30-11:30am

Industrial Controls Effect on Workflow Efficiency

Creative

Authors(s):
Simon Randel Beazly† (Polytechnic)

Abstract:
Traditionally, manufacturing processes relied on manual control, in which operators had to monitor equipment, perform repetitive tasks, and make adjustments throughout the cycle. This approach results in process inconsistencies, higher downtime rates, and additional labor expenses. The implementation of programmable logic controllers (PLCs) has helped automate many of those processes. PLCs read sensor data and trigger mechanical actions, thereby increasing the efficiency of industrial processes. This exploratory research project will investigate the application of PLC-based industrial controls to increase efficiency of the manufacturing workflow. The research will focus on comparing manual control of manufacturing processes with PLC-based control, considering aspects such as process consistency, response time, the operator's role, and production efficiency. To understand the above-mentioned aspects, future work involves researching industrial controls used in manufacturing and analyzing manufacturing processes before and after PLC implementation. The programming and logic of PLC controls will be examined to identify how automation can help avoid unnecessary operator intervention and increase workflow efficiency.

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1207
Presentation Time: Session 2: 10:30-11:30am

Bridging the Gap: Comparing U.S. and European Infrastructure via Economic, Longevity, and Environmental Impacts

STEM

Authors(s):
Olivia Maria Biggs† (Engineering)

Abstract:
Infrastructure networks—encompassing transportation, water management, and structural systems—directly govern daily quality of life, impacting everything from commute times and local commerce to clean drinking water and public health. are fundamental to public safety and mobility. However, while American infrastructure maintains an overall "C" grade from the American Society of Civil Engineers (ASCE) across 18 different infrastructure categories, European systems are frequently recognized for greater long-term sustainability despite higher initial economic demands. This study compares U.S. and European civil engineering practices by examining how differences in financial models, material selection, urban density, and vehicle integration influence infrastructure performance and daily human outcomes.

Using a comparative lifecycle and economic analysis of historical maintenance expenditures, budgetary allocations, and design standards, this project evaluates the structural, health, and environmental trade-offs between the two regions. Discussions with professors, professionals, and personal real-world experience indicate that European frameworks prioritize proactive lifecycle management and durable material standards, resulting in extended asset longevity and reduced environmental footprints.

Conversely, U.S. reliance on reactive maintenance leads to recurring deferred costs, frequent road disruptions, and heightened public health risks from overly aged infrastructure. Expected results suggest a critical necessity for U.S. policy and engineering practice to pivot toward sustainable material standards and hybrid investment models. Incorporating proactive European maintenance strategies can mitigate long-term economic burdens and enhance environmental resilience across American infrastructure.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1208
Presentation Time: Session 2: 10:30-11:30am

Studies of the GEF Activity of PLC Episilon

STEM

Authors(s):
Daniela Christina Boyer† (Science)

Abstract:
The purpose of this research was to investigate the activation of Rap1A by phospholipase Cε (PLCε) via its N-terminal guanine nucleotide exchange factor (GEF) domain. This CDC25 domain should maintain its GEF activity on its own without the assistance of other domains of PLCε, but mutation of important amino acid residues should decrease its ability to be a GEF for Rap1A. Investigation of the GEF was done through truncation of PLCε so that only the N-terminal of PLCε remained, followed by mutagenesis of key amino acids within the CDC25 domain that are suspected of binding to Rap1A. Further testing will be done on these mutants using an in vitro fluorescence polarization GEF assays understand the mechanism of binding between PLCε and Rap1A and show the ability of PLCε to facilitate the exchange of GDP to GTP. Activated Rap1A can activate other inactive PLCε molecules, making this function essential to understand. It is the sustained activity of PLCε that drives the overexpression of genes that cause cardiac hypertrophy. If activation of Rap1A decreases due to these mutations in PLCε GEF activity, the activation of other PLCε proteins should decrease, and therefore, the sustained activity present in cardiac hypertrophy will not be possible due to this pathway.

Mentor(s):
Stephanie Lynn Barrios (Science); Angeline M Lyon (Science)

Other Acknowledgment(s):
Elisabeth E Garland* (Science)

Poster Presentation Abstract Number: 1209
Presentation Time: Session 2: 10:30-11:30am

Discrepancies in Autism Diagnosis by Gender

Social Science

Authors(s):
Lydia Brady† (Polytechnic)

Abstract:
In the United States, the median age of an Autism Spectrum Disorder (ASD) diagnosis is about 6 years old, despite the average being 10.5 years old. In recent years, this average has gone up due to an increase in adulthood diagnoses, specifically in women. One in every four females diagnosed with ASD in 2024 were over the age of 18, which is more than twice the number of men diagnosed in adulthood in the same year (Bartlet et al., 2025). In this exploratory research project, I will examine the distribution of age at autism diagnosis in women compared to men and identify the possible reasons behind this difference. Preliminary research suggests that women often camouflage, or mask, their behaviors more than men do, hence a delay in diagnosis. I will examine this history of camouflaging, as well as the possibility of gender bias in diagnoses. This research will contribute to the understanding of Autism Spectrum Disorder in women and increase awareness of this unfortunate discrepancy.

Keywords: Autism; Neurodivergence; Women; Adult Diagnosis; ASD; Gender Bias; Sex Bias; Psychological Diagnosis; Autism Spectrum Disorder

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1210
Presentation Time: Session 2: 10:30-11:30am

Patient-Facing Conversational Agents Supporting Genetic Testing Decision-Making: A Systematic Review

STEM

Authors(s):
Natalie Margaret Brenner† (HHS|JMHC); Amanda Schuler† (HHS|Liberal Arts|JMHC); Munazzah M Ali‡ (HHS|JMHC)

Abstract:
Genetic testing is increasingly used, but access to genetic counseling remains limited. Patient-facing conversational agents, including chatbots and virtual assistants, may help patients navigate complex genetic testing information and decisions. This review examined current evidence on how these tools support genetic-testing decision-making. We systematically searched PubMed, Embase, Scopus, PsycINFO, CINAHL, and IEEE Xplore through September 2026. Eligible studies evaluated patient-facing conversational agents supporting genetic-testing decisions and reported decision, behavioral, or user outcomes. Decision-support functions were classified using the Ottawa Decision Support Framework. Of 3,578 records screened, 16 studies were included. Of them, six included a comparison group; the remaining studies were feasibility studies, qualitative, or mixed-methods evaluations. Contexts included hereditary cancer (n=11), prenatal and carrier screening (n=2), APOL1 testing (n=2) and population genomics (n=1). Most tools used non-generative conversational mechanisms; only one used generative AI based on a large language model. All provided information and risk communication. Many also clarified testing choices, supported deliberation or communication, and guided testing or follow-up. Usability and acceptability were generally favorable, but engagement varied. Some studies found improved knowledge or testing uptake, but findings were mixed and multicomponent interventions limited attribution to the agent alone. Patient-facing conversational agents show preliminary promise for improving access to genetic-testing information and supporting informed decision-making. However, current tools emphasize education and risk communication, with less attention to values clarification and personalized decision support. Further research should use more rigorous designs to determine their effectiveness in improving decision quality and patient outcomes.

Mentor(s):
Haocen Wang (HHS)

Other Acknowledgment(s):
Trinity Fe Miranda* (DSB|JMHC); Valentina Santoyo-Angulo* (HHS); Evan K Perrault* (Liberal Arts); Yadira Santiago Banuelos* (HHS)

Poster Presentation Abstract Number: 1211
Presentation Time: Session 2: 10:30-11:30am

Development of Lightweight Autonomous Aircraft and Identification Systems for Motion-Capture Testing

STEM

Authors(s):
Braden Callaway† (Engineering); Aru Patwardhan† (Engineering); Simarleen Kaur† (Engineering); Noah Robert Wykoff† (Engineering); Bo Chen† (Engineering); Aryaan Hegde† (Engineering)

Abstract:
This research focuses on the iterative development and testing of lightweight, autonomous unmanned fixed-wing aircraft for scalable swarm applications using Purdue University's PURT (Purdue University Research Testbed) facility. The project utilizes primarily off-the-shelf components to develop an easily manufacturable aircraft. Design improvements, including optimized landing gear geometry, forward center-of-mass placement, ailerons, and 3D-printed pushrod eyelets, enhance flight stability, controllability, and mechanical efficiency.

The PURT facility uses high-precision motion-capture cameras to simulate onboard sensors and evaluate navigation, control algorithms, and overall flight performance. To enable simultaneous tracking of multiple aircraft, a custom printed circuit board (PCB) was developed to assign each aircraft a unique flashing-light frequency, improving identification reliability and experimental scalability. The integration of the aircraft platform, identification system, and motion-capture testing environment establishes a foundation for advancing autonomous flight systems. Future work will focus on further optimizing aircraft stability, structural design, and flight performance.

Mentor(s):
James Michael Goppert (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1212
Presentation Time: Session 2: 10:30-11:30am

Cleaner Air, Healthier Lives? Evaluating the Public Health Impact of U.S Air-Quality Regulations, 1970-2000

Humanities

Authors(s):
Lydia Campbell† (Science)

Abstract:
Environmental policies play an important role in protecting human health by limiting exposure to harmful pollutants. Established in 1970, the Environmental Protection Agency (EPA) became a central federal agency responsible for regulating air pollution and protecting public health. This research will examine how deferral environmental policy, particularly the development and implementation of EPA air-quality regulations between 1970 and 2000, influenced human health in the United States. Through a review of historical environmental legislation, EPA regulations, and existing research on air pollution and health outcomes, this study will investigate the relationship between changes in air-quality standards and indicators such as respiratory illness and pollution-related mortality. The analysis will focus on identifying patterns between regulatory changes and reported health outcomes while recognizing that factors such as industrial activity, technological advancements, and economic conditions may also influence air quality and public health. This study expects to find that stronger air-quality regulations were associated with reductions in harmful air pollution and improvements in certain public health outcomes. Understanding this relationship is important because it demonstrates how federal environmental policy can affect human well-being and provides historical context for evaluating current debates over environmental protections and the future role of the EPA.

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1213
Presentation Time: Session 2: 10:30-11:30am

Towards a Global Conflict Heatmap informed by Climate Change Stressors

Social Science

Authors(s):
Triet Minh Cao† (Science)

Abstract:
Several studies have established an aggregate description of the climate-conflict relationship, but they lack mechanistic understanding. We constructed panel data with theoretical relationships defining variables like Heat Stress, GDP, Energy Shortage, Military expenditure, political factors, etc. and learned a probabilistic dependency structure from countries that have previously witnessed conflict. We used a hill-climbing algorithm and BIC to learn the optimal structure of the directed acyclic graph (DAG) and the conditional probability tables (CPTs).

Observations from preliminary experiments suggest that the process is heterogeneous; climate does not mechanically cause conflict. Local markets, food systems, energy systems, economic capacity, political fragility, and current social conditions significantly influence how the climate shock propagates. The mediators play different roles in different countries. We map the probability of conflict conditions, P(C|l,t), where C is conflict, l is the country, and t is the time slice in years. The conditional conflict can be mapped in a time-series probabilistic map; then the heat map is constructed at the country level to show conflict probability over time.

We have learned a probabilistic dependence of variables from climate to conflict through economic and social dependencies, and we use it to predict future conflict conditions. Upon running prediction runs for the full Bayesian Network, we see the heterogeneity due to local conditions in action. A hot, low GDP per capita country with an internally unstable government, like Pakistan, sees a 95% accumulation of conflict by year 6 whereas a colder, better off and more stable country like Norway could take well beyond 200 years to see the same. Certain isolated countries like Australia do not see conflict conditions at that level even after 400 years whereas countries like Oman might take about 150 years despite heat stress, owing to an internally stable government.

Mentor(s):
David R Johnson (Engineering|Liberal Arts); Matthew Huber (Science); Pragathi Jha (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1214
Presentation Time: Session 2: 10:30-11:30am

A Comprehensive Analysis of the Spatial and Seasonal Shifts in Tornado Activity in the United States - A Case Study

STEM

Authors(s):
Natalie Cebulko† (Liberal Arts|Science)

Abstract:
Derived from recent research, it has been observed that the long-portrayed "Tornado Alley" in the Great Plains, once served as the primary region of tornado activity in the United States, has now shifted. Studies have identified a geographical shift in tornado frequency toward the Midwest and Southeast, and to accompany this claim, a shift in seasonal occurrence from the warmer months toward the colder months of the year. This case study proposes to examine these changes by comparing two sets of tornado activity data in time intervals from 1951-85 and 1986-2020. The analysis will focus on tornado occurrence, days of tornado touchdown, and tornado path lengths to evaluate shifts in geographical distribution and seasonal prevalence of tornadoes across the United States. The study aims to improve understanding of evolving tornado patterns and to employ further public risk awareness as well as severe weather preparedness. Relationships between these changes and recent climate change trends may also be considered, while recognizing that, rather than being established as the primary cause, serves as just a potential factor.

Mentor(s):
Ace Rounds (Science); Anna Elizabeth Ellery (Liberal Arts|Science|JMHC)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1215
Presentation Time: Session 2: 10:30-11:30am

Optimizing Electromagnetic Field Therapy for Tissue Regeneration

STEM

Authors(s):
Juan David Cepeda† (Engineering)

Abstract:
Extremely low frequency electromagnetic field (ELF-EMF) therapy is a promising approach for tissue recovery, yet its effectiveness depends on delivering an accurate field dose. This presentation describes the electromagnetic modeling of an ELF-EMF device to support and validate both its design and the behavior of its constituent materials. A COMSOL Multiphysics finite element model of a ferrite-core coil system was developed to characterize the normal magnetic field component (Bz) under stationary and time-dependent studies, and was compared against experimental data acquired with an array of Hall-effect sensors at multiple field values. This approach effectively predicts the field profile of the device at the design stage, reducing the need for trial-and-error prototyping. Moreover, comparison between experimental results and simulations revealed differences in field profile, which guided the optimization of the core geometry and material choice, enabling higher and more accurate doses. The automation of this modeling framework using Python increased its consistency and reusability, facilitating the future design of dose-controlled ELF-EMF platforms for tissue recovery therapies. This framework allows field delivery to be specified, predicted, and verified before clinical or preclinical use. Future applications may contribute to standardizing field characterization across devices, improving the reproducibility of ELF-EMF studies and facilitating the comparison of therapeutic outcomes.

Mentor(s):
Ramses Martinez (Engineering)

Other Acknowledgment(s):
Daniel Kiyoshi Kuratomi* (Engineering)

Poster Presentation Abstract Number: 1216
Presentation Time: Session 2: 10:30-11:30am

Comparative Analysis of Automated and Manual Workflows of Sample Preparation for Mass Spectrometry-Based Proteomics

STEM

Authors(s):
Maria Chaklasi† (Science|JMHC)

Abstract:
Mass spectrometry-based proteomics is the large-scale study of proteins and their different forms present in biological samples. Proteins can undergo processes such as alternative splicing, oxidation, and others that add post translational modifications (PTMs) to each protein, resulting in a modified form that can be differentiated between disease states, biomarkers, and potential drug targets. Extracting proteins from cellular components to study these modifications can require detergents and buffers for complete recovery. If these interferents are not removed prior to performing mass-spectrometry, they can suppress ionization and limit sensitivity, reducing the ability to collect valuable measurements. Single-pot solid-phase-enhanced sample preparation (SP3) is a prominent sample cleanup and protein recovery method used for mass spectrometry-based proteomics. Unlike other sample preparation methods, SP3 is adaptable to automation due to the use of magnetic beads that allow for localized capture and elution. Adapting our method to automation can minimize variance produced between manual preparation, leading to more consistent data collection and results between samples. In addition, it can enable future method optimization by reducing duration of sample preparation for replicates of different variables. To evaluate whether manual and automated sample preparation can produce similar results, samples were prepared by hand and using a Hamilton MicroLab Prep using HeLa cell lysate. High resolution intact protein mass spectra were gathered on an Exploris 480 mass spectrometer and analyzed using Proteome Discoverer. By comparing the total modified proteins across modes of sample preparation, hypothesis and variance testing uncovers the significant differences between automated and manual protein sample preparation.

Mentor(s):
Isabella Grace Feltenstein (Science); Bryon Shane Drown (Science)

Other Acknowledgment(s):
Weiguo Andy Tao* (Agriculture|Science); Nathaniel Merrick Miller* (Agriculture)

Poster Presentation Abstract Number: 1217
Presentation Time: Session 2: 10:30-11:30am

Extending the Atalla Vector Core for Training: Sublane Parallelism, Nonlinear Function Support, and Systolic Array Chaining

STEM

Authors(s):
Anant Varadaraja Chary† (Engineering); Don Anh Nguyen† (Engineering); Nicha Muninnimit† (Engineering); Mayank Patibandla† (Engineering|JMHC); Mixuan Pan† (Engineering); Aaryan Panigrahi† (Engineering)

Abstract:
AI models rely on two dominant workloads: matrix multiplication, handled by a systolic array, and nonlinear layers, handled by a vector core. The Atalla AI chip's vector core accelerates the nonlinear layers between matrix multiplications and was designed solely for inference. Thus, our goals are to further optimize and extend Atalla's capabilities to training. Our work targets three shortcomings. First, the instruction issue overhead bottleneck: since each instruction operates on a single vector, processing a matrix tile requires issuing many instructions. Second, the core lacks support for pooling, GELU, and tanh, which are common for both running and training CNNs and Transformers. Third, the vector core stalls for the systolic array to produce complete results, leaving hardware idle.

To address these shortcomings, we present three extensions in this implementation. We divide each vector lane into M sublanes so a single instruction operates on M vectors. We add variable-stage comparator trees for pooling and optimized pseudo-instructions for GELU and tanh. Finally, we chain the systolic array to the vector core by splitting output dependencies, allowing the vector core to begin computing partial results.

We synthesize all designs on 45nm MITLL technology nodes, performing CACTI sweeps and evaluating PPA at our target 800MHz clock. These optimizations carry tradeoffs: sublanes add crossbars, leakage power, and waste hardware when lanes go unfilled, GELU and tanh are high-latency operations, pooling may be memory-bound, and chaining demands careful synchronization. Additionally, as the optimizations were developed independently, chaining and sublane optimizations may cause a design conflict. To resolve this uncertainty, future work includes

benchmarking our extensions against Atalla Ax01 to determine whether the performance gains on these bottlenecks justify their added area and power.

Mentor(s):
Nikhil Kishore Vaidyanath (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1218
Presentation Time: Session 2: 10:30-11:30am

Cost-Sensitive Session Modeling: Optimizing E-Commerce Promotional Targeting and Margin Preservation

Business Case Study

Authors(s):
Ana Claudia Chavez† (DSB); Daniela Caro Cabral† (DSB|Liberal Arts); Alan Fefer† (DSB); Mauricio Tovar Balma† (DSB)

Abstract:
How can an online store offer discounts to shoppers who need a nudge without wasting money on those who would buy anyway? Over 80% of browsing sessions end without a purchase, and site-wide discounts cut margins while rewarding customers who were already planning to buy. We aim to predict whether a visit ends in a purchase (Revenue = 1) so offers go only to sessions where the expected benefit exceeds the discount cost. We use 12,330 sessions from the UCI Online Shoppers Purchasing Intention dataset (one row per visit, 17 features, target Revenue, 15.5% positive). Main predictors include PageValues, ExitRates, BounceRates, page counts and durations, VisitorType, and Month. Buyers spend over twice as long on product pages (median 1,110s vs. 510s) with lower exit rates. Durations are right-skewed and zero-inflated, and PageValues (r = 0.49 with Revenue) may be unavailable at decision time, so we test every model with and without it. A leakage-safe scikit-learn pipeline, fit on a stratified 60/20/20 split (seed 474), applies log transformations and one-hot encoding. Logistic Regression is the baseline. Decision Trees, Random Forests, and HistGradientBoosting are compared because purchase behavior likely involves nonlinear effects and interactions, such as long product-page time mattering mainly when exit rates are low. Models are compared with stratified 5-fold cross-validation, using ROC-AUC as the primary metric and PR-AUC as a co-metric, since ROC-AUC measures how well sessions are ranked by purchase likelihood and PR-AUC targets the rare buyer class. The validation set selects the threshold minimizing expected cost per 1,000 visits, and the test set is scored once. We expect lower costs than discounting everyone, though gains depend on assumed costs, and the model predicts purchase likelihood, not offer response.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1219
Presentation Time: Session 2: 10:30-11:30am

Predicting National CO_2 Emissions per Capita: Linear vs. Nonlinear Models Using Economic and Energy Indicators

Business Case Study

Authors(s):
Hsiao Tse Chiang Lin† (DSB); Pranav Mudiam† (DSB); Tammy Kong† (DSB); Huei-Ying Cheng† (DSB)

Abstract:
How accurately can economic and energy consumption indicators predict a country's CO_2 emissions per capita? As climate change becomes an increasingly urgent concern, understanding differences in emissions across countries can support more targeted sustainability efforts. This project uses GDP per capita, energy consumption per capita, and other predictors to predict national CO_2 emissions per capita.

Our analysis uses country-level data from Our World in Data's CO_2 and Greenhouse Gas Emissions database, after restricting the dataset to 195 sovereign countries from 2000 to 2019. The study excludes years after 2019 to avoid potential COVID-19-related disruptions and focuses on the post-2000 period to maintain a consistent economic-emissions relationship. We will train our models on 2000-2010 and test on 2011-2019 to evaluate forecasting performance within a consistent regime. Data preparation and analysis are conducted in Python. We compare multiple linear regression, ridge regression, and random forest, the latter to capture potential nonlinearity.

Preliminary findings show that among 3047 complete observations, CO_2 per capita is strongly correlated with energy per capita ($r = 0.89$) and GDP per capita ($r = 0.78$), and the two predictors are highly correlated ($r = 0.84$), motivating ridge regression and random forest to address multicollinearity. We expect this project to clarify whether nonlinear models improve predictive performance over linear approaches, evaluated using out-of-sample metrics for fair comparison. The findings may offer insight into how economic and energy indicators predict cross-country differences in emissions, while highlighting the importance of data quality, predictor selection, and validation in applied predictive analytics.

Mentor(s):
Adrian Hoffert Wolanski (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1220
Presentation Time: Session 2: 10:30-11:30am

Build Large AI-Ready Database for Interface Science

STEM

Authors(s):
Wen Xun Chua† (Engineering); Bunshiro Fujiwara† (Engineering); Purnata B Dey† (Engineering)

Abstract:
Metal-supported ultrathin materials are important in catalysis and interface engineering because their stability and properties can differ significantly from their bulk counterparts. However, it remains difficult to systematically organize and compare many calculated interface systems across different substrates, overlayers, compositions, structures, and energies. This project addresses that problem by developing an interactive database for density functional theory calculated metal, oxide, and hydroxide interfaces. Data from computational interface studies were converted into structured files and organized by substrate identity, overlayer composition, surface structure, lattice parameters, magnetic properties, total energy, and interface formation energy. These entries were then used to build a searchable platform that allows users to filter materials, view structural information, and compare trends in interface stability. This database will help identify metal-supported ultrathin materials that may be more stable than their corresponding bulk phases.

Mentor(s):
Shaista ijaz Khan (Science); Zhenhua Zeng (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1221
Presentation Time: Session 2: 10:30-11:30am

Helping College Students with Credit Scores Below 619 Navigate the Credit Market

Business Case Study

Authors(s):
Galiena Rebecca Colon† (DSB); Isha Shree Gollapudi† (DSB); Anh Thi Van Nguyen† (DSB); Marlee L Brimner† (DSB|Liberal Arts|JMHC)

Abstract:
How can emerging borrowers with limited credit histories identify credit card products suited to their tier without risking wasted, score-damaging rejections? College students and consumers with credit scores of 619 or lower face significant search friction, often applying blindly for cards that strictly exclude them. To address this information gap, this project develops a supervised binary classification framework using the Consumer Financial Protection Bureau's Terms of Credit Card Plans survey, analyzing 662 credit card agreements across 143 reporting features through December 2025. During data preparation, we removed empty and duplicate records, filled missing fees as $0 when cards don't charge them, and created key features like whether a card offers rewards or requires a cash security deposit. Our exploratory data analysis showed that while 46.4% of cards accept beginners, getting approved comes with obvious trade-offs: security deposits jump to 17.3% for beginner cards (compared to just 0.8% for prime cards), rewards drop from 83.1% down to 61.9%, and major Top-25 banks offer fewer of these starter cards than smaller regional institutions and credit unions. To prevent data leakage across related bank products, models are evaluated using bank-grouped 5-fold cross-validation. Baseline Logistic Regression measures straightforward linear fee penalties, while Decision Trees, Random Forests, and XGBoost capture complex, non-linear cutoffs between deposit rules and fee structures. Models are evaluated using ROC-AUC to measure how reliably accessible cards are ranked above restricted ones across all decision thresholds, helping applicants identify viable options. While this plan-level model cannot guarantee personal approval, it provides a data-driven pre-screening tool that categorizes card accessibility and informs safer credit-building decisions.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1222
Presentation Time: Session 2: 10:30-11:30am

Mapping Data Centers in Indiana: Land Use, Communities, and Local Policy

Business Case Study

Authors(s):
Paula Fernanda Correales Diaz† (DSB); Mirari Dariana Lopez Olarte† (DSB)

Abstract:
Data centers have been largely responsible for supporting data processing, storing, and computing needs of the digital age in the twenty-first century. More recently, the growing use of generative artificial intelligence and large language models is drastically increasing the demand for data centers. As these facilities expand, questions arise about their relationship with land use, local development, and surrounding communities. However, information about data centers is often fragmented across different sources, making it difficult to understand how their development is changing over time.

This research aims to create a tool and an integrated dataset to study the growth of data centers across Indiana and their relationship with nearby communities. By combining data center locations with land use and historical data, the study will explore how surrounding areas have changed over time. Demographic information will help describe nearby communities, while local regulations, zoning policies, restrictions, and incentives will be examined to better understand how local governments are responding to data center development.

By bringing this information together, the project seeks to provide a clearer picture of data center growth across Indiana. The resulting dataset and tool are expected to support future research and help researchers, planners, and communities better understand the relationship between data center expansion, land use, and local policies.

Mentor(s):
Steven R Dunlop (DSB); Dutt Jagdish Thakkar (DSB); Stephan Robert Biller (DSB|Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1223
Presentation Time: Session 2: 10:30-11:30am

Synchronized Heterogeneous Assets for Deceptive Effects (SHADE)

STEM

Authors(s):
Grant Creedican† (United States Military Academy)

Abstract:
SHADE develops the Credal Steering Game (CSG), a formal framework for evaluating military courses of action in which deception shapes an adversary's beliefs. Instead of assuming a single model of enemy behavior, a CSG tracks a bounded set of plausible belief models and measures how a proposed plan shifts that set through costed, observable actions, returning a value range plus diagnostics rather than a single score. The CSG is implemented as a typed, auditable pipeline: a domain-specific language compiles to a validated game spec, which runs through a Data Transport Layer that enforces per-actor observation privacy and full replay/audit logging. This lets humans, scripted policies, and AI agents all play the same game under identical rules. AI agents act as hypothesis generators and emulated adversaries within that contract, proposing belief models and stress-testing plans without ever directly certifying their own results. The current phase extends this core toward a live bridge to military mapping and situational-awareness tooling (Team Awareness Kit, or TAK), building toward a reusable instrument for training decision-makers and evaluating deception-aware plans at scale.

Mentor(s):
Andrew Banko (United States Military Academy West Point)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1224
Presentation Time: Session 2: 10:30-11:30am

Studying Frog-Biting Mosquito Host Selection Between Native and Invasive Hosts

STEM

Authors(s):
Benjamin Cruser† (Science)

Abstract:
Animals rely on algorithms shaped by selection using specific cues to forage on profitable hosts and prey. However, invasive prey may emit cues similar to the native profitable resources while providing different nutritional values, ultimately creating challenges for native predators looking for prey or hosts. Native predators are expected to incur high costs when exploiting these novel resources. Uranotoaenia lowii is a mosquito species that feeds on different anuran hosts by using their mating calls for host localization, yet these seemingly reliable species-specific cues can lead to variable fitness consequences. We have shown that call similarity is high between the call of invasive cane toads (Rhinella marina) and native barking tree frogs (Dryophytes gratiosus), and host identity can determine offspring production and development. Surprisingly, for instance, feeding from the invasive toad results in larger eggs. While the calls of both species are attractive to the mosquitoes when presented independently, it is unclear if there is a preference for one of those species. We hypothesize that Ur. lowii host-seeking responses are determined by a joint evolutionary history with their host, and predict that despite the acoustic similarity, mosquito attraction is higher to the native hosts. We thus performed a two-choice preference phonotaxis behavioral assays in which Ur. lowii female mosquitoes were simultaneously exposed to calls of invasive cane toads and native barking tree frogs. By comparing the phonotaxis responses from the frog-biting mosquitos we are able to test preference in host selection. This research can provide more information on how predators respond when historically reliable cues become decoupled from resource quality, shaping predator responses to biological invasions.

Mentor(s):
Ximena Bernal (Science); Richa Singh (PWL)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1225
Presentation Time: Session 2: 10:30-11:30am

Reducing Sensor Orientation Dependence in Wearable Sensor Postural Stability Assessment Through Functional Alignment

STEM

Authors(s):
Kate Curran† (United States Military Academy West Point)

Abstract:
Postural stability, or the ability to maintain balance, is an important indicator of neurological function and can help identify impairments associated with traumatic brain injuries (TBI). Traditional balance assessments often rely on controlled laboratory environments and force plates, limiting their practicality in military, athletic, and other field environments where rapid assessment may be critical. Wearable inertial measurement units (IMUs) offer a portable alternative, but differences in sensor placement and orientation can introduce measurement errors and reduce reliability. This study investigates a functional alignment method that uses controlled body movements to align sensor measurements with anatomical axes, allowing for more consistent assessment of postural stability. Using principal component analysis (PCA), the primary axis of rotation is identified from calibration movements, while gravitational acceleration establishes the vertical axis. These reference axes are used to transform sensor data into a common anatomical reference frame, enabling more accurate interpretation of postural control metrics. Custom MATLAB code was developed to compare acceleration and orientation metrics before and after alignment. The method was further evaluated through controlled experiments using known sensor orientation offsets of up to 15 degrees. These findings support the potential of functional alignment to improve the accuracy, consistency, and practicality of wearable sensor usage as a way to quantify postural stability. Overall, this study contributes to the goal of advancing the development of portable balance evaluation methods for TBI detection in military and athletic populations.

Mentor(s):
Andrew Banko (United States Military Academy West Point)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1226
Presentation Time: Session 2: 10:30-11:30am

Design of a Second-Order Discrete-Time Delta-Sigma Modulator for Bluetooth Low Energy Receivers

STEM

Authors(s):
Nguyen Viet Dinh† (Engineering); Jingya Xu† (Engineering)

Abstract:
This project focuses on designing a second-order discrete-time delta-sigma modulator(DSM) for use in the ADC of a Bluetooth Low Energy (BLE) receiver. The design uses a CIFB architecture with a bandwidth of 1 MHz, an oversampling ratio of 32, a 64 MHz sampling frequency, and a 1.2 V supply. Unlike a continuous-time DSM, which uses continuous-time loop filters, the discrete-time architecture processes sampled signals and is implemented using switched-capacitor integrators. MATLAB is first used to build and test the behavioral model of the modulator such as the noise-transfer function, filter loop coefficients, internal integrator states, and in-band noise. Simulations show that the modulator achieves approximately 59 dB SNR at a −3 dBFS input. This design specifically uses a 1-bit quantizer and a 1-bit feedback DAC in TSMC 65 nm CMOS. The main design challenges are amplifier gain and settling time, capacitor mismatch, sampling noise, switch nonidealities, and limited voltage swing. The goal of the project is to develop a delta sigma modulator that can be used in a low-bandwidth wireless receiver.

Mentor(s):
Seyedehmarzieh Rouhani (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1227
Presentation Time: Session 2: 10:30-11:30am

The Houthis' Use of Technology to Achieve Political Objectives in the Red Sea Region

Social Science

Authors(s):
Makayla Dull† (Liberal Arts)

Abstract:
This research paper studies how advancing technology, particularly unmanned aerial vehicles, missiles, and cyber warfare, is used by non-state actors to carry out terrorist attacks and make asymmetric warfare less disproportionate. It examines how the Houthis, a group of non-state actors in Yemen, have used technology in its strategic aims to control and disrupt the Red Sea between 2014-2026. The Houthis have attempted to use technology to exert power over states like Saudi Arabia. Their objective is to negotiate legitimacy, prevent military intervention, and stop support for Yemen's government. The paper seeks to answer whether access to technology has made it easier for the Houthis to achieve its political objectives, and if so, what does this mean for the future of terrorism? This is determined by analyzing case-studies of and data from attacks conducted by the Houthis. These methods will be viewed through a systemic level of analysis because the Houthis actions in the Red Sea have global consequences due to the disruption of popular shipping routes. The analytical framework used to research this question is a Realist framework. This follows the assumption that terrorism is a strategic and rational tactic used to meet political objectives because it is cost-effective and the best way to achieve a goal. This is helpful for understanding why non-state actors have adapted their strategies to incorporate advancing technology. Using this framework and methodology, the paper concludes that the Houthis have utilized advancing technology because it is a cheaper and more effective way to achieve their political objectives in the Red Sea region. The implication of this conclusion is that terrorist attacks could become more frequent and costly, while increasing the difficulty of state regulation, as non-state groups continue to incorporate the use of technology. This presents challenges for containing and stopping the current conflict in the Red Sea.

Mentor(s):
Chiara Cervini (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1228

Presentation Time: Session 2: 10:30-11:30am

AtallaCC: Optimizing a VLIW Compiler Backend for the Atalla AI Accelerator

STEM

Authors(s):
James Robert Erwin† (Engineering|JMHC); Aman Katyal† (Engineering); Aryan Shekhar Karani† (Engineering); Seth Jacob Baird† (Polytechnic); Simon P Bosslet† (Science); Sanjay Sriram† (Engineering); Aditya Puri† (Engineering); Khushi Umesh Shaha† (Engineerin

Abstract:
As AI research evolves rapidly, Domain-Specific Accelerators (DSAs) must remain programmable to adapt to changing workloads without costly hardware redesigns. Atalla Ax01 is a VLIW (Very Long Instruction Word) DSA for accelerating AI training and inference. AtallaCC lowers packaged sequences of AtallaC kernels, written in a modified version of C and generated by a frontend graph compiler, into packetized assembly for Ax01. While AtallaCC produces functionally correct code, the initial version lagged behind hand-written assembly due to greedy packetization decoupled from instruction scheduling, unoptimized stack allocations causing redundant memory reloads, and missing loop optimizations that left VLIW slots underutilized. We propose redesigning the AtallaCC backend to couple packetization with latency-aware scheduling and register allocation to remove false dependencies, introduce SSA promotion and register coalescing to eliminate spurious stack traffic, and implement loop unrolling, software pipelining, and strength reduction to increase instruction-level parallelism. AtallaCC and hand-written kernels are evaluated for accuracy through numerical error and cosine similarity relative to a higher-precision golden model, and for efficiency using VLIW slot utilization, bytes read and written, and packet count. Early results show AtallaCC surpassing some hand-written kernels. However, the proposed optimizations may conflict for some kernels due to increased register pressure from software pipelining and loop unrolling, potentially reintroducing stack traffic. Additionally, the hand-written kernels are not known to be optimal, and so once AtallaCC fully surpasses them they will no longer serve as a meaningful reference for judging further efficiency gains. Ultimately, these proposed improvements will establish AtallaCC as the primary means by which code is generated for Ax01 while preparing the compiler for future multi-tiling and hardware sparsity extensions.

Mentor(s):
Hassan Al-alawi (Engineering)

Other Acknowledgment(s):
Mikhail Golovenchits* (Engineering)

Poster Presentation Abstract Number: 1229
Presentation Time: Session 2: 10:30-11:30am

Bike allocation and rebalancing to reduce waste and costs associated with Cyclistic bike sharing services

Business Case Study

Authors(s):
Ethan C Espinoza† (DSB); Amarti T Tesfaye† (DSB); Yuqiao Wang† (DSB)

Abstract:
Cyclistic is a bike share company with a bike allocation problem. Too many or too few bikes at a station leads to increased balancing costs, waste, and dissatisfied customers. How do we minimize balancing costs while allocating the right amount of bikes per station? To achieve this aim, we will develop a model that predicts the number of bicycle rentals per hour based on previous bike trips from the Cyclistic bike-share dataset. Cyclistic needs to predict how many bikes and rebalancers are needed per station to minimize waste and excess costs. Our dataset is a 2.97 Gb with a sample size of 3,839,490 unique rows. We have 13 features in the dataset, with member type having the greatest effect. Data cleaning will involve the removal of duplicate records, checking timestamps, and managing missing values. we will Aggregate data into hourly counts and generate features such as hour, weekday, month, and type of ridership. The exploratory analysis will allow us to find baseline interaction between our features and data formatting strategies we will need for our model. The mean number of riders per given hour and given day will provide our baseline. We will use a linear regression model, followed by random forest and gradient boosting, which pick up nonlinear interactions to attempt to surpass our baseline models. Using Python, pandas, and scikit-learn, we shall use time series cross validation and train the models using the data from previous weeks only. The mean absolute error (MAE) expressed in bikes per hour is chosen as our main indicator since it fits the decision-making process in the company. The MAE will also help us define the threshold for when we start rebalancing between stations. The root mean squared error (RMSE) is our second indicator since it heavily punishes high errors found during peak hours. These findings will assist in the decision of how Cyclistic could allocate its bikes and reduce waste and financial costs.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1230

Presentation Time: Session 2: 10:30-11:30am

Process Development of High-Selectivity Al2O3 Hardmask DRIE for Applications in 3D Integration

STEM

Authors(s):

Kenzo Avery Evans† (Engineering); Samridh Prabhakar† (Engineering); Matthew Tran Dinh† (Engineering); Ethan Xinghan Tan† (Engineering|JMHC); Sophia Ho† (Engineering); Aarush Agarwal† (Engineering|JMHC)

Abstract:

As transistor scaling approaches physical and economic limits, 3D advanced packaging has emerged as a critical strategy for improving performance, increasing interconnect density, reducing latency, and enabling heterogeneous integration of memory and logic devices. Through-Silicon Vias (TSVs) are fundamental to advanced 3D integrated packaging, enabling high-density vertical interconnections between stacked memory and logic devices. As integration density increases, fabrication of ultra-high aspect-ratio vias with high mask selectivity and structural integrity presents significant manufacturing challenges. This work builds upon prior development of a selective aluminum oxide (Al2O3) hard mask process by integrating reactive ion etching (RIE) for precise pattern transfer and deep reactive ion etching (DRIE) using the Bosch process for silicon via formation. RIE parameters were optimized to achieve anisotropic Al2O3 etching with strong pattern fidelity and dimensional control. Subsequent DRIE cycle parameters were tuned to balance passivation and etch steps, enabling high aspect-ratio silicon structures while minimizing mask erosion. Al2O3 was specifically investigated due to its extremely high Si etch selectivity compared to existing materials for Si etching such as SiO2 or resist alone. Additionally, using an oxide hardmask enables the usage of SF6/O2 based Non-Bosch continuous etch schemes that would quickly erode resist softmasks. Post-etch stripping was evaluated using KOH solutions to characterize etch rate, uniformity, and compatibility with etched silicon features. Results demonstrate successful hard mask pattern transfer, consistent deep silicon etching with minimal mask degradation, effective post-etch mask and nonvolatile AlFx removal. Overall, this study establishes a complete TSV process flow from hard mask definition through final stripping, enhancing reliability and scalability for advanced 3D packaging applications.

Mentor(s):
Peter Bermel (Engineering); Saeed Mohammadi (Engineering); Noah F Opondo (Centers & Institutes); Joon Hyeong Park (Centers & Institutes)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1231
Presentation Time: Session 2: 10:30-11:30am

Collapse of the Human Thermal Body Plume: Modeling and Characterization of Gravity-Dependent Gas Exchange

STEM

Authors(s):
Henry Ewald† (Engineering); Ethan Wayne Williamson† (Engineering); Graham Wright Templeton† (Engineering|JMHC); Zachary Ray White† (Engineering); Anusha Sharma† (Engineering); Karan Vijayakumar† (Engineering); Danish S Sanwarwala† (Engineering); Claire A

Abstract:
On Earth, gravity influences gas exchange through buoyancy and biothermal convection, generating a 'human thermal body plume' (HTBP) that drives airflow around the human body and facilitates effective gas exchange. In contrast, natural convective forces are absent in a microgravity environment, rendering exhalants to be diffusion-driven and leading to CO_2 accumulating as a "bubble" around the astronauts' heads. This biophysical phenomenon leads to CO_2 rebreathing that is particularly concerning aboard the International Space Station (ISS), where cabin CO_2 levels already average 4,000 ppm – concentrations linked to significant cognitive impairment, including reduced decision-making ability and diminished attention span in otherwise healthy individuals.

To investigate HTBP behavior, we developed a high-fidelity computational fluid dynamics model, capturing the biophysical impact of gravity and temperature gradients in governing gas exchange. For experimental validation, we constructed a multipoint CO_2 sensing headset to characterize the local flow distributions and experimentally validate CFD predictions.

Mentor(s):
D. Marshall Porterfield (Agriculture|Engineering)

Other Acknowledgment(s):
Manisha Dagar* (Agriculture|Engineering); Alvin Hu* (Engineering)

Poster Presentation Abstract Number: 1232
Presentation Time: Session 2: 10:30-11:30am

Geospatial Airspace-Geometry Modeling For UAVs

STEM

Authors(s):
Brian Farkas† (Engineering); Naveen Mundlapudi† (Engineering)

Abstract:
Existing geofencing methods for unmanned aerial vehicles (UAV) often rely on static airspace restrictions, limiting their ability to account for computational dynamic data to the degree necessary for UAV operations in urban environments. To address this, the Geospatial Airspace-Modeling team under AIDA^3 aims to develop a web-based UAV route-planning application that integrates both static and dynamic datasets within a three-dimensional airspace.

Static restrictions (controlled airspace, no-fly-zones, etc.) will be represented as prisms. We plan to represent static restricted volumes as extruded prisms, while dynamic sources (ADS-B, Weather, etc.) will be represented as moving round volumes. These volumes will be displayed alongside an OpenStreetMap layer, which will be run on a web-based application using react, where users can select drop points for autonomous routes via a 3+ click planner. The application will then determine the most efficient route and verify that the route is possible using signal temporal logic (STL). The web-app will update the user using live data collected during flight from the UAV. Success will be based on the number of false negatives (zero) the program produces, the number of effective violations, and the target update time.

The project is currently using an extract, load, and transform (ELT) pipeline as the basis for the data. For the initial release, the database is used to store, manage, and refine both our static and dynamic data sources, supporting the integration of an efficient three-dimensional model. A Flask based backend facilitates communication between the backend and the React front end to consistently update the front-end user interface for near-real-time visualizations. This format works to ensure low latency, maintain quality control, and ensure route planning and validation is done with the most up-to-date information.

Mentor(s):
Christopher Rashidian (Polytechnic); Sabine Brunswicker (Polytechnic)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1233
Presentation Time: Session 2: 10:30-11:30am

Optimization of Propeller Design for Amphibious Drones

STEM

Authors(s):
Jess Fetter† (Engineering); Madison Taylor Jac Kang† (Engineering); Owen Paul Spiezio† (Engineering); Aditya Shailendra Itnal† (Engineering); Eren Latif Ozeken† (Engineering); Brandon Chen† (Engineering); Ross L Miller‡ (Engineering); Reece Robb* (DSB); B

Abstract:
Amphibious drones are unmanned vehicles capable of operating in both air and water with the possibility to assist search and rescue teams with underwater searching and surface scanning, enhance inspection of underwater infrastructure including bridges, oil rigs, or flooded infrastructure, and facilitate environmental and scientific research by tracking marine wildlife and mapping coastlines and underwater features. One considerable barrier to amphibious drone design is propulsion inefficiency, as a drone requires propellers or engines capable of efficiently operating in both normal aerial environment and a higher density aquatic environment, as well as being able to seamlessly transition between the two. Our project primarily focuses on effectively designing and testing propellers for eventual use in an amphibious drone. This will be done using both physical experiments and computational fluid dynamics (CFD). We will design a test stand capable of measuring and recording the thrust of propellers in both air and water, then use the results to verify CFD simulations of various propellers to determine optimal propeller design.

Mentor(s):
Curtis Earl Marshall (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1234
Presentation Time: Session 2: 10:30-11:30am

Machine Learning for Automated Gamma-Gamma Coincidence Analysis and Nuclear Level Scheme Reconstruction

STEM

Authors(s):
Nicholas B Flowers† (Engineering); Truman Carl Parrish† (Engineering); Leo Sun† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Andy Jung (Science); Ace Rounds (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1235
Presentation Time: Session 2: 10:30-11:30am

Evaluating Teacher Well-Being and Student Outcomes in Classrooms With and Without Pets: A Quantitative Analysis

Social Science

Authors(s):
Bryanne Garcia† (Education|HHS|JMHC)

Abstract:
Many teachers across different grade levels integrate animals into their classrooms. This integration may include inviting guest animals, visiting animals on field trips, and keeping animals as pets within the classroom. To date, research has examined the ways in which teachers include animals in their classrooms, as well as the social-emotional and academic outcomes of classroom pets on students. However, there remains a gap in understanding how classroom pets may impact teacher well-being and efficacy alongside these student outcomes. The objective of the study was to quantitatively explore the impacts of classroom pets on teacher well-being and student outcomes via online surveys. A total of 529 participants (K-12 teachers that either have a pet living full-time in the classroom or who have never had a classroom pet) completed a Qualtrics survey at three timepoints spanning from the beginning to end of the 2025-2026 academic year. Data, including demographics as well as self-report measures on student engagement; student behavior; teacher efficacy; and teacher burnout, were analyzed descriptively in RStudio. Independent samples t-tests indicated significantly higher student engagement and teacher efficacy scores in classrooms with pets than classrooms without pets. In addition, teachers with classroom pets scored significantly lower on the emotional exhaustion and depersonalization domains and significantly higher on the personal accomplishment domain of the burnout inventory, indicating they experienced less burnout overall than teachers without classroom pets. There were no significant differences in student behavior between classrooms with and without pets. Findings provide insight into the potential positive impacts of full-time classroom pets on teachers and students. These insights can serve as guidance for refining the use of classroom pets in classrooms around the country, with the potential to improve outcomes for both teachers and their students.

Mentor(s):
Leanne Nieforth (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1236
Presentation Time: Session 2: 10:30-11:30am

Why Drag Sails and Active Debris Removal Cannot Keep Up With Low Earth Orbit

STEM

Authors(s):
Zane Gilmore† (Engineering)

Abstract:
Low Earth orbit (LEO) is getting crowded as companies like SpaceX and OneWeb launch mega-constellations of thousands of satellites. When these satellites die, they can collide with other objects and break into thousands of pieces, which could lead to Kessler Syndrome, a chain reaction of collisions that keeps creating more debris. Engineers have developed two main ways to deal with this problem, drag sails and active debris removal (ADR). In this preliminary research, I compare test missions like InflateSail, RemoveDebris, and ELSA-d, along with the European Space Agency's 2026 Space Environment Report and the FCC's deorbit rules, to determine how well each method reduces collision risk and whether either can keep up with launch rates. My preliminary findings show that both methods have worked in orbit, but neither is ready to solve the problem alone. Drag sails only prevent new debris, and ADR missions can only remove one or two objects at a time. Based on this research, I argue that these methods will only make LEO safer if they are paired with deorbit requirements, built-in disposal devices on new satellites, and shared funding to remove the most dangerous debris.

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1237
Presentation Time: Session 2: 10:30-11:30am

Lunabotics Microcontroller Research Team Abstract

STEM

Authors(s):
Aspen E Gilstrap† (Engineering); Andrew Zhe Chen† (Liberal Arts|Polytechnic); Caden Joshua Clifford† (Engineering)

Abstract:
This technical report presents a comprehensive trade study evaluating the RP2350B microcontroller as a high-durability replacement for the legacy Teensy 4.1 board within the Lunabotics team's custom controller subsystem. The documentation details the RP23250B's hardware specifications, including its dual-core Arm Cortex-M33 architecture, 150 MHz clock speed, 80-pin QFN package, and 48 GPIO pins, alongside the necessary supporting circuitry required for a standalone design, such as QSPI flash memory, crystal oscillators, and voltage regulation. A bill of materials estimates prototype per-board material costs to range from $19.84 to $32.46, addressing economic trade-offs against historical board replacement expenses. The study also evaluates onboard electrical protections, including Fault-Tolerant digital pins, ESD thresholds, and integrated Brownout Detection and Power-On-Reset logic, demonstrating how custom board-level safeguards mitigate previous failures associated with voltage spikes and USB vulnerability.

Mentor(s):
Curtis Earl Marshall (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1238
Presentation Time: Session 2: 10:30-11:30am

Identification of a Novel BICD2 Variant that is Linked to Autosomal Dominant Motor Neuron Disease in Siberian Cats

STEM

Authors(s):
Jenna L Golden† (Science|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Madeline Christina Coffey (Vet Med); Kari J Ekenstedt (Vet Med)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1239
Presentation Time: Session 2: 10:30-11:30am

Design and Implementation of a Hydraulically Powered Autonomous Mobile Vehicle for Heavy-Load Handling

STEM

Authors(s):
David Esteban Gonzalez Rozo† (Polytechnic)

Abstract:
This project focuses on the design and implementation of an autonomous mobile vehicle for manufacturing applications. The vehicle is designed to pick up, transport, and store heavy loads weighing between 80 to 100 kg using hydraulic actuation systems. The platform will integrate translation, load lifting, and load securing functions with an autonomous navigation system for traveling between desired locations. The design targets industrial applications involving the handling loads at low speeds in dynamic workspaces, such as environments where humans and machines operate in close proximity along pathways approximately 1.2 m wide.

The project is structured into two main stages: design and implementation. The first involves analyzing operational requirements, performing force, energy, and kinematic calculations to establish system requirements, and selecting suitable components for the actuation and load handling. The second stage includes component and material acquisition, adjustment and parts machining, subsystem assembly and integration, and experimental testing to evaluate overall performance. Building on previous work, this project uses a previously developed digital twin framework of hydraulic application to support the implementation of the system’s fluid power architecture.

Testing is expected to characterize the vehicle's performance in terms of load capacity, travel time, and vehicle's ability to avoid collisions within the work area. It will also assess the integration of hydraulic actuation in terms of the hydraulic plant digital twin model and its performance. The project aims to identify the prototype's main technical limitations and establish a foundation for future improvements and potential applications in industrial material handling.

Mentor(s):
Jose M Garcia Bravo (Polytechnic)

Other Acknowledgment(s):
Marvin Raymundo Durango Cogollo* (Polytechnic)

Poster Presentation Abstract Number: 1240
Presentation Time: Session 2: 10:30-11:30am

How Music Quantization Affects Groove Perception and Brain Activity

Social Science

Authors(s):
Nathaniel Gregory Grimm† (Polytechnic)

Abstract:
Modern digital audio software allows producers to adjust the timing of notes and drum hits with extreme accuracy by placing them onto a timing grid through a process called quantization. However, human musicians naturally create small timing variations during a performance, and previous research on rhythm and groove suggests that these variations may affect listeners' experiences. For this project, I will examine how small timing variations in human-performed music affect the perception of groove and engagement compared to quantized music, focusing on whether these differences are shown in brain activity. I reviewed current research on digital audio processing, microtiming, rhythmic entrainment, and music perception while comparing studies that measure listener responses and brain activity. Because research on this topic is still ongoing, this project will focus on existing studies and what is already known about digital timing precision and human musical perception. The goal is to better understand how timing in digital music production may influence the way people perceive rhythm.

Keywords: music quantization, microtiming, groove perception, rhythmic entrainment, digital audio processing, music perception

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1241
Presentation Time: Session 2: 10:30-11:30am

Adaptive Meshing for Computational Quantum Electromagnetics

STEM

Authors(s):
Ramiro Guntin Rodriguez† (DSB|Engineering); Lindsey Liu† (Engineering); Arnav Srivastava† (Engineering); Ronick N Kothare† (Engineering); Tony Chen† (Science)

Abstract:
Quantum devices are fundamentally based on electromagnetic effects; thus, computer simulations are an indispensable tool for their analysis and design. However, such simulations involve a large number of small and complex features that make modeling computationally intensive. The motivation behind this project is to improve how meshes are built and refined in order to make simulations more efficient. Instead of refining the entire model, refinement is concentrated in areas with high estimated errors. This adds detail where needed while reducing unnecessary mesh growth. Current testing shows that much of the error is concentrated near the region of interest, supporting targeted refinement. Other parts of the project explore different mesh shapes and aim to improve the tools used to create and simulate CAD geometries. Overall, the project aims to make accurate electromagnetic simulations of quantum devices faster and more practical.

Mentor(s):
Ghazi Khan (Engineering); Samuel Theodore Elkin (Engineering); Thomas Roth (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1242
Presentation Time: Session 2: 10:30-11:30am

Correlation Signature of Noise in Quantum Systems

STEM

Authors(s):
Siena Haase† (Engineering)

Abstract:
Scalable photonic quantum architectures require indistinguishable single photons, motivating the characterization of noise that limits optical coherence. Here, we investigate temporally correlated fluctuations in quantum emitters and quantum communication channels using classical statistical methods. We quantify temporal correlations, decompose the measured fluctuations into deterministic and nondeterministic components, and assess their respective contributions to the observed correlation structure. Using conditional mutual information, we then quantify the information that past measurements provide about future observations beyond what is available from the present measurements alone. Preliminary results reveal correlation lengths ranging from 3 to 100 sampling intervals in quantum emitters and from 483 to 1,462 sampling intervals in quantum communication channels. Variations within each platform suggest differences in the local noise environment. These findings provide a statistical basis for assessing the predictability of measured fluctuations and inform future strategies for noise prediction and control aimed at improving single-photon optical coherence.

Mentor(s):
Pranshu Maan (Engineering); Alexander V Kildishev (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1243

Presentation Time: Session 2: 10:30-11:30am

Improving Diagnostic Quality of Bronchoalveolar Lavage Samples

STEM

Authors(s):
Emma Grace Hannon† (Agriculture|JMHC)

Abstract:
To preserve diagnostic quality of equine bronchoalveolar lavage fluid (BALF) samples, this study evaluated the effects of sample concentration, storage temperature, and storage duration on the diagnostic quality of equine BALF cytologically. For each horse, BALF was assigned to all combinations of storage temperature (refrigerated or room), sample concentration (concentrated or non-concentrated), and storage duration (1, 24, 48, or 72h). Samples were cytocentrifuged onto slides and stained with a modified Wright's stain. Two slides were prepared for each horse-treatment combination. Differential cell counts were performed, and diagnostic quality was scored on a 0-4 scale (0=non-diagnostic; 4=excellent). Evaluators were blinded to treatment. Main effects and interactions were analyzed using a repeated-measures generalized linear model, and least-squares means (LSM) with 95% CL were calculated. Diagnostic quality was significantly affected by storage duration, temperature, and sample concentration, while no interaction terms were significant. Quality declined over time ($p<0.0001$), with LSM decreasing from 3.15 (2.83-3.48) at 1h to 2.01(1.69-2.33) at 72h. Refrigerated samples had higher quality scores than room-temperature samples, with LSM of 2.66 (2.39-2.94) and 2.43 (2.16-2.71), respectively. Concentrated samples had significantly lower diagnostic quality than non-concentrated controls ($p < 0.0001$), with LSM of 2.30 (2.02-2.58) and 2.80 (2.52-3.08) respectively. No two or three-way interactions were significant ($p>0.2$), indicating independent effects of each factor. These findings inform recommendations for BALF submission. Because diagnostic quality declines substantially after 24h, samples should be delivered promptly. Immediate refrigeration and cold-pack shipment are recommended, and BALF concentration prior to storage and cytologic preparation is not recommended. Following these recommendations may improve sample quality and improve diagnostic yield.

Mentor(s):
Kathleen M Ivester (Vet Med); Laurent L Couetil (Vet Med)

Other Acknowledgment(s):
Laura M Murray* (Vet Med)

Poster Presentation Abstract Number: 1244
Presentation Time: Session 2: 10:30-11:30am

Race to Zero

Business Case Study

Authors(s):
Jacob Peter Hargreaves† (DSB|JMHC); Omar Faruk Elias Troncoso† (DSB); Advik Bajpai† (DSB); Karla Maldonado† (Engineering); Caleb Michael Clifford‡ (Polytechnic); Mark Aaron Fine‡ (DSB); Paisley Autumn Fletcher‡ (Engineering); Thu Huong Le‡ (DSB|Engineerin

Abstract:
[Abstract Redacted]

Mentor(s):
John W Sheffield (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1245
Presentation Time: Session 2: 10:30-11:30am

Using Machine Learning to Predict How Gut Bacteria Respond to Whole-Grain Foods

STEM

Authors(s):
Jasmine Harper† (Science|JMHC); Norah Riley Kopolow* (Science)

Abstract:
Dietary fibers from whole grains influence microbial community composition and metabolic activity in the human gut, resulting in changes in the production of short-chain fatty acids (SCFAs) and other fermentation products. Understanding how microbial communities respond to fiber substrates may advance personalized nutrition and microbiome-based dietary interventions. This project aims to develop a machine-learning framework to predict microbiome function, including fermentation kinetics and SCFA production, from microbial community composition, using data from in vitro fecal fermentations across a diverse fiber panel.

During a 12-week randomized controlled clinical trial, fecal samples were collected at weeks 0, 6, and 12 and used as inoculum for in vitro fecal fermentations. Samples were incubated anaerobically with five fiber substrates: wheat arabinoxylan, inulin, resistant maltodextrin, resistant starch, and wheat bran, to model microbial fermentation in the colon. Community composition, diversity metrics, and fermentation outcomes will be integrated into predictive models, beginning with regression-based approaches and expanding to machine-learning methods. Model inputs include microbial abundance and community structure features, while outputs include fermentation products such as SCFAs.

Current work focuses on data organization, feature selection, model development, and evaluation of predictive approaches. Future work will compare model performance across machine-learning methods and evaluate model accuracy in predicting fermentation outcomes. This project seeks to identify key microbial and community-level predictors of fermentation outcomes and establish a foundation for microbiome-informed dietary intervention strategies. By improving our ability to predict how microbial communities respond to different fibers, this work may contribute to more targeted dietary interventions and a better understanding of individual variation in responses to whole grains.

Mentor(s):
Stephen R Lindemann (Agriculture); Mariana Guzman Sanchez (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1246
Presentation Time: Session 2: 10:30-11:30am

Applied Engineering Services Expansion Strategy

Business Case Study

Authors(s):
William Frederick Haunz† (DSB); Ethan W Norris† (DSB); James William Chostner† (DSB|Liberal Arts); Camden Phillip Gehle† (DSB); John Michael Dabler† (DSB); John Ryan Foley† (DSB)

Abstract:
This project examines how Applied Engineering Services (AES) can expand its operations beyond Indiana into the broader Midwestern market. The planned approach has two components. First, we will review AES's current marketing approach. Second, we will compare it with the marketing strategies of its local competitors. From that comparison, we will try to identify a market segment that is ready for penetration and fits AES's existing service line. The expected output is an effective marketing strategy to support the company's expansion outside of Indiana. At the time of submission, our research and recommendations are incomplete. We nonetheless expect to produce meaningful insights that will improve AES's entry into the Midwestern market.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1247
Presentation Time: Session 2: 10:30-11:30am

Neurodivergent Students and Mathematics

Social Science

Authors(s):
Bella Fleur Hiemstra† (Science)

Abstract:
Many neurodivergent people crave structure in their lives because it provides comfort to an overactive mind. STEM subjects, especially mathematics, are governed by strict rules. The purpose of this exploratory research project is to learn if college-level mathematics is inherently intuitive to neurodivergent students. I will start by investigating how neurodivergent individuals think mathematically, then explore both quantitative and qualitative accounts on how this thinking impacts their performance in college-level mathematics. This research will explore unique advantages neurodivergent college students have, emphasize lesser-known benefits of mathematics courses, and will highlight a positive outlook on ASD and ADHD.

Keywords: Autism; ADHD; Mathematics

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1248
Presentation Time: Session 2: 10:30-11:30am

Preliminary Design of a Hypersonic Aircraft for the 2027 Undergraduate Flight Design Competition

STEM

Authors(s):
Ella Dominica Hodnett† (Engineering); Lucas Garrett Doggett† (Engineering); Henry Lucas Zitoun† (Engineering); Rishi Jignesh J Bhate† (Engineering); Abigail Lim† (Engineering)

Abstract:
This research presents the preliminary design of a subscale hypersonic glide vehicle (HGV) for the 2027 Hypersonic Flight Design Competition. The key engineering design constraints of this project are for the aircraft to maintain stability in all three axes at speeds above Mach 8, carry a 10 kg payload included in the 120 kg total mass, and withstand extreme heat and pressure while keeping internal temperatures under 350 K (170.33 F) at ground impact.

To optimize performance within the physical constraints of a 2-meter length and 40 cm diameter, our design uses a conical geometry with a circular cross-section. This configuration will allow us to utilize Commercial Off-The-Shelf (COTS) avionics while maintaining multi-axis stability. The aircraft's outer geometry uses a blunted nose to push peak stagnation heat flux off the skin, and uses delta wings, aerospike nose cones, and a coke-bottle body shape to minimize wave drag. Additionally, the design includes a multi-layer thermal protection system (TPS) and a preliminary sensor configuration featuring Flush Air Data Sensing (FADS) nose ports and an internal gyroscope to evaluate navigation performance through plasma blackout.

Mentor(s):
Curtis Earl Marshall (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1249
Presentation Time: Session 2: 10:30-11:30am

Kinenova: Adapting a Kinemo to controlling the Kinova Gen3 Arm

STEM

Authors(s):
Rayna Huang† (Engineering)

Abstract:
Assistive Robotic Manipulators, specifically Wheelchair-mounted Robotic Arms (WMRAs), can enable users with upper limb or manual impairments to perform daily tasks, providing functional autonomy to their lives. The Kinova Jaco is one of the most commonly used robotic arms for people with upper limb impairments. However, current joysticks for controlling the Jaco present challenges for these individuals. The joysticks are often unintuitive, requiring a high cognitive load, and individuals with higher levels of impairments have a higher difficulty performing the movements required to use the joystick.

Eye gaze tracking provides an alternative solution to the physical joystick and has been previously implemented as a method of interacting with web interfaces and directly controlling a Kinova arm. The Kinova Kortex Web App is a web interface that can directly control a Kinova arm, offering a potential method for implementing eye gaze tracking to control a Kinova. While the Kortex Web App works well for general robotic arm control, the interface can be difficult for a person with upper limb impairments to interact with. The virtual joysticks on Kortex require a clicking and dragging of a mouse, which is difficult to differentiate from natural eye movements using eye gaze tracking. A competitor to eye gaze tracking comes in the form of the Kinemo, a wearable device with highly sensitive modular motion tracking sensors to allow users to remotely control a device's screen. The Kinemo requires similar head movements as eye gaze tracking but provides more options for user customization for mouse clicks and drags. As no Kinemo-friendly interface exists, new interfaces are being developed to adapt the Kinemo to controlling a Kinova Gen3 arm. Future steps include a comparative usability study between eye gaze tracking and the discussed Kinemo control methods. Overall, this solution can potentially enhance quality of life for an individual with upper limb impairments.

Mentor(s):
Shaiv Mehra (Engineering); Bradley S Duerstock (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1250
Presentation Time: Session 2: 10:30-11:30am

Analyzing the Impact of Gender Stereotyping on Pediatric Subspecialty Fellowship Matching within the United States

Humanities

Authors(s):
Abigail Anne Imler† (HHS|JMHC)

Abstract:
During 2024, the United States had the lowest pediatric match percentage for the National Resident Matching Program (NRMP) in 30 years. If these trends continue, in less than eight years there likely will be significant workforce shortages in pediatric subspecialty care (Azok et al., 2024). The aim of this study is to identify the impact of gender stereotyping on the pediatric specialty match. To analyze the impact of gender stereotyping on the pediatric specialty match, I performed a preliminary research analysis. I limited the peer-reviewed published sources used to primary data collection studies and summarized the research. The findings showed that there are multiple potential causes for the decline in matching rates for pediatrics, with the main issues stemming from financial disparities in the medical field and medical school debt. While gender stereotyping played a role in pay disparities and the gender of pediatric applicants, I was unable to establish gender stereotyping as a main reason for declining pediatric subspeciality matching. Medical schools would benefit from more pediatric mentorship before and during medical school to encourage more pediatric matching. This study can also be a valuable resource to lawmakers and hospital administrators that wish to discuss the pay gap between pediatrics and adult specialties. Additional studies that use data collection to identify the impact of gender stereotyping on pediatric matching are needed.

Mentor(s):
Jessica M Mercado (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1251
Presentation Time: Session 2: 10:30-11:30am

ARCADE: Running Research Simulations on Supercomputers from a Web Browser

STEM

Authors(s):
Fernando Injoque Guadana† (Engineering)

Abstract:
Research groups write simulation software for supercomputers, but running it takes a supercomputer account, command-line experience, and knowledge of the job scheduler, so scientists in other fields and in industry rarely use it. Science gateways solve this with a web interface, but most run as a separate web service that someone must host and maintain. ARCADE, built with Professor Tillmann Kubis's research group in Electrical and Computer Engineering, is a science gateway with no server of its own. Supercomputers already offer researchers Jupyter, a browser notebook service for writing code. ARCADE uses it instead to serve a web application, so users work with a form, not code, and installing it needs no administrator. Its first application, the group's microdroplet workflow, simulates the atoms in a microscopic liquid droplet. The form checks entries, estimates the cost in computing hours, submits the work, emails the user when it ends, and displays the results. The cost estimate was fitted to twenty measured runs, which showed that four processor cores cost less than a fifth as much per step as forty while giving identical energies. Runs that reach the machine's time limit can continue automatically from their last step, and every run stores the code version and inputs that produced it. ARCADE runs on Purdue's Negishi supercomputer and on Anvil, a national supercomputer, where installing it took under five minutes, and the same simulation on both produced energies identical to every reported digit. Next steps are a full-length simulation and a second tool.

Mentor(s):
Robert A Campbell (PWL); Tillmann C Kubis (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1252
Presentation Time: Session 2: 10:30-11:30am

Designing for Early Literacy: Development of an Interactive Reading App for First-Grade Learners

STEM

Authors(s):
Nakul Iyer† (Engineering); Hudson Cote† (Science); Nishant Sudeep Sudeep Nair† (DSB|Engineering); Jake Adius Schmucker† (DSB); Sahil Sadiq Lalani‡ (Engineering)

Abstract:
Early literacy is essential for children's academic development, yet students enter elementary school with varying levels of reading readiness and foundational literacy skills. Providing accessible and engaging learning opportunities is particularly important during the early grades. This project addresses this need through the development of an interactive literacy application that integrates phonics, letter tracing, and first-grade reading activities. The project explores how these foundational literacy components can be integrated into a digital learning environment that accommodates differences in children's learning needs and levels of independence. The student team is developing an application that includes phonics exercises to strengthen letter-sound recognition, interactive tracing activities to support letter formation, and age-appropriate reading exercises involving words and short sentences. The design prioritizes intuitive navigation, clear instructions, and developmentally appropriate content. An iterative design process will guide prototype development and refinement. The proposed evaluation will involve teacher feedback and usability testing with elementary school teachers. Teachers will assess the instructional relevance and age appropriateness of the activities, while usability testing will examine children's ability to navigate the application, interpret instructions, complete tasks, and engage independently. Findings will inform subsequent design improvements. The anticipated outcome is a functional literacy application that supports foundational reading practice. The project also contributes practical insights into designing accessible educational technologies that respond to the developmental and instructional needs of early elementary learners.

Mentor(s):
Aparajita Jaiswal (Engineering)

Other Acknowledgment(s):
Logan Thomas Anderson* (Engineering)

Poster Presentation Abstract Number: 1253
Presentation Time: Session 2: 10:30-11:30am

The Right Information for the Right Situation: Supporting Driver Decision-Making During Automated Vehicle Takeovers

STEM

Authors(s):
Siyona Jayant† (Engineering)

Abstract:
Automated vehicles allow drivers to disengage, to some extent, from the driving task, but when it reaches its operational limits, drivers must quickly regain situation awareness and resume manual control. In-vehicle human-machine interfaces (HMIs) can support drivers by identifying relevant traffic elements, explaining potential hazards, and recommending maneuvers. However, it is unclear whether providing more information always enables drivers to execute safer takeovers. Traffic density may influence drivers' information needs: denser traffic involves more relevant vehicles, more complex maneuver decisions, and potentially fewer safe maneuvering options. This study investigates how traffic density influences drivers' information support needs during takeovers

The study uses advanced driving simulations and a human-subject experiment to investigate four information conditions: one baseline and three types of support targeting different stages of decision-making: information acquisition, information analysis, and decision selection. Participants experience low- and high-density traffic while performing a secondary visual task during simulated conditional automated driving. During lane change or braking takeovers, participants receive auditory HMI messages and are required to resume vehicle control. Drivers' perceived situation awareness is assessed using the Situation Awareness Rating Technique (SART), while eye tracking data, takeover response time, decision accuracy, and vehicle control measures characterize driver attention and takeover performance. Participants also report workload, information satisfaction, and trust in the system.

This study aims to identify which types of HMI support are most beneficial under different traffic conditions. Findings are expected to

inform context-aware in-vehicle communication by identifying when drivers benefit most from hazard information, traffic explanations, or maneuver recommendations.

Mentor(s):
Jing Zang (Engineering); Brandon J Pitts (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1254
Presentation Time: Session 2: 10:30-11:30am

Meeting Practices and Student Participation in Campus Ministries: A Comparative Study of Christian Ministries at Purdue

Social Science

Authors(s):
Andrew Jensen† (Engineering|JMHC)

Abstract:
How are meeting practices and interpersonal recruitment associated with participation in voluntary campus ministries? This study uses Christian ministries at Purdue University as a case to examine meeting frequency, formats, and attendance, with The Salt Company as a focal organization for exploring recruitment experiences. It addresses broader questions about how campus ministries attract and engage members. A directory of 44 Christian ministries, retrieved from BoilerLink in September 2026, was screened to identify 31 eligible, active, coed groups serving Purdue students. The first component is an observational, descriptive census using public ministry websites and information from ministry leaders. The analysis will document the prevalence of different meeting practices, examine their associations with attendance, and compare The Salt Company with other ministries. The study hypothesizes that frequent meetings and varied meeting formats are relatively uncommon but more prevalent among ministries with higher attendance. The second component, a planned survey of members of The Salt Company and potentially other ministries, will examine recruitment experiences, involvement in other ministries, and pathways into participation. It will explore the hypothesis that interpersonal invitations feature prominently in members' accounts of joining The Salt Company. Together, these components will document campus ministry operations, identify associations between meeting practices and participation, and develop hypotheses about peer recruitment and organizational growth. The findings will contribute case-based evidence to broader research on participation and recruitment in voluntary campus ministries.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1255
Presentation Time: Session 2: 10:30-11:30am

Comparison of Spray Drone and Ground Sprayer Carrier Volumes on Translocation of Contact and Systemic Herbicides in Waterhemp

STEM

Authors(s):
Allison Morgan Jones† (Agriculture)

Abstract:
Understanding how herbicide carrier volume and dose influence activity is important for improving application strategies and weed management. The objective of this study was to evaluate the effect of carrier volume and herbicide dose on glyphosate (systemic) and glufosinate (contact) translocation, as assessed by the distribution of injury symptoms above and below the treated leaf. A greenhouse experiment was conducted using a completely randomized design with four replications and a two-factor factorial arrangement. Factor A consisted of two carrier volumes [3 and 15 gallons per acre (GPA)], and Factor B consisted of herbicide dose (low, medium-low, medium-high, and high). Herbicide solutions were applied to the uppermost fully developed leaf of approximately 4-inch-tall waterhemp plants, with dose levels established by varying the number of 0.5-µL droplets. Visual injury and the number of affected nodes above and below the treated leaf were assessed at 3 days after treatment (DAT) for glufosinate and 7 DAT for glyphosate. For glyphosate, the highest dose resulted in the greatest waterhemp injury (44%) and the greatest number of nodes affected above the treated leaf (2.75), which was comparable to the medium-high rate (1.75). The interaction between factors was significant for the number of nodes affected below the treated leaf, ranging from 4 with the high herbicide dose at 15 GPA to zero with the low herbicide dose at 3 GPA. For glufosinate, there was a significant interaction between factors for the number of nodes affected below the treated leaf, ranging from 4.25 with the medium-high dose to 1.25 with the low dose, both at 15 GPA. These findings demonstrate that herbicide dose and carrier volume influence the distribution of visible injury symptoms differently. Furthermore, these results indicate that although glufosinate is a contact herbicide, some translocation occurred within the plant, which may help explain weed control observed at low carrier volumes.

Mentor(s):
Tommy Butts (Agriculture); Bryan G Young (Agriculture); Julie M Young (Agriculture); Maria Carolina de Carvalho Rocha Souza (Agriculture)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1256
Presentation Time: Session 2: 10:30-11:30am

Automatic Segmentation of Figure-of-8 Walking into Straight and Curved Paths Using a Single Trunk-Worn IMU

STEM

Authors(s):
Avani Kabra† (Science|JMHC)

Abstract:
Walking along curved paths places greater demands on balance and coordination than straight-line walking, and the Figure-of-8 walk captures these demands in a brief, repeatable task. To analyze turning separately from straight walking, each segment of the figure 8 must first be located within a continuous recording. Existing inertial measurement unit (IMU) turn detectors were designed to find sharp isolated turns during community ambulation rather than the alternating straight-and-curved structure of Figure-of-8 walking. To address this gap, we developed an algorithm that segments Figure-of-8 walking using the yaw rate from a single trunk-worn IMU. The signal is low-pass filtered to suppress step-to-step trunk sway, converted into a windowed root-mean-square detection signal, and classified as straight or curved using an automatically selected Otsu threshold, with a minimum-duration rule to remove brief spurious segments. When tested on pilot data, this approach reached 95% segmentation accuracy. We will freeze the algorithm and apply it to 25 to 50 young and middle-aged adults (18–61 years) who walked a 2-ft-wide Figure-of-8 path at their preferred pace, at 120% of preferred pace with audio speed feedback, and under an accuracy constraint requiring tandem steps along the center line. Performance will be benchmarked against the El-Gohary turn detector, the field-standard algorithm used to identify turns in human locomotion. Performance will be validated using reference straight, clockwise, and counterclockwise segment boundaries that were marked in real time by an experimenter using a lap-timing app. We expect that our task-specific algorithm will out-perform the El-Gohary turn detector and identify the segments reliably across the three tasks and across ages. We seek to establish a task-specific, single-sensor approach can reliably segment Figure-of-8 walking, supporting automated, turn-specific gait analysis in future studies of mobility across the lifespan.

Mentor(s):
Satyajit S Ambike (HHS); Jeffrey M Haddad (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1257
Presentation Time: Session 2: 10:30-11:30am

Toward Reliable Surrogates for Reactor Optimization: Comparing Neural Network Approaches to Physical Constraints

STEM

Authors(s):
Sai Karthik† (Engineering|Science)

Abstract:
Repeated reactor simulations can make the search for better operating conditions computationally costly. Neural network surrogates offer a way to approximate reactor behavior efficiently, but their usefulness for process optimization depends on both prediction accuracy and physical consistency. This study develops a reproducible comparison of four neural network approaches for a membrane reactor that converts methanol to dimethyl ether, examining how the method of incorporating a conservation constraint affects surrogate performance. A standard neural network serves as the baseline for three approaches that incorporate a total molar balance through a training penalty, output reconstruction, or output projection. The comparison uses an existing dataset of 1,022 simulated operating conditions, with seven inputs and eight outputs describing flows, temperatures, and pressure. Fixed training, validation, and test partitions and scaling determined only from training data provide a common evaluation protocol. A bounded tuning campaign screens six configurations per model family and compares baseline and selected configurations across three random seeds, using 1,000 epochs per training run. Configurations are selected using validation error before evaluation on a frozen test set. Assessment considers prediction error alongside balance residuals and inequality violations to examine the tradeoffs between fitting the data and satisfying physical constraints. The resulting workflow supports model selection for subsequent export and optimization studies. Future work in this project will focus on verifying surrogate predictions against the reference simulator, clarifying dataset units and provenance, and establishing engineering acceptance criteria to support reactor optimization.

Mentor(s):
Yirang Park (Engineering); Andres Felipe Cabeza Pulido (Engineering); David Esteban Bernal Neira (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1258
Presentation Time: Session 2: 10:30-11:30am

Power to the Players: Combating the Erosion of Consumer Rights

Humanities

Authors(s):
Nicholas Shea Kelly† (Agriculture)

Abstract:
[Abstract Redacted]

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1259
Presentation Time: Session 2: 10:30-11:30am

A Three-Fingered-6-DOF Robotic End Effector

STEM

Authors(s):
Sophie Kelly† (Engineering); Aravind Narayan Balasubramanian† (Engineering); Caden James Rowse† (Engineering); Sahil Vijay† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Jaeeun Kim (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1260
Presentation Time: Session 2: 10:30-11:30am

Development of a Physical Design Verification and Signoff Flow for SoCET

STEM

Authors(s):
Seokjae Kim† (Engineering); Dakyung Kim† (Engineering); Hsin-Yu Tsern† (Engineering); Ningang Han† (Engineering)

Abstract:
Before an integrated circuit can be manufactured, engineers must verify that its design meets both functional and manufacturing requirements. Verification is performed throughout the physical design process to ensure that the chip operates as intended and follows manufacturing constraints. However, these checks often require multiple tools, complex configurations, and time-consuming debugging, making the signoff process challenging.

This project aims to develop a reliable and reusable physical design verification and signoff flow for a System-on-Chip (SoC) developed by Purdue University's System on Chip Extension Technologies (SoCET) team. The verification process includes Logic Equivalence Checking (LEC), Static Timing Analysis (STA), and physical verification. LEC ensures that the implemented logic remains consistent with the original design, while STA analyzes signal timing, including the effects of resistance and capacitance from physical interconnections, to verify that the chip meets its timing requirements. Physical verification includes Design Rule Checking (DRC) to identify manufacturing rule violations and Layout Versus Schematic (LVS) to confirm that the physical layout matches the intended circuit connections.

The project will establish repeatable verification procedures, improve automation, and document methods for identifying and resolving violations. Success will be evaluated by completing the required signoff checks without unresolved violations and producing consistent, reproducible verification results. Although successful signoff reduces design and manufacturing risks, it cannot completely eliminate defects introduced during fabrication. Ultimately, this project will improve the efficiency and reliability of SoCET's chip development process while providing a reusable verification framework for subsequent projects.

Mentor(s):
Niels van Ritbergen (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1261
Presentation Time: Session 2: 10:30-11:30am

Grammatical Gender Patterns Across Languages: A Comparative Study of Russian, German, and French

Humanities

Authors(s):
Gabrielle Klimeck† (PFW)

Abstract:
This project investigates patterns of grammatical gender in Russian, German, and French by examining the gender distribution of common nouns, such as animals, anatomical terms, and plants. Through a comparative analysis of lexical and morphological categories, the study seeks to identify whether there are patterns in gendering nouns across different languages as well as within a singular language and what those patterns are. The study will also identify the extent to which grammatical gender may influence interpretation and translation. In addition to advancing research in comparative linguistics and translation studies, the project has a strong educational component, developing pedagogical resources and strategies that help learners recognize patterns in grammatical gender, reduce memorization, and facilitate vocabulary acquisition in gendered languages.

Mentor(s):
Olga Lyanda-Geller (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1262

Presentation Time: Session 2: 10:30-11:30am

A Groundbreaking Innovation: ClearPro's Clear Whey Protein Powder

Business Case Study

Authors(s):
Matthew Robert Krunnfusz† (DSB); Anna A Dedhia† (DSB); Katherine Grace Gowarty† (DSB); Avnika Ameya Vamaraju† (DSB); Varsha Niranjan† (DSB); Vedasri Surada† (DSB)

Abstract:
Clear Pro, a Purdue research-funded protein start-up, has a groundbreaking clear whey protein powder; however, they have not defined a target market or a go-to-market strategy. The purpose of our study is to analyze the protein product industry and create a business-to-business go-to-market strategy for ClearPro's clear whey protein powder. This project will involve researching protein industry trends, potential B2B markets, target customers, and competitors to better understand the current market landscape. Using this research, we will identify potential market opportunities and evaluate factors that may influence ClearPRO's competitive positioning, including customer needs, product differentiation, and market demand. The findings will be used to develop strategic recommendations for reaching potential business customers and establishing ClearPRO's presence in the market. The planned deliverable is a set of actionable recommendations to support ClearPRO's B2B marketing and go-to-market strategy. This project is expected to provide ClearPRO with a practical foundation for identifying target markets and making informed decisions about its market entry growth.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1263
Presentation Time: Session 2: 10:30-11:30am

Use of Software-Defined Radios for Agile & Terrestrial Alt-PNT in Contested Environments

STEM

Authors(s):
Sean Larson† (Engineering); Matthew C Lee† (Engineering); Thomas Grant Helmbrecht‡ (Engineering); Valentino Angel Cattaneo‡ (Engineering); Thomas Edward Lowry‡ (Engineering); Jack M Triglianos‡ (Engineering); Brandon Myles Strug‡ (Engineering); Vidyut C M

Abstract:
The purpose of this project is to determine the feasibility, benefits, and limitations of rapid-deployed terrestrial radionavigation systems for use in environments where traditional, GNSS-derived PNT is degraded or fully denied, without dependence on onboard "local" solutions such as Simultaneous Localization and Mapping (SLAM) or terrain-based navigation systems. The specific target of this project is the demonstration of reliable PNT provisioning for a Group 1 UAS within a multipath-prone environment (buildings, obstacles, foliage) alongside other active RF transmitter sources (telemetry, control links, deliberate RF noise), within a traditional GNSS-quality fix of 2-4m deviation. Through the utilization of Software Defined Radios, this project also seeks to demonstrate frequency agility as a potential solution for jamming by altering the center frequency of the system to overpower wideband jammers and "dodge" narrowband jammers. Confirmed feasibility of this project may provide a technical basis for low-cost, rapidly-deployable PNT solutions for various emergency response, national security, or military applications, where GNSS or other PNT solutions are deemed unreliable or unreachable.

Mentor(s):
James Michael Goppert (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1264
Presentation Time: Session 2: 10:30-11:30am

Illuminating Dynamic Triple-Phase Boundaries in Toluene-in-Water Emulsions via Electrochemiluminescence

STEM

Authors(s):
Reagan Laser† (Science); Ehren Kuehl† (Science)

Abstract:
Oil-in-water emulsions are widely used in chemical and biological systems, where interactions at the oil|water interface can influence chemical reactivity and droplet behavior. However, directly visualizing these interfaces and their dynamics remains challenging. Here, we demonstrate the use of electrochemiluminescence (ECL) microscopy to visualize individual toluene droplets at an electrified interface. An ECL system consisting of tris(2,2′-bipyridine)ruthenium(II) ($[Ru(bpy)_3]^{2+}$) and 2-(dibutylamino)ethanol (DBAE) was employed to take advantage of their solubilities. DBAE preferentially partitioned into the toluene droplets while $[Ru(bpy)_3]^{2+}$ remained in the aqueous phase. Upon application of a potential sufficient to oxidize both species, localized ECL was generated at the triple-phase boundary between the electrode, aqueous solution, and toluene droplets. This spatially confined light emission enabled direct visualization of individual droplets and their dynamic behavior at the electrode surface. These results demonstrate the potential of ECL microscopy as a tool for studying multiphase interfaces and tracking droplet dynamics in emulsions, providing a new approach to investigating interfacial phenomena in heterogeneous chemical systems.

Mentor(s):
Patrick Herchenbach (Science); Jeffrey Edward Dick (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1265
Presentation Time: Session 2: 10:30-11:30am

Simultaneous Localization and Mapping (SLAM) in Dark and Low-Feature Environments

STEM

Authors(s):
Michael K Lau† (Engineering); Dharmik Rasineni† (Engineering); Yash Pankhaniya Das† (Engineering); Ishan Murthy† (Engineering); Corrine Tseng† (Engineering)

Abstract:
This project proposes the selection of a simultaneous localization and mapping (SLAM) algorithm to support dark and low-feature environmental mapping and navigation without GPS for a drone in Purdue University's PURT-UAS Vertically Integrated Projects program. The drone currently uses CogniPilot for autopilot control and is equipped with an inertial measurement unit and an Intel D435 camera for the proposed SLAM system. The project will use a literature review to identify candidate algorithms suitable for the available sensor configuration and compare them primarily on robustness and localization accuracy. The review will examine evidence supporting each candidate's suitability and identify limitations that could affect its application to the drone. Preliminary work has consisted of an initial literature review, and no algorithm has yet been selected or experimentally validated. The proposed outcome is an evidence-based algorithm recommendation to guide subsequent implementation and testing with the drone's existing hardware and autopilot. Further evaluation will be needed to establish whether the selected approach can provide reliable mapping and localization for navigation without GPS.

Mentor(s):
James Michael Goppert (Engineering); Alexander Kmetko (Engineering)

Other Acknowledgment(s):
Aditya K Chintakayala* (Engineering)

Poster Presentation Abstract Number: 1266
Presentation Time: Session 2: 10:30-11:30am

Novel Bulk Film Functionalization of Conductive Hydrogels for Electrochemical Sweat Analysis

STEM

Authors(s):
McKenzie Laucher† (Engineering)

Abstract:
For individuals working in high-stakes, mentally demanding professions (Air Traffic Controllers, etc.), quantitatively monitoring cognitive workload is key to minimizing errors. When completing mentally exhaustive tasks, the composition of human sweat varies due to an autonomous nervous system response. This variation allows for a measure of physiological signals associated with cognitive workload. Though stationary, medical-grade devices are currently capable of taking these measurements, they cannot be implemented in the workplace, where non-invasive, continuous monitoring is critical. Thus, creating a demand for developing portable, wearable sensors. Previous works have shown functionalized hydrogels are viable materials for wearable, skin-interfacing sensors. Hydrogels synthesized with biocompatible polymers allow for direct application to the skin without causing irritation or inflammation. Thin, flexible hydrogel films provide improved wearability due to superior mechanical compliance with human skin. Additionally, being hydrophilic with a robust crosslinked structure, hydrogels can retain large amounts of moisture while maintaining mechanical stability. Hydrophilicity is important as it enables hydrogels to absorb sweat into the bulk of the sensor, increasing the sensing surface area compared to conventional electrochemical sensors for sweat analysis. This work focuses on the development of a novel conductive hydrogel with combined sweat accumulation and sensing components. With this approach, we focus on an impedimetric—rather than the traditional voltammetric—sensing mechanism. In particular, our work focuses on the development of custom conjugates capable of isolating electrolytes in sweat. These conjugates will then be grafted on the polymeric back bone of our hydrogel to bulk-functionalize our sensor. Here we show that the bulk-functionalized sensing approach further increases our sensing surface area, resulting in improved sensitivity of our device.

Mentor(s):
Nachiket Vatkar (Engineering); Wenzhuo Wu (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1267
Presentation Time: Session 2: 10:30-11:30am

Designing a Boot Architecture for a Custom Stack-Based ZPU System-on-Chip

STEM

Authors(s):
Harrison Lee† (Engineering)

Abstract:
A processor cannot run software until it reliably moves from reset to application code. The SoCET ZPU is new this semester, so no boot process exists for its developing hardware and software architecture, and existing ZPU implementations cannot be adopted as-is because their boot assumptions do not match our Wishbone bus and team-defined memory organization. Without a boot process, the ZPU Core, Bus & Memory, Software, and Peripherals teams cannot run programs on the processor.

This project proposes an end-to-end boot architecture that defines the initial program counter, startup memory and memory layout, boot-code location, application-loading mechanism, and application entry point. After reset, the processor fetches instructions from startup memory over the Wishbone bus, executes startup code, loads or locates the target application, and transfers control to its entry point. Success is measured by a test application executing at the defined entry point after reset, verified in simulation.

Because the ZPU architecture is still under development, the reset address, startup-memory location, loading mechanism, and handoff procedure are not yet final, so this design depends on decisions from the other ZPU teams. Reset behavior, memory organization, and Wishbone integration are the interfaces already identified for coordination. Next steps are to finalize these parameters, implement a bootloader, and verify it, giving the ZPU a reliable path from hardware initialization to software execution and enabling all later software development on it.

Keywords: Boot Process; Wishbone Bus; Processor Architecture

Mentor(s): Mark Johnson

Mentor(s):
Mark Johnson (Engineering); Cole Aaron Nelson (Engineering)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1268
Presentation Time: Session 2: 10:30-11:30am

Quantifying Antioxidants and Associated Metabolites in Fungal Tissue and Exudate of Mycoponic Pleurotus ostreatus

STEM

Authors(s):
Ana Sofia Leiva Aldana† (Agriculture|Engineering)

Abstract:
Fungal exudation in P. ostreatus is underexplored but may support pharmaceutical biomanufacturing and natural product discovery. Previous analyses detected signals consistent with lovastatin, ergothioneine (EGT), and ergocalciferol in exudate. Confirming compound identities and quantifying concentrations across cultivation conditions will help assess this potential.

Exudate volume was assessed in a 21-day 2 × 2 factorial experiment (relative humidity, 97–99% vs. 40–60%; inoculation cohort, February vs. June 2026; n = 16). Linear mixed models indicated independent effects of humidity ($p = 0.007$) and culture age ($p < 0.0001$), with no significant interaction. Preliminary DESI-MS detected features with m/z values consistent with EGT, mannitol, and arabitol. The putative EGT signal was strongest in clean amber exudate; mannitol and arabitol signals were higher in contaminated exudate.

Authentic standards and calibration curves are being used to confirm candidate identities and quantify compounds informed by RNA-seq and preliminary DESI-MS: EGT; mannitol, sorbitol, and arabitol; NAD+, hydrogen peroxide, acetyl-CoA, and uric acid; choline, phosphocholine, glycerophosphocholine, phosphatidylcholines, monoacylglycerols, glycerol, and 2-hydroxypalmitic acid; glucose-1-phosphate, glucosamine, glutamate, and glutamine; and formate and acetate. The mannitol/sorbitol isomer pair will be evaluated with standards and MS/MS. Concentrations will be compared by humidity, contamination status, culture age, and collection day.

Environmental and nutritional variables are expected to be optimized to increase production of target molecules, particularly EGT and other antioxidants.

Mentor(s):
D. Marshall Porterfield (Agriculture|Engineering); Richard John Barker (Engineering)

Other Acknowledgment(s):
Shiva Ataei* (Science); Nicolas Mauricio Morato Gutierrez* (Centers & Institutes)

Poster Presentation Abstract Number: 1269
Presentation Time: Session 2: 10:30-11:30am

Model for Investigation of Mechanical Stresses in Endothelial Cells

STEM

Authors(s):
Grace Lincoln† (Engineering); Argustus Louis Powell† (Engineering)

Abstract:
Cellular mechanics play an important role in maintaining homeostasis by initialing and regulating gene expression changes to provide adaptive structural stability for the cell. Computational models of cells serve as a useful tool to explore the structure and response at an intracellular level. This research project orients around studying and simulating the forces that endothelial cells are under and how they move the cytoskeleton and the nucleus in response to external forces from blood flow. The current models of endothelial cells do not fully simulate the cell's response to forces from blood flow as well as intracellular remodeling of the cytoskeleton and nucleus. Also, this project will attempt to build cell model that is more realistic in shape and size. The overall goal of this project is to accurately model the forces of the shear stress and stretching of the cell from blood flow. This computational model of forces on endothelial cells will be compared to experimental data to better understand force transduction in cell and re-organization of cytoskeleton and nucleus in response to external forces.

Mentor(s):
Julie Ying Hui Ji (PWL); Sungsoo Na (PWL)

Other Acknowledgment(s):
Scotty Secrist* (PWL)

Poster Presentation Abstract Number: 1270
Presentation Time: Session 2: 10:30-11:30am

Preparation of STM-Compatible, Atomically Pristine hBN Samples as Platform for Single Quantum Defect Generation

STEM

Authors(s):
Audrey Lynne Lindberg† (Science); Manaswini Singh‡ (Science)

Abstract:
Hexagonal boron nitride (hBN) defects boast quantum and optical properties promising for applications such as quantum computing and sensing. In particular, the defects are boron vacancies hosting localized electron spins that can serve as qubits for advancements in nanoscale sensing of temperature, magnetic fields, or strain. However, such defects are often created imprecisely. A controlled method is using scanning tunneling microscopy (STM) to generate a bias voltage between the microscope tip and the sample, thereby ejecting a boron atom from the surface hBN layer. The result is a spin-active, negatively charged boron vacancy that is electronically isolated from the surrounding lattice, thanks to hBN's wide bandgap, and whose location and structure are well-defined. This level of control allows for direct correlation of atomic structure to observed quantum and optical behavior. It also allows for the defect to be placed near other nanoscale devices with maximum precision.

My work this semester centers on preparing samples for STM. First, I peel hBN and graphene into thin layers, as allowed by their weak van der Waals interlayer bonding, using a manual adhesive tape method. Then, I use a polypropylene carbonate (PPC) stamp to pick up three specifically chosen flakes and form a carefully designed stack. A bottom thick hBN flake provides support; a middle graphene flake provides electrical conductivity; and a top thin hBN is the flat, unreactive surface ideal for hosting the target vacancies. Once prepared and cleaned, the stack is analyzed with atomic force microscopy (AFM) to verify that the thin hBN is sufficiently clean and thin, as this hBN's number of layers impacts its dielectric and electronic characteristics. These samples will allow STM to create and study isolated boron vacancies one at a time.

Mentor(s):
Tiancong Zhu (Science)

Other Acknowledgment(s):
Christopher Antonio Ulate* (Science); Kyung Jun Lee* (Science)

Poster Presentation Abstract Number: 1271
Presentation Time: Session 2: 10:30-11:30am

Cardinal-Simulator: A Cycle-Accurate Simulator for the Cardinal Cx01 GPU

STEM

Authors(s):
Felix Liu† (Engineering); Zay Linn Htet* (Engineering); Tushar Singh* (Engineering|JMHC)

Abstract:
Chip design flow is an extensive process where designs must match specifications, but poor architectural decisions may be discovered late, resulting in delays and RTL rewrites. Evaluation of these decisions require a simulator that is fast to run and modify. We present the Cycle-Accurate Simulator for the Cardinal Cx01 GPU, written in C++ with a modular, parameterizable architecture. A previous implementation was written in Python but doesn't have easily parametrizable modules and slow runtime.

We validate with module-level unit tests and running compiled programs, comparing the resultant memory output with expected output. Event counters are used to compare and verify if an architectural decision pays off. For example, Greedy-then-Oldest (GTO) has an 8% improvement in total cycles over round-robin for saxpy. This simulator sees a 16-294x speedup in runtime over the previous implementation.

Mentor(s):
Zach Anthony Barna (Engineering)

Other Acknowledgment(s):
Shams Tahsinul Hoque* (Engineering)

Poster Presentation Abstract Number: 1272
Presentation Time: Session 2: 10:30-11:30am

Does Humidity Leave a Nanoscale Memory in Orally Disintegrating Films?

STEM

Authors(s):
Sreshta Reddy Loka† (Engineering|JMHC); Sricharan Pusarla† (Engineering); Nehemiah Namin Kim‡ (Pharmacy); Keaton T Hale‡ (Science); Tuna Tamkan‡ (Engineering)

Abstract:
Orally disintegrating films (ODFs) are thin polymer films that disintegrate in the mouth, allowing medication administration without water and offering an alternative for patients who have difficulty swallowing tablets. Moisture exposure during storage can alter film properties, making humidity sensitivity important to formulation design. This study will investigate whether PVA and pullulan films recover their initial nanoscale surface morphology after high-humidity exposure and return to lower humidity, and whether addition of 20% glycerol plasticizer affects recovery.

We will use atomic force microscopy (AFM) to investigate the effect of humidity exposure on morphological surface properties of four thin-film formulations: PVA and pullulan, with and without 20% glycerol, using DI water as solvent. Each batch will supply initial, humid, and recovered coupons, giving 4 formulations x 2 batches x 3 conditions = 24 total coupons. All coupons will first equilibrate 48 hours at ~33% relative humidity over saturated magnesium chloride hexahydrate. Humid and recovered coupons will move to ~75% humidity over saturated sodium chloride. After humidity exposure, the humid cases will be characterized immediately while recovered coupons will return to 33% humidity for 48 hours.

Standard tapping-mode AFM will scan two locations per coupon, measuring surface height while minimizing film damage. Each image will cover 10x10μm². Root-mean-square roughness will be the main outcome; a recovered-to-initial roughness ratio close to 1 will demonstrate shape memory. Mean roughness values, height mapping, and phase contrast mapping images will support the interpretation. The results will aid in formulating ODFs with improved shelf-life stability and moisture resistance under varying humidity conditions.

Mentor(s):
Ryan B Wagner (Engineering); Subham Das (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1273
Presentation Time: Session 2: 10:30-11:30am

Evaluation of Stepwise Solvent Variation in Surface Touch Extraction for Small Molecule Profiling of Soybean leaves

STEM

Authors(s):
Silvia Helena Lopez Serrano† (Purdue University); Sara Sofia de Fatima Bucheli Lazo‡ (Purdue University); Isabella Zuluaga Gomez‡ (Purdue University)

Abstract:
[Abstract Redacted]

Mentor(s):
Christina R Ferreira (Centers & Institutes); Ryan T Hilger (Science); Devender Arora (Centers & Institutes)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1274
Presentation Time: Session 2: 10:30-11:30am

Design of the Texturing Subsystem Within the Cardinal GPU

STEM

Authors(s):
Yoshita Mahesh† (Engineering); Taviish Bothra† (Engineering)

Abstract:
Previous iterations of the Cardinal GPU lacked dedicated memory structures for storing textures used in scene rendering. Real-time rendering requires millions of data accesses per second, and the lack of dedicated hardware for improving scene rendering is a significant bottleneck for performance. To solve these issues, we are implementing a texture management unit (TMU) to handle specific texture mapping techniques such as UV mapping and mipmapping to optimize texel fetching. The TMU will contain a texture cache (t-cache) that leverages 2-D spatial locality to store data from the TMU more efficiently. Once the RTL of the t-cache is completed and verified, it will be integrated with the rest of the TMU as well as other parts of the GPU. The functionality of the t-cache RTL will be verified by sending texture requests to a GPU that contains the cache and one without to verify that the cache is increasing performance by reducing the cycles it takes to fetch data from memory. A limitation of the cache is that the additional address calculations have to be done to store the data in the cache. This increases the latency which would decrease the performance of the cache. In the future, simulations will be done of the texture unit as a whole to understand how beneficial the texture unit is with and without the cache.

Mentor(s):
Zach Anthony Barna (Engineering); Charles Spencer Bowles (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1275
Presentation Time: Session 2: 10:30-11:30am

Autonomous Vehicles in the Workplace: Assessing Commercial Driver Safety and the Psychosocial Impacts of Job Displacement

Social Science

Authors(s):
Julia Shea Malino† (HHS); Leyla Catherine Sleime† (HHS); Elizabeth Kathleen Goebel† (HHS); Reigan Kay Nies† (HHS); Ashley Fontana† (HHS)

Abstract:
This study aims to examine the occupational health trade-offs of integrating automated vehicles (“self-driving vehicles”) into the transportation workplace, particularly the impacts on commercial driver safety and job displacement. While designed to reduce human-error collisions and physical exertion while driving, software bugs, fatigue from passive monitoring, and threats of large-scale job replacement raise concerns. This study was developed collaboratively by researchers at Purdue University in the U.S. and Phenikaa University in Vietnam.

Our study aims to explore the impacts of autonomous vehicles on commercial driver safety and the psychosocial impacts of job displacement. To answer this question, we will conduct a literature review and qualitative thematic analysis.

We will systematically review peer-reviewed public health and occupational health literature, primarily through PubMed, evaluating vehicle error rates compared with human performance and employment security across different contexts.

Our findings will highlight the dual public health impacts of vehicle automation. We expect the literature to show that while autonomous vehicles may reduce conventional driving risks, they also create new occupational health challenges, including system failures and software bugs, diminished driver alertness and response times in unexpected circumstances, and psychosocial consequences such as anxiety, stress, and job displacement. We will compare autonomous vehicle deployment in the United States with selected pilot sites and case studies in Vietnam, examining differences in adoption rates, regulatory and infrastructural preparedness, and challenges posed by Vietnam’s compact and dynamic traffic environment.

These findings suggest that commercial automation policies should balance engineering efficiencies with proactive labor protections, human-centered ergonomic design, and institutional support for mental health and career transitions within the workforce.

Mentor(s):
Mark Wilson (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1276
Presentation Time: Session 2: 10:30-11:30am

Projection Augmented Reality for Introductory Chemistry Pre-Lab Instructions

STEM

Authors(s):
Omkar Abhay Mamidpalliwar† (Science)

Abstract:
Introductory chemistry students often commit procedural and equipment-use errors because text-based prelab readings require them to mentally map written instructions onto unfamiliar physical equipment. This project seeks to explore if a projection-based spatial augmented reality (AR) device that overlays guidance directly onto lab stations can reduce these errors compared to traditional text instruction. We developed the Prism lamp, a custom projector device that displays equipment labels and step-by-step procedures onto the physical lab bench, and will test it with undergraduate introductory chemistry students. Using a between-subjects design, students will complete a lab task with either projected guidance or a text-based prelab, with errors recorded and categorized alongside surveys of confidence and cognitive load. We anticipate that students using projected guidance will commit fewer procedural and equipment-use errors and report lower cognitive load than the text-instruction group. These findings would establish projection-based spatial AR as a hands-free, shared alternative to smartphones and headset AR for improving student preparedness, safety, and confidence in undergraduate laboratories.

Mentor(s):
Jonathan C Rienstra-Kiracofe (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1277
Presentation Time: Session 2: 10:30-11:30am

Predicting Global Video Game Sales Using Genre, Developer, and Critic Scores

Business Case Study

Authors(s):
Paulina Michele Marengo† (DSB); Vihaan Anoll Mercchant† (DSB); Ziheng Ma† (DSB)

Abstract:
To what extent can video game genre, developer, and critic scores predict global sales, and which factors best distinguish commercially successful games? Developing and marketing video games requires substantial investment, and inaccurate sales expectations can lead to financial losses. Our goal is to predict global sales, identifying characteristics associated with commercial success. We use the real-world VGChartz 2024 video game sales dataset from Kaggle: 64,016 rows (one per game-console release) and 14 columns. The target is total sales; predictors are critic score, genre, and developer. Because many observations lack sales or critic scores, we use the 4,126 games (6.4%) with complete information. Sales are right-skewed, and games scoring above 9 average 2.5 million units versus 0.3 million at 6 or below. Reviewed games sell more than unreviewed ones, limiting generalization. Data preparation includes log-transforming sales, grouping rare developers, encoding categorical variables, and splitting into training, validation, and test sets before preprocessing to prevent data leakage. We compare a mean-prediction baseline, linear regression (interpretable benchmark), decision trees (simple rules), and random forest (nonlinear interactions) in Python, using five-fold cross-validation with RMSE on log sales as the primary metric, which penalizes large proportional errors; MAE and R^2 are secondary. These findings could help publishers understand characteristics associated with commercial success, supporting marketing decisions. However, results reflect associations rather than causal relationships, and critic-score predictions are most relevant after reviews become available.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1278
Presentation Time: Session 2: 10:30-11:30am

The Importance of Onboarding in Research Projects

STEM

Authors(s):
Ella Marks† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Jaeeun Kim (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1279
Presentation Time: Session 2: 10:30-11:30am

Evaluation of Yttrium-89 Activation as a Multi-Channel Diagnostic for 14 MeV Neutron Dosimetry

STEM

Authors(s):
Michael Marsigliano† (United States Military Academy)

Abstract:
Accurate measurement of high-energy neutron fluence is critical for fusion diagnostics, radiation effects testing, neutron transport validation, and nuclear survivability applications. At approximately 14 MeV, passive activation dosimetry provides an alternative to direct neutron detection by measuring radioactive products generated during irradiation. Niobium-93 is an established activation monitor for 14 MeV neutron fluence through the 93Nb(n,2n)92mNb reaction. This research evaluates Yttrium-89 as a complementary activation material with the potential to provide multiple diagnostic observables. Naturally monoisotopic Yttrium-89 has several relevant reaction pathways, including 89Y(n,2n)88Y, 89Y(n,p)89Sr, and 89Y(n,α)86Rb. Their radioactive products have distinct decay characteristics that may enable cross-validation of neutron measurements and investigation of neutron-energy dependence.

The research integrated activation-product evaluation, dosimetry-pack design, Monte Carlo N-Particle (MCNP) modeling, and experimental deployment at the OMEGA Laser Facility. A facility-scale MCNP model was developed to represent the target chamber, structural geometry, and dosimetry-pack configurations using an approximately isotropic 14 MeV neutron source. Multiple experimental campaigns deployed Yttrium foils alongside Niobium and other activation materials to investigate activation response and neutron fluence distributions. The campaigns did not produce sufficient measurable Yttrium activation for quantitative analysis. Differences in foil-position fluence and the limited activation observed under the experimental conditions highlighted the challenges of obtaining measurable Yttrium activation. This work establishes a computational and experimental foundation for evaluating Yttrium-89 as a complementary diagnostic and informs future improvements to dosimetry-pack design, irradiation conditions, and activation measurement sensitivity.

Mentor(s):
Andrew Banko (United States Military Academy West Point)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1280
Presentation Time: Session 2: 10:30-11:30am

Using Fatty Acid Synthesis to Produce Diverse Monomers for PHA Production

STEM

Authors(s):
Sabina Anna Mazur† (Agriculture|Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Karthik Sankaranarayanan (Agriculture|Engineering); Ryan Elisabeth McLellan (Graduate)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1281
Presentation Time: Session 2: 10:30-11:30am

Can a Healthy Romantic Relationship Change an Insecure Person's Attachment Style?

Social Science

Authors(s):
Kelly Rose McAleese† (HHS)

Abstract:
The purpose of my research is to see if a healthy romantic relationship can change an insecure person's attachment style. The primary research will be gathered through surveys of Purdue students and other individuals in relationships to ask whether their trust levels, anxiety levels, or avoidance levels have changed based on being in a healthy romantic relationship. The survey would also investigate if their attachment style has changed at all while being in the relationship. The findings in this survey will be used to show if attachment style has been changed due to being in the relationship, or if only some feelings have changed.

Mentor(s):
Catherine Jean Shukle (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1282
Presentation Time: Session 2: 10:30-11:30am

Forecasting Retail Demand: Using Store Fixed Effects, Lag Variables, and Macro Indicators to Predict Weekly Sales at Walmart

Business Case Study

Authors(s):
Samuel McBroom† (DSB); Joseph Becker Mumford† (DSB); Theodore Dean Schmidt† (DSB); Ethan Heeres† (DSB)

Abstract:
Retail demand fluctuations create risks for supply chains: inventory shortages lead to lost revenue, while overestimating demand increases carrying costs. Can historical sales data, seasonal trends, and macroeconomic indicators help mitigate these supply chain risks through week-ahead forecasting? This study predicts total weekly sales across 45 Walmart stores using 6,435 weekly observations from February 2010 through October 2012, with a goal of evaluating how macroeconomic shifts and cyclicity influence store-level demand. The data is prepared by first addressing sales disparities across locations with dummy variables, extracting cyclical calendar trends, and tracking local indicators (CPI, unemployment rate, fuel price, and temperature). Through store grouping, the project team engineers sales lag variables from the prior week along with a four-week rolling average to capture short-term sales momentum. Models are evaluated with a chronological 80/20 train-test split and cross-validation. The project team uses Python to estimate and compare baselines models, Ordinary Least Squares (OLS), Ridge and Lasso regressions, and store-specific ARIMA benchmarks. Preliminary analysis shows that prior-week demand is strongly correlated ($r = 0.95$) with current sales, and demand predictably increases around holiday weeks. The team anticipates that the models will illustrate that recent demand momentum out-predicts broader macroeconomic effects, which will be observed during LASSO variable isolation; redundant collinear features will be eliminated resulting from penalizations inherent to that type of regression. Translating forecast errors into a 90% demand-coverage buffer, this study leverages predictive analytics to solve practical retail supply chain problems.

Mentor(s):
Adrian Hoffert Wolanski (DSB)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1283
Presentation Time: Session 2: 10:30-11:30am

Policy in Professional Sports: A Problem of Clarity and Intent in Writing

Social Science

Authors(s):
Adam Joseph McGill Caiola† (Engineering)

Abstract:
Policy in professional sports governs every part of the game, but these policies often fall short of what they are meant to do. However, research suggests that policies can be improved upon to protect athlete safety, keep competition fair, and maintain public transparency of the associations. For example, in 2022 the NFL's concussion protocol let Tua Tagovailoa return to a game after a big hit left him visibly unstable because the written rule allowed it if the doctors blamed the instability on a non-head injury; they blamed it on his back injury, and his return jeopardized his safety. The league found that the protocol had been followed, but the outcome was not what the rule intended, and it closed the loophole within weeks. The ambiguity that stems from cases like these allows for loopholes, removes case-by-case discretion, and cannot be revised quickly enough to address developing issues, causing outdated rules within months of being established. Therefore, I aim to explore sources of failure in the written policies of professional sports, where rules are often unclear or too rigid to work as intended. By drawing on law review articles, court and arbitration rulings, and news coverage of recent cases, I will investigate how to solve the problem of unclear and rigid written policy in professional sports.

Mentor(s):
Garrett Ivan Colon (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1284
Presentation Time: Session 2: 10:30-11:30am

Automating Histological Analysis of Human Aortic Tissue

STEM

Authors(s):
Adam Matthew Mirmina† (Liberal Arts|Science); Bea Olivia Cabot‡ (HHS|Science)

Abstract:
Thoracic aortic aneurysms are asymptomatic dilations of the thoracic aorta that can be fatal due to dissection or rupture. Measuring medial degeneration (loss of elastin and smooth muscle cells, buildup of proteoglycan) is vital to understanding what contributes to aneurysm growth. The gold standard for quantifying it is manual color segmentation, a tedious process across several software tools.

Aortic root tissue from 5 patients undergoing root replacement and from 5 healthy donors was stained with Movat's pentachrome: elastin shows up as black, collagen yellow, proteoglycan blue-green, and cells red. We built an application that automatically finds and measures the aortic medial width, outlines regions at equal spacing along the wall, and segments them using one color reference per staining batch, such that colors no longer need selecting for each sample. It reproduced the old plugin's clustering across every region and slide in a batch and exports results to a shared workbook. A web app let analysts mark the same regions by hand, to test that the tool differs from a person no more than another person does.

The tool produced results as accurate as the old workflow in less time. On one human aortic root section, it placed 99.9% of pixels in the same cluster as the plugin. Two analysts' results differed by about 7 percentage points per tissue, depending on the colors they clicked. Once reference colors are chosen, it processed one slide (two sections, three regions each) in under a minute; by hand, two readers took 47 and 61 minutes for three regions. Across 30 regions, its wall widths fell within 5% of the average of three readers in 24.

The tool saves researchers' time and appears to work as well as an expert working manually. We plan to validate the tool further against fiber identifications by a veterinary histopathologist (murine) and a pediatric cardiologist (human), using ICC, R^2, and bias.

Mentor(s):
Craig Goergen (Engineering); Shubh Parag Mehta (Engineering); Cortland Hannah Johns (Engineering); Abigail D Cox (Vet Med); Benjamin Landis (Indiana University)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1285
Presentation Time: Session 2: 10:30-11:30am

Dose Dependent Effects of Chloropyrifos on Embryonic Cortical Neurons

STEM

Authors(s):
Kishan Kumar Namburi† (Science); Preema Rahman Bhuiya* (HHS); Nikita Goldfeld* (HHS)

Abstract:
Background and Purpose

Chlorpyrifos (CPF), a widely used organophosphate pesticide, has been tied to neurotoxic effects in children, particularly those exposed before birth. These effects include abnormal brain development, behavioral changes, and structural deficits. Research shows that CPF disrupts the neuronal networks of postnatal cortical neurons, but its impact on embryonic cortical networks is poorly understood. Studies also suggest that embryonic neurons may be more vulnerable to CPF than postnatal neurons. This study aims to determine whether the embryonic cortical neuronal network is more sensitive to CPF than postnatal neurons have been shown to be.

Methods

Primary cortical neurons were isolated from embryonic day 17 (E17) Sprague-Dawley rat embryos and plated onto 48 multi-well microelectrode array (MEA) plates, each containing 16 nanotextured microelectrodes. The neurons were grown in Neurobasal medium, which was switched to BrainPhys on Day in Vitro (DIV) 5. On DIV 13, rising concentrations of CPF (0.1 μM, 1 μM, 3 μM, 5 μM, and 10 μM) were added.

Results

CPF exposure caused significant drops in key measures of neuronal activity, including spikes, network burst frequency, burst duration, spikes per burst, inter-spike interval (ISI) within bursts, and overall network synchronicity. These effects appeared even at the lowest CPF concentration (0.1 μM).

Conclusions

Our findings suggest that embryonic cortical neurons are more sensitive to CPF than postnatal neurons, with effects detectable at concentrations as low as 0.1 μM. More research into CPF-induced neurotoxicity, especially during embryonic development, is needed to understand the mechanisms and long-term impacts of these effects.

Mentor(s):
Jason R Cannon (HHS); Reeya Tanwar (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1286
Presentation Time: Session 2: 10:30-11:30am

Thickness Dependence of Single-Photon Emitter Formation in HDPCVD Silicon Nitride Films

STEM

Authors(s):
Ky Nguyen† (Engineering)

Abstract:
Single-photon emitters (SPEs), which release one light particle at a time, are important building blocks for quantum computing and communication. Recently discovered SPEs in amorphous silicon nitride (SiN_x) films deposited by high-density plasma chemical vapor deposition (HDPCVD) offer a promising platform for integrated quantum photonics owing to their compatibility with CMOS fabrication processes. Previous studies have demonstrated room-temperature characteristics and explored integration with photonic platforms. However, the microscopic origins of these emitters remain unresolved, and further work is needed to improve their single-photon purity, brightness, and emission lifetime. Here, we investigate the thickness dependence of SPE formation by fabricating and characterizing SiN_x/SiO_2 stacks with varying SiN_x film thicknesses. Time-correlated single-photon counting (TCSPC) measurement probes emission characteristics, while spectroscopic ellipsometry evaluates film thickness and optical properties. Scanning electron microscopy (SEM), transmission electron microscopy (TEM), and atomic force microscopy (AFM) provide complementary assessments of film structure, thickness, and surface morphology. This study aims to identify the minimum SiN_x thickness required for SPE formation, providing insight into emitter origins and informing the design of integrated quantum photonic devices.

Mentor(s):
Jae Ik Choi (Engineering); Jeffrey Zexi Yang (Engineering); Alexandra Boltasseva (Engineering); Vladimir M Shalaev (Engineering); Alexander V Kildishev (Engineering); Miroslava Marinova Marinova (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1287
Presentation Time: Session 2: 10:30-11:30am

Process Optimization and Statistical Process Control of RC and RLC Circuits

STEM

Authors(s):
Pham Anh Minh Nguyen† (Engineering); Sanjith Jothi Bala† (Science); Ky Nguyen† (Engineering); Paul Aiden Williams† (Engineering); Matthew P Thomas† (Engineering); Zixuan Fei† (Engineering|JMHC)

Abstract:
Thin-film RC and RLC circuits integrate passive components on a common substrate for timing, signal filtering, and radio-frequency applications. This integration can reduce reliance on discrete components and support more compact electronic systems. Realizing these benefits requires precise control of component values through reliable and reproducible fabrication.

Previous work established the design and fabrication of RC circuits incorporating metal-insulator-metal (MIM) capacitors, with a fabrication yield of approximately 70%. However, measured time constants across three designs were 1.42–1.77 times the theoretical predictions. This project investigates the sources of these discrepancies, optimizes the RC fabrication process, and extends the platform to RLC circuits.

Individual resistance and capacitance measurements are combined with time-response characterization to assess each component's contribution to the observed deviation. Device characterization results are compared with design values to examine relationships between fabrication variation and electrical performance. Process optimization and statistical process control are used to identify sources of variation, improve fabrication yield, and increase the repeatability of measured time constants.

RLC development includes independent evaluation of planar spiral inductors before integration with the existing RC platform. Turn count, trace width, and spacing are varied to balance inductance, series resistance, fabrication tolerance, and electrical testability within available instrumentation. The selected geometry is incorporated into a photomask layout compatible with the RC fabrication process. By connecting device design, process control, and electrical characterization, this work aims to improve agreement between predicted and measured circuit behavior and establish reproducible fabrication of thin-film RC and RLC circuits.

Mentor(s):
Zhihong Chen (Engineering); Joerg Appenzeller (Engineering)

Other Acknowledgment(s):
Peter Bermel* (Engineering); Saeed Mohammadi* (Engineering)

Poster Presentation Abstract Number: 1288
Presentation Time: Session 2: 10:30-11:30am

Energy Economies as a Wartime Weapon: Political Limits of Weaponized Asymmetric Interdependence

Social Science

Authors(s):
Zayan Niaz† (Liberal Arts|Science)

Abstract:
Economic interdependence is traditionally viewed as mutually beneficial cooperation and a source of restraint on conflict; however, in wartime, such dependencies can become tools of coercion. This project explores the Russia-EU energy dispute during the 2022-23 phase of the Russo-Ukrainian War to assess the political effectiveness of weaponizing asymmetric interdependence. Russia attempted to leverage Europe's dependence on Russian natural gas through supply constraints. At the same time, the European Union and its allies imposed sanctions, restricted imports, and imposed oil price caps to constrain Russian energy revenues. Building on traditional liberal theories of complex and weaponized interdependence, the study will employ a qualitative case study design with descriptive analyses of Eurostat energy-imports statistics and Center for Research on Energy and Clean Air reports about Russian fossil-fuel exports and revenues. The study distinguishes between the ability to impose economic costs and the ability to secure political concessions from the target. Preliminary evidence indicates that both sides possessed significant short-term economic leverage, which did not consistently translate into political compliance. Coercive use of the energy markets appeared to have accelerated adaptation: Europe diversified away from Russian gas, while Russia redirected a larger share of energy exports toward non-European markets. The dynamics highlighted in this case suggest a central limit to the political effectiveness of weaponizing interdependence: exploiting an asymmetric dependency may generate immediate pressure while simultaneously creating incentives for the target to reduce the vulnerability that made coercion possible in the first place.

Mentor(s):
Chiara Cervini (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1289
Presentation Time: Session 2: 10:30-11:30am

Demographic-based Behavioral Reactions to Indoor Thermal Discomfort

STEM

Authors(s):
Ria Subodh Nimbkar† (Science)

Abstract:
Thermal discomfort is a powerful behavioral stimulus capable of revealing meaningful differences in how individuals respond physically to indoor environments. In particular, machine learning can automatically analyze discomfort related behaviors and quantify these behavioral differences by demographics. Therefore, this study investigates whether a machine learning model can be trained to distinguish between demographics based on human behavioral reactions to thermal discomfort. Starting with raw video data, the behaviors were categorized into overall actions and then broken down into distinct categories. The RGB video data was then converted into skeleton data on which the preliminary clustering analysis will be completed in order to determine if a model is capable of grouping actions together based on movement and then creating predictions from those groupings. These findings can contribute to practical significance for workplace design because by better understanding the thermal discomfort behaviors of occupants of different demographics, organizations can develop more personalized climate control systems that improve comfort, productivity, and safety across diverse work forces.

Mentor(s):
Kwonsik Song (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1290
Presentation Time: Session 2: 10:30-11:30am

Benchmarking Post-Quantum Cryptography, Quantum Key Distribution, and Hybrid Key Establishment

STEM

Authors(s):
Ayomiposi O Olofin† (Polytechnic)

Abstract:
Quantum computing poses a risk to the public-key cryptography that protects today's key exchange and digital signatures (such as RSA and elliptic-curve schemes), so businesses have begun to migrate to quantum-safe alternatives. Post-quantum cryptography (PQC) and quantum key distribution (QKD) have emerged as ways to counter the harm that quantum computing can pose to sensitive data. PQC and QKD offer two different answers to the threat that quantum computers pose to today's key establishment. PQC relies on mathematical problems believed to resist quantum attacks, such as those based on lattices and error-correcting codes, while QKD relies on the laws of physics but requires specialized hardware and an authenticated classical channel. Combining the two into a hybrid scheme has been proposed as defense in depth, but whether the added security is worth the additional cost is rarely quantified.

This project develops a reproducible benchmarking framework that compares PQC-only, QKD-only, and hybrid PQC + QKD key establishment. We evaluate NIST-selected key-encapsulation mechanisms (KEMs), namely the Module-Lattice-Based Key-Encapsulation Mechanism (ML-KEM) and Hamming Quasi-Cyclic (HQC), and simulated BB84 and E91 QKD protocols, with every architecture producing the same session key. We study computational performance, memory and communication overhead, and examine security through the threat scenarios each design survives and its ability to detect eavesdropping.

Results will be analyzed with non-parametric statistics and effect sizes. The study aims to clarify when, or if, a hybrid design is worth its cost compared to QKD-only or PQC-only designs. It also aims to give practitioners measurable guidance for choosing among quantum-safe key-establishment strategies.

Mentor(s):
Jon Walatkiewicz (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1291
Presentation Time: Session 2: 10:30-11:30am

Synthetic Aperture Radar Passives: Implementation of Antennas, Filters, and Couplers for Low Cost RF System

STEM

Authors(s):
Emilio Orcullo† (Engineering); Jake Myles Carmona† (Engineering); Atishay Sati† (Engineering); Andrew Doru Bogdan† (Engineering)

Abstract:
This paper presents the passive RF components of a 5.8 GHz FMCW synthetic aperture radar (SAR) for small UAV platforms. The radar is fully polarimetric: the transmit polarization alternates between horizontal (H) and vertical (V) directions on successive chirps through an SPDT switch. Two receive chains capture H and V simultaneously, giving the HH, HV, VH, and VV channels. Full polarimetry reveals surface type and structure that single-polarization SAR cannot, improving classification for disaster response and agricultural monitoring. The design goals are compact size, low weight, and enough isolation for high-resolution imaging. Four passive components are developed: a fifth-order coupled-resonator bandpass filter, a dual-polarized aperture-coupled patch-excited horn antenna, a directional coupler, and a Wilkinson power divider. The bandpass filter passes the 5.725 to 5.875 GHz ISM band and rejects signals outside it, which keeps the radar within the allocated spectrum and suppresses power amplifier harmonics and out-of-band interference on the transmit path and on each receive chain. The dual-polarized horn serves as both the transmit and receive aperture, with 10 dBi gain. The directional coupler samples the transmit chirp for the LO with low insertion loss. The Wilkinson divider then splits the LO equally between the two receive mixers and keeps the channels balanced. Together these components form a lightweight passive chain that fits within the payload limits of a small drone. Simulated results and integration with the full SAR RF chain is discussed.

Mentor(s):
Nishaant Guptan Veemboor (Engineering); Andrew Owen Fewell (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1292
Presentation Time: Session 2: 10:30-11:30am

Advancing Laser-Induced Graphene Integration into Soft Polymers through Interfacial Engineering and Processing Optimization

STEM

Authors(s):
Elena Paias Ferreira† (Engineering)

Abstract:
The performance of stretchable electronics depends not only on the properties of their conductive materials but also on how well these materials interact with soft substrates. Laser-Induced Graphene (LIG) offers great potential for wearable sensors due to its electromechanical properties and scalable fabrication. However, its fragile structure and weak adhesion to stretchable polymers can cause cracks and changes in electrical conductivity when the materials are stretched. Improving the connection between LIG and soft polymers is therefore essential for developing wearable electronics that remain reliable under mechanical stress.

Building upon previous efforts to optimize the structural integrity and fabrication of LIG, this work focuses on improving its integration into soft polymeric substrates through bioinspired interfacial engineering. A functional coating strategy is employed to enhance interfacial interactions and promote stress transfer between LIG and the surrounding polymer. The influence of coating parameters, including coating thickness and permeation behaviour are examined to determine how substrate properties and processing conditions influence LIG integration. Different integration approaches, including polymer infiltration at partially cured stages, are explored to improve interfacial contact and mechanical stability. To evaluate the broader applicability of this strategy, the approach is investigated across two distinct polymeric systems, allowing comparisons of their integration behaviour and performance.

By improving the integration of LIG with different soft polymers, this work aims to establish a more reliable and adaptable approach for developing stretchable electronics. These improvements could support the development of durable, high-performance wearable sensors for long-term health monitoring.

Mentor(s):
Wenzhuo Wu (Engineering); Pedro Henrique de Souza Barbosa (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1293
Presentation Time: Session 2: 10:30-11:30am

Quantifying the Breakdown of Majorana Zero Modes Under Random Lattice Disorder in 1D Superconducting Nanowires

STEM

Authors(s):
Rahul Ashok Pakkala† (Science)

Abstract:
Topological quantum computing relies on Majorana zero modes (MZMs): quantum states that emerge at the ends of 1D superconducting nanowires. Since these modes exist at exactly zero energy and are separated from other states by a superconducting gap, they are theoretically immune to environmental noise. This topological protection, however, assumes a perfectly clean crystalline lattice and ideal ballistic electron transport. In practical manufacturing, nanowires contain atomic defects that force electrons into a disordered, diffusive transport regime, threatening stability of the quantum state.

This computational physics project investigates failure thresholds of topological protection by simulating the transition from ballistic to diffusive transport in a 1D Kitaev chain. Using Python and NumPy, one can construct a 2N x 2N Bogoliubov-de Gennes (BdG) tight-binding Hamiltonian matrix for a 50-site nanowire. To simulate manufacturing impurities, a randomized on-site potential disorder term is introduced and iteratively scaled across the lattice. Energy eigenvalues are calculated at each disorder increment to map topological phase transition.

By analyzing resulting energy spectra and degradation of the quantized zero-bias conductance peak (employing Landauer-Büttiker formalism), this simulation determines the exact threshold of atomic disorder where the superconducting gap closes and topological protection fails. This research bridges condensed matter physics and applied electrical engineering to provide a predictive, device-level failure analysis for manufacturing next-generation quantum computing hardware.

Keywords: 1D Kitaev chain, Majorana zero modes, Bogoliubov-de Gennes Hamiltonian, topological phase transition, ballistic transport, Landauer-Büttiker formalism, Andreev reflection, on-site potential disorder.

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1294
Presentation Time: Session 2: 10:30-11:30am

Developing a C++ Golden Reference Simulator to Verify a Stack-Based ZPU SoC

STEM

Authors(s):
Atharva Pandey† (Engineering); Sai Sudeep Punukollu† (Engineering); Ivan Kivelevitch† (Engineering); Tommy Cruz Chan† (Engineering)

Abstract:
Testing is essential to any hardware project, since there is no way to know whether a design will work in practice until it has been checked against real use cases. For the ZPU, testing directly on FPGA hardware is slow and offers little visibility into the processor's internal state, which makes errors difficult to trace. A simulator addresses this by moving verification into software, where the design can be run through test cases and each output checked against its expected result. The simulator serves as a golden reference that other teams will use to validate their RTL designs. Through SystemVerilog's Direct Programming Interface (DPI), the simulator can be called directly from the RTL testbench, which allows the hardware and software models to be compared automatically, instruction by instruction.

The motivation of the ZPU team is to create a low power CPU for light administrative tasks. Prior to this, there was no framework to simulate a fully working ZPU in software. By making our own implementation we can cater to the needs of the RTL designs and provide a detailed simulation for them to reference if they need any assistance. Additionally, implementing a simulator builds industry-transferable skills. We will measure success by whether the simulator correctly executes every instruction in the ZPU specification across multiple test programs.

One limitation is that the simulator must be consistent with the RTL of the other teams. Memory and I/O behavior, for example, are not based on ZPU specification but rather on the RTL diagrams. Because these details may change while the RTL is still in development, the simulator must be updated alongside them. As the golden reference, our simulator must be assumed to be correct even if our team misreads the ZPU documentation, so every team that passes based on our simulation runs the risk of making the same mistake.

Next, we will integrate the simulator with the RTL teams' testbenches through DPI, and confirm its accurac

Mentor(s):
Cole Aaron Nelson (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1295
Presentation Time: Session 2: 10:30-11:30am

Thermodynamic and Heat-Mass Transfer Modelling Along with Geometric Analysis for a Single Screw Compressor

STEM

Authors(s):
Mudit Pandey† (Engineering); Ishan Gopu Nair‡ (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Junyan Ren (Engineering); David Warsinger (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1296

Presentation Time: Session 2: 10:30-11:30am

Finding targets for inhibition of endothelial to mesenchymal transition induced by YAP1::TFE3

STEM

Authors(s):
Nicolas David Parra Vargas† (Purdue University)

Abstract:
Epithelioid Hemangioendothelioma (EHE) is a rare vascular sarcoma that arises from fusion proteins like YAP1::TFE3 (YT). Due to their rarity, there is a lack of effective treatments and a poor prognosis. We previously found that YT ptomotes endothelial to mesenchymal transition (EndMT) associated with the loss of normal endothelial characteristics and gain of mesenchymal properties. The overall goal of this project is to characterize the YT dimerization properties, evaluate the therapeutic potential of targeted therapies, and understand the potential role of regulatory miRNAs in YT driven EHE. MS-1 endothelial cells that express YT with a doxycycline inducible system were tested against Selinexor and Gedatolisib, in mono and combinatorial therapy, to see the effects on reversion of the EndMT induced by YT. Our findings demonstrated that Selinexor and Gedatolisib in monotherapy are capable of reducing EndMT, with a slight increase in sensitivity when treated with Selinexor but not Gedatolisib. Then when testing combined therapy, a slight synergy was observed, but not enough to conclude a synergistic effect rather than an additive effect. On other aim of the project, we sought to demonstrate which are the dimerization partners of YT within the TFE3 domains. Co-immunoprecipations indicate that endogenous TFE3 interactors were not observed, suggesting that YT homodimerizes instead of heterodimerize with other transcription factors. This will be validated with HA-tagged TFE3 in subsequent experiments. Finally, with the miRNA dataset of YT expressing cells compared to control, we observed downregulation of miR-335, a key factor of endothelial phenotype. Thus, a cell model of overexpression for miR-335 was created to characterize EndMT changes on YT expressing cells. With this data, this refines the molecular mechanisms of YT driven EHE and highlights the potential importance of YT dimerization disruption that could be important in other TFE3-fused cancers.

Mentor(s):
Jason Hanna (Science)

Other Acknowledgment(s):
Nimod Dilushan Janson* (Science)

Poster Presentation Abstract Number: 1297
Presentation Time: Session 2: 10:30-11:30am

Characterization of Aerosolized PFAS Particle Size Using Cascade Impactors

STEM

Authors(s):
Parth Hetal Patel† (Science)

Abstract:
Per- and Polyfluoroalkyl substances (PFAS) are a class of chemicals known to persist in the human body and environment, raising concerns about potential adverse health effects. Ingestion is considered a primary route of PFAS exposure; however, given the presence of PFAS in dust and indoor air, inhalation of aerosolized PFAS is an under characterized exposure route. The objective of this study is to characterize the aerodynamic particle size distribution of aerosolized PFAS and evaluate its potential relevance to inhalation exposures. PFAS-containing aerosols were generated using a controlled aerosol generation system and characterized using a cascade impactor, which separates particles based on aerodynamic diameter. Collected samples from each impactor stage were analyzed gravimetrically to facilitate calculation of mass median aerodynamic diameter (MMAD) and geometric standard deviation (GSD) of the particle size distribution. Determining the particle size distribution of aerosolized PFAS is critical, as particle size influences deposition location within the respiratory tract and, consequently, potential biological exposure and health outcomes.

Experimental analysis is ongoing. Results will provide important insights into the aerosol characteristics of PFAS and support a better understanding of inhalation exposure pathways, informing future assessments of occupational and environmental health risks associated with airborne PFAS.

Mentor(s):
Amit Gupta (Battelle Memorial Institute)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1298
Presentation Time: Session 2: 10:30-11:30am

Generative AI for Real-Time Adaptive Guidance for Patient Portals

STEM

Authors(s):
Shrung Patel† (Science|JMHC); Vikram Ramchander Kavalipati† (Science)

Abstract:
Our project seeks to improve digital literacy among the elderly with respect to online Patient Portals by creating an AI agent that can navigate a mockup of the medical mobile application MyChart. This conversational agent references a knowledge graph that represents the navigational states of the healthcare app to understand the optimal paths and the relevant pages that the user needs to access so it can improve the user's understanding. The agent is evaluated for accuracy through a benchmark for optimal paths and which was used to compute a score for its helpfulness. Since our goal was for the person to learn to ultimately perform the navigation independently, different states of interference by the agent were considered as there are a variety of skill levels among our audience. After the initial prototype, we iterated on the underlying LLM parameters, usability factors like timing and assessing the user's understanding to improve our agent.

Mentor(s):
Sooyeon Jeong (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1299
Presentation Time: Session 2: 10:30-11:30am

Hotel Booking Cancellation Prediction: A Classification Approach to Enhancing Hotel Operations and Revenue Management

Business Case Study

Authors(s):
Amy Michelle Peckel† (DSB|JMHC); Dexter McCann Kelleher† (DSB); Anisha Nanda† (DSB|JMHC); Haonan Huang† (DSB|JMHC)

Abstract:
Can hotels predict which reservations will be canceled before guests arrive? Cancellations can leave rooms unsold, reducing revenue and disrupting occupancy and staffing. Last-minute cancellations are especially costly because hotels have little time to find replacement guests. This project will estimate cancellation risk to support better hotel decisions.

We will use the Hotel Booking Cancellation Prediction dataset published by Youssef Aboelwafa on Kaggle, containing 36,285 reservations and 17 columns (15 potential predictors, booking ID, cancellation outcome). Preliminary EDA shows that online bookings and reservations made further in advance have higher cancellation rates. These patterns suggest that market segment and lead time, along with booking history and special requests, may help identify high-risk bookings and guide modeling.

We will check for missing values, duplicates, data-type issues, and outliers. Removing identifiers and information unavailable before arrival as well as using a stratified train/test split will prevent leakage. Training-only preprocessing will impute missing values if found, encode categorical variables, and scale numerical variables when appropriate. We will compare a DummyClassifier baseline with Logistic Regression, Decision Tree, and Random Forest models. Logistic Regression provides an interpretable benchmark, while tree models capture nonlinear patterns and interactions. Stratified five-fold cross-validation and GridSearchCV tuning will guide model selection before final testing.

ROC-AUC will be our primary metric because it measures how well the model ranks cancellation risk, helping hotels prioritize high-risk bookings despite class imbalance. Precision and recall will assess false cancellation alerts versus missed cancellations. Predictions could inform

overbooking limits and deposit policies, helping reduce lost revenue and improve room and staffing decisions. The models estimate risk, not why a guest cancels.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1300
Presentation Time: Session 2: 10:30-11:30am

Design and Testing of Flexible Piezoresistive Tactile Arrays for Robotic and Wearable Interfaces

STEM

Authors(s):
John Pelan† (Engineering)

Abstract:
Integrating tactile sensing into robotic hands and grippers requires sensors that accommodate varied geometries while preserving spatial contact information. This work investigates a common piezoresistive sensing architecture implemented in two custom geometries: a hand-shaped array developed for the LEAP Hand and a compact rectangular array intended for robotic grippers and wearable interfaces. Both sensors were designed and fabricated using a pressure-sensitive conductive film (Velostat) sandwiched between two flexible printed circuit boards. Orthogonal row and column electrodes define individual sensing elements, or taxels, whose resistance changes under applied force. Sensor responses are visualized through live heatmaps that display contact location and relative signal intensity. The taxels in both arrays were individually tested to verify their response and correspondence with the heatmap. All tested taxels exhibited a piezoresistive response, and localized probing produced heatmap responses at the corresponding sensing locations. These observations establish functional contact localization in both geometries using the same fabrication approach. The rectangular sensor has also been mounted on a silicone finger form for use in an initial tactile sleeve prototype, with integration onto a LeRobot gripper planned. Force calibration can further relate taxel responses to contact-force magnitude, extending the arrays' utility beyond touch localization. Together, contact location and calibrated force measurements could help robots adjust grasping force and identify shifts in object contact that vision alone may miss. This work demonstrates a practical basis for adapting tactile arrays to different intended interfaces and provides functioning prototypes for investigating how spatial contact data can inform robotic manipulation.

Mentor(s):
Md Rakibul Islam Prince (Engineering); Yu She (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1301
Presentation Time: Session 2: 10:30-11:30am

When Knowledge Fails: Why Understanding a Behavior is Harmful Doesn't Prevent It

Humanities

Authors(s):
Leo-Paul Perrin† (Engineering)

Abstract:
The purpose of this project is to analyze why, despite knowing some behaviors are self-destructive, many individuals fail to follow through in correcting them. In Mikhail Lermontov's novel "Hero of Our Time", the protagonist, Pechorin, suffers from chronic boredom, finding interest in conflict and conquest over more traditional avenues of fulfillment. In several cases, this brings him fear and regret, to the extent it may be inferred he regrets some of his actions. However, despite this and his own, explicit knowledge that this behavior is abnormal and dangerous, he does not give a sustained effort to correct it and instead continues to seek thrills to avoid "boredom". Despite his high degree of intelligence, professional capability, and opportunities to obtain a more fulfilling yet standard life, he prefers to continue to seek conquest than settling down to enjoy what he already has. By analyzing Pechorin's reflections and actions alongside modern research on self-gratification and reward-seeking, this paper will explore why recognizing the harm of a behavior may not be enough to change it. This paper will then consider similar behaviors in contemporary times such as compulsive social media usage and persistent sleep deprivation. Through this comparison, this paper seeks to examine the limits of self-awareness in overcoming persistent and potentially harmful behavioral patterns.

Mentor(s):
Olga Lyanda-Geller (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1302
Presentation Time: Session 2: 10:30-11:30am

A Scale for Food Safety risk derived from Food Safety Labeling Survey

STEM

Authors(s):
Cole Philipczak† (Agriculture|JMHC)

Abstract:
Foodborne illness remains an important public health concern, resulting in significant health and economic burdens on individuals and society. Many food safety risks are influenced by human factors, such as individuals' food safety knowledge, attitudes, risk perceptions, and behaviors. Understanding these factors is important for identifying consumer food safety needs and developing effective strategies that enable consumers to make informed decisions and reduce their food safety risks.

In spring 2025, the Food Safety Human Factors research lab conducted a survey of 1100 participants to understand the influence of prior food safety knowledge and labeling when dining out. As an undergraduate researcher, I have been categorizing the data for reactions to Food Safety labeling warnings on hypothetical restaurant menus. My hope is that this method and approach provides insight to the research question: does awareness of food safety warning labels affect the degree of risk (ex. Raw eggs in a salad dressing & medium rare burger) consumers are willing to take?

In my findings to create a risk scale, I have also noticed that existing research around food safety labeling clarity and consciousness has been geared towards the food-service side of restaurant work and developing countries. This, as well as the other points of data in the survey regarding food safety knowledge and demographics could contribute to the quantification of an individual's degree of risk and labeling's overall effectiveness.

Mentor(s):
Yaohua Feng (Agriculture); Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1303
Presentation Time: Session 2: 10:30-11:30am

Weather Effects on Self-Driving Cars

Humanities

Authors(s):
Thuan Phu† (HHS)

Abstract:
The technology of Self-Driving cars is improving at an incredible rate. More car companies, like Tesla, XPeng, and Waymo, are capitalizing on this technology to implement or improve self-driving features in their products. One of the most important environmental aspects that affects performance of these self-driving cars is the weather. Whether it is rain, snow, hail, or even storms, each type of inclement weather affects performance of self-driving cars differently. In this exploratory project, I examine the reliability of self-driving cars during inclement weather. I conducted a preliminary literature review including popular sources focusing on safety features and peer reviewed articles focusing on the internal components of self-driving cars and how they react to weather conditions. This research will contribute to ongoing and future debates concerning the reliability of self-driving cars, helping inform future and current consumers about the risks and concerns of self-driving vehicles. In addition, this topic will help inform consumers who plans to experience self-driving features from services such as Waymo in the future so that they have more information to consider before experiencing it in order to maximize their safety. This project won't just benefit future consumers of self-driving cars, it will also aid current and future car companies by offering suggestions concerning self-driving features with the goal of reducing risks and maximizing the consumer's safety.

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1304
Presentation Time: Session 2: 10:30-11:30am

Investigating the Role of PP2A-B56α in Epithelial-to-Mesenchymal Transition and Pancreatic Cancer Progression

STEM

Authors(s):
Elisabeth Porter† (HHS)

Abstract:
Pancreatic cancer is the leading cause of cancer-related deaths, with a 5-year survival rate of 13.3%. Over 80% of pancreatic patients present with metastasis upon diagnosis, further lowering the survival rate to 3.2%. The initiating step of metastasis is an epithelial-to-mesenchymal transition (EMT), which is where cells change morphology and epithelial cells lose cell-cell adhesion and start to increase their motility, transforming them into a more migratory and invasive mesenchymal cell. PP2A is a major ser/thr phosphatase in the cell and is a major tumor suppressor that negatively regulates many pathways, including the KRAS and EGFR pathways. Previous work in lung cancer has shown that when there is a decrease of PP2A-B56α, the cancer cells enter EMT and begin the process of metastasis as shown by an increase in Vimentin, a mesenchymal cell-state marker, and a decrease in E-cadherin, an epithelial cell-state marker. Data from our lab suggests that PP2A-B56α plays a role in maintaining an epithelial cell-state within lung cancer, however, it is unknown whether this is the case in pancreatic cancer as well. Assessing the role of PP2A-B56α in regulating cell state in pancreatic cancer is crucial in understanding metastasis in one of the most fatal cancers. Early preliminary data from our lab suggests that when PP2A-B56α is completely removed from pancreatic cancer cells, there is a change in morphology, characteristic of an EMT. In my project, I will be using HPAFII pancreatic cancer cells with CRISPR knockout of B56α to analyze the changes that occur within the cell via qRT-PCR, western blot, and immunofluorescent analysis in addition to phenotypic assays.

Mentor(s):
Sanika Santosh Gulavani (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1305
Presentation Time: Session 2: 10:30-11:30am

Vision and Language Models in Enhancing Aphasia Recovery

STEM

Authors(s):
Naitik Rambhia† (Science|JMHC)

Abstract:
Aphasia is a language disorder that can result from a stroke or other brain damage affecting the regions responsible for language production and comprehension. This research project involves developing a pipeline to supplement the treatment of people with Aphasia (PWA). We use structural priming as a method of treatment for these patients. PWAs are first shown correct sentence structures and then tested using different sentences and images consisting of similar sentence structure as the patients had previously seen. This speech data is then collected and analyzed.

Specifically, we focus on the computational pipeline of assessing aphasia recovery. This involves the use of both Large Language Models (LLMs) and Vision Language Models (VLMs) to generate quantitative surprisal (the negative log-likelihood of a token given context) metrics for the treatment of PWA. We calculated token-level surprisal scores and several other metrics based on PWA discourse, including Delta-UID, Mean-UID, and Regression to the Mean (RTM). We compared results across baseline and post-treatment sessions and evaluated differences between LLMs and VLMs.

Preliminary findings showed higher surprisal scores for PWA compared to HC, consistent with our initial predictions. Moreover, VLMs produced generally lower surprisal scores than LLMs, while mismatched images increased surprisal, further strengthening our hypothesis that visual context meaningfully influences discourse processing.

Overall, these findings demonstrate the potential of LLMs and VLMs to provide quantitative metrics to capture language lost and re-learning in PWA. In the future, these measures could help researchers and clinicians better evaluate treatment outcomes and develop more personalized approaches to aphasia recovery.

Mentor(s):
Yan Cong (Liberal Arts); Ji Yeon Lee (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1306
Presentation Time: Session 2: 10:30-11:30am

Predicting Flight Delays: Improving Airline Scheduling and Passenger Communication Through Data Analytics

Business Case Study

Authors(s):
Mason Patrick Ray† (DSB); Kyle Clayton† (DSB); Bradley Stewart Heim† (DSB|Engineering); William Schnefke† (DSB)

Abstract:
Can pre-departure information predict which U.S. flights will arrive at least 15 minutes late? Early warnings could help airlines allocate staff and gates and inform passengers before disruptions spread. We analyze 3 million flights from the 29-million-record Flight Delay and Cancellation Dataset (2019–2023), sourced from the U.S. Bureau of Transportation Statistics via Kaggle. Of its 32 variables, main pre-departure predictors include carrier, origin/destination airports, scheduled departure time, day, month, distance, and scheduled duration. We will exclude post-departure fields to prevent leakage. Our EDA finds 17.2% of flights arrived at least 15 minutes late; 82.8% did not. Thus, predicting every flight as on time yields 82.8% accuracy but misses all delays. According to our previous EDA, COVID-19 restrictions also sharply reduced flight volume and delay rates versus other years. We will be excluding these observations by removing the 2020 rows to avoid models learning atypical patterns. We will compare a majority-class baseline with logistic regression, random forests, and gradient boosting. Logistic regression provides interpretability, while tree ensembles capture nonlinear patterns and interactions. After preprocessing missing and categorical values, we will hold out 20% for final testing and apply walk-forward cross-validation to the remaining 80%. Primary evaluation will use precision–recall AUC, which is suited to the minority delay class; recall, F1-score, and accuracy will provide additional context. We expect useful risk rankings, not perfect forecasts, because unexpected weather and network disruptions remain uncertain. Results could improve resource allocation, disruption planning, and passenger communication.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1307
Presentation Time: Session 2: 10:30-11:30am

Investigating the Relationship Between Bone Micro-to-Macro Dimensional Ratios and Bending Strength

STEM

Authors(s):
Kaley Roe† (Engineering)

Abstract:
Engineering and biology often use scaling laws to describe the relationships between structural and mechanical properties of biological materials. These relationships provide insight into how biological structures look across different length scales and how their organization influences mechanical performance. This project focuses on the relationship between bone dimensional scaling and bending strength. Bones have macroscale properties, such as length and diameter, as well as microscale properties. At the microscale, bones consist of building blocks called osteons, which are tubular structures that contribute to the organization of the cortical bone. Previous studies have investigated the relationships between bone micro and macro dimensions and bending strength independently. However, the relationship between the relative proportions of the dimensions and bending strength remains unknown. We are looking determine whether ratios between micro and macro dimensions are related to the differences in bone bending strength across species. Data on bone dimensions and mechanical strength were gathered from established literature and compiled into an Excel sheet for analysis into whether relative structural dimensions are related to bending strength. By plotting micro-to-macro dimensional ratios against bending strength, we aim to find potential relationships between bone structural organization and mechanical performance. Understanding this may provide a look into how bone structure across multiple length scales contributes to its ability to resist bending and failure.

Mentor(s):
Thomas H Siegmund (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1308
Presentation Time: Session 2: 10:30-11:30am

The Psychology of Safety: Athletes Selection of Football Helmets

Social Science

Authors(s):
Alexander Ruch† (Polytechnic)

Abstract:
If football players have the option for statistically safer helmets, then why do they not choose to wear them? This research study seeks to identify and better understand the psychological factors that influence an athlete's decision to choose one football helmet over another.

As awareness of concussions and chronic traumatic encephalopathy (CTE) has increased, football helmet manufacturers and players' associations have placed greater emphasis on improving head protection. Modern players have access to advanced helmet designs as well as over-the-helmet protection, i.e., Guardian Caps. The National Football League Players Association (NFLPA) publishes annual helmet performance rankings that identify recommended and banned helmet models. Despite these developments, athletes do not always choose the highest safety performing equipment.

Helmet selection therefore cannot be solely about safety performance. Factors as comfort, appearance, familiarity, perceived safety, peer influence, and personal preference may affect the athlete's decision. This study will examine these factors to better understand how players evaluate protective equipment and why an athlete may choose one helmet over a statistically safer helmet.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1309
Presentation Time: Session 2: 10:30-11:30am

Granzyme A regulation of male reproductive function

STEM

Authors(s):
Rebecca Rust† (Science|JMHC); Jade Augusta Cathcart‡ (Science|JMHC)

Abstract:
The reproductive tract requires regulated immune responses to maintain homeostasis and fertility. Our lab previously described a role for the immune-derived serine protease Granzyme A (GzmA) in promoting female reproductive function and fertility. Conversely, GzmA may also contribute to male reproductive tract function and fertility. Therefore, my study aims to define GzmA's role in regulating gonad development and sex hormone production in male mice. In our initial work, we observed decreased expression of the steroidogenic enzyme Cyp19a1 in male GzmA-deficient testes and early indications of altered testicular and epididymal development. However, local and systemic testosterone levels were similar between GzmA-deficient and WT mice. In future work, we will further evaluate sex hormones by ELISA and steroidogenic enzyme expression (i.e., Cyp11a1 and Cyp17a1) by qPCR. We will measure sperm counts and activity to assess reproductive function. Together, these experiments will determine whether GzmA deficiency alters male endocrine pathways or reproductive function. This work will provide insight into immune-endocrine crosstalk in the reproductive tract and the broader non-cytotoxic functions of immune proteases in reproductive health.

Mentor(s):
Matthew Olson (Science); Jenny Alejandra Rodriguez Osorio (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1310
Presentation Time: Session 2: 10:30-11:30am

Predicting E-Commerce Purchase Conversion: A Machine Learning Approach to Session Behavior Analysis

Business Case Study

Authors(s):
Samuel Ruzas† (DSB); Hector J Silen† (DSB); Han Huang† (DSB); Yoav Naturman† (DSB)

Abstract:
Could the behavior of visitors, their time on session, and characteristics be used to predict if the

online shopping session would result in a purchase? In this research, the goal is to predict

purchase conversion probabilities to filter out high-intent visitors. Since the nature of ecommerce businesses lies in having a lot of traffic with a low conversion rate, reliable

predictions are important to focus on marketing efforts correctly.

Based on an authentic dataset of 12,330 commercial browsing sessions with 15.5% purchases

made, we are designing behavioral features to quantify the strength of session and designing a

safe leakage classification pipeline. With the help of a stratified holdout split and 5-fold cross

validation, we will test baseline, Logistic Regression, Decision Tree, and Random Forest

approaches. Target leakage is mitigated with the help of two tracks of features which include the

very predictive PageValues metric. Due to a great imbalance in class distribution, we will be

testing models with PR-AUC and F1 scores and not accuracy.

The preliminary analysis indicates that there are substantial differences in conversions between

different types of visitors, especially that new visitors have a conversion rate of 24.9%. We

expect that our final ensemble models would be able to successfully predict the purchase intent,

although its effectiveness will be compromised when focusing on delayed session features such

as PageValues.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1311
Presentation Time: Session 2: 10:30-11:30am

Proliferation Risk of 239Pu in PWR Spent Fuel

STEM

Authors(s):
Madeleine Rygh† (United States Military Academy)

Abstract:
With advances in isotope separation technologies, this project reassesses the magnitude of nuclear proliferation risk associated with a generic Pressurized Water Reactor (PWR). Using modeling techniques, it estimates the 239Pu content of spent fuel from a PWR operating under a standard power cycle and compares the results to the International Atomic Energy Agency's (IAEA) definition of a significant quantity. This study demonstrates how simplified modeling can be used to evaluate real-world nuclear proliferation questions. By connecting reactor operations to internationally recognized thresholds, the work highlights how basic analytical tools can inform discussions on strategic risk.

Mentor(s):
Andrew Banko (United States Military Academy West Point)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1312
Presentation Time: Session 2: 10:30-11:30am

Machine Learning Risk Scoring of Extended Berkeley Packet Filter Bytecode

STEM

Authors(s):
Leonardo Sabetta† (United States Military Academy)

Abstract:
The Extended Berkeley Packet Filter (eBPF) is a technology that allows for the speedup of various (generally kernel level) operations like networking and security monitoring by letting verified programs run inside the Linux kernel. However, the eBPF verifier checks that a program will not crash the kernel rather than whether it is malicious. Adversaries thus increasingly seek to abuse eBPF as a method of gaining stealthy persistence, installing rootkits, and exfiltrating data. Runtime tools such as Tracee match kernel events against fixed signatures instead of scoring a program's bytecode, and other similar projects require the program to be loaded first. This project seeks to fill that gap by producing an open-source tool that scores the risk of eBPF programs without loading or executing them. A Python ELF/BTF reader and disassembler parses compiled object files, and a bpftool adapter reads programs already loaded on a live host. After extracting 70 features from the bytecode, eBPF programs are classified by the tool (a combination of a gradient-boosted tree and a set of rules as low, medium, or high risk). The tool is currently in development, with initial results via leave-one-family-out cross-validation achieving a 2.4% false-positive rate and 70.0% recall (across 1,377 programs compiled from 26 public projects). When including our synthetic adversarial programs (397 more), we achieved a 5.0% false-positive rate and 81.8% recall. The tool catches most unseen threats, before loading them. We are evaluating the performance of frontier LLMs compared to this tool, and are focused on collecting more eBPF programs for training and validation.

Mentor(s):
Andrew Banko (United States Military Academy West Point)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1313
Presentation Time: Session 2: 10:30-11:30am

Biofilm Formation in Low-Moisture Food Facilities

STEM

Authors(s):
Leslie Santos† (Agriculture)

Abstract:
Low-moisture foods (LMFs) are characterized by having a water activity (Aw) below 0.85 at 25°C and are generally perceived as low-risk to consumers. However, outbreaks linked to spices, peanut butter, flours, and cereals demonstrate otherwise. Because LMF facilities must maintain low moisture levels, alcohol-based sanitizers are used in place of traditional water-based methods. Cronobacter sakazakii and Salmonella enterica are biofilm-forming pathogens of increasing concern in LMFs, as reduced Aw can increase their heat resistance, allowing survival of high-temperature thermal treatments, and their tolerance to sanitizers. Pseudomonas aeruginosa, is among the most resistant biofilm formers because of its strong extracellular polymeric substance (EPS) matrix, which protects against sanitizers and, in mixed species biofilms, can increase resistance and virulence, making it a useful benchmark. This research compares how EPS composition, desiccation tolerance, and stress response mechanisms differ across the three organisms, and which may best explain survival after exposure to alcohol-based sanitizers. Using data from published experiments, I will examine relationships between these adaptations and possible prevention and sanitation strategies.

Keywords: Biofilm; Sanitation; Low moisture; Pseudomonas aeruginosa; Cronobacter sakazakii; Salmonella enterica

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):
Daniel Alfonso Fajardo Reyes* (Agriculture)

Poster Presentation Abstract Number: 1314
Presentation Time: Session 2: 10:30-11:30am

Predicting Hotel Booking Cancellations: A Data-Driven Approach to Overbooking Strategy

Business Case Study

Authors(s):
Gia Sareen† (DSB|Science); Simona Ann Fuller† (DSB); Kaawon Kim† (DSB); Shamitha Chadaga† (DSB)

Abstract:
Can hotel booking cancellations be accurately predicted using information available before a guest's arrival, such as lead time, length of stay, number of guests, deposit type, market segment, and previous booking behavior?

We aim to predict whether a hotel booking will be canceled using only the information a hotel has when a reservation is made. Cancellations are costly. About 37% of bookings in our dataset were canceled, leaving the hotels with over 154,000 unsold nights worth roughly $16.7 million to fill. If a hotel knows which bookings are likely to cancel, it can make better decisions on overbooking and pricing.

We started with 119,390 bookings from two hotels in Portugal. We removed columns that are filled in only after a guest arrives, and added features like total nights and prior cancellation rate. In Python, we will fit a LASSO logistic regression, train it on 2015-2016 bookings, test it on 2017, and evaluate it mainly by F1 score.

Our exploratory findings show that cancellations rise from 10% for bookings made within a week of arrival to 68% for those made over a year ahead. In addition, as the number of special requests increases the cancellation rate decreases. This tells us that when and how a booking was made matters more than who the guest is.

Predicting cancellations can help hotels make more informed revenue decisions. By identifying bookings with a higher likelihood of cancellation, hotels can better anticipate occupancy, manage room availability, and reduce potential revenue losses. Although our data represents two Portuguese hotels from 2015-2017, this project demonstrates how predictive analytics can turn historical booking data into insights that support future business decisions.

Mentor(s):
Adrian Hoffert Wolanski (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1315
Presentation Time: Session 2: 10:30-11:30am

ARL Explores Mobilized Hybridized Power Resources

STEM

Authors(s):
Jacob Sears† (United States Military Academy)

Abstract:
Future battlefields are projected to host many autonomous systems, such as unmanned ground vehicles and aerial systems; however, the current limitation of these systems is their finite power supply, which requires complex, undesirable logistical networks for system refueling. The Atmospheric Intelligence for Hybridized Power Advancement [AIHPA] project through the Power and Energy Division of Army Research Laboratory seeks to assess mobilized capabilities of the AIHPA Testbed. The “Mobile AIHPA Testbed Transport” (MATT) is a recent design whose goal is to autonomously deploy hybridized, alternative-energy power to areas needing electrical power. In this phase of engineering design, the mobilized AIHPA Testbed design holds potential for animating its own mobility, as well as a multi-class laser module set. In this presentation, we capture the key features of the design, and highlight lessons learned while evaluating MATT’s capability in self-movement and mission support.

Mentor(s):
Andrew Banko (United States Military Academy West Point)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1316
Presentation Time: Session 2: 10:30-11:30am

Investigating Dopant Effects on Layered Metal Oxide Cathodes for Sodium-Ion Batteries

STEM

Authors(s):
Sachiv Sekaran† (Engineering)

Abstract:
This research investigates how dopants influence the electrochemical performance of nickel-based layered metal oxide cathodes for sodium-ion batteries. Nickel provides the primary redox capacity, while aluminum and an additional metal dopant are incorporated to stabilize the cathode material and suppress unwanted phase transitions. The goal is to evaluate doped cathode compositions and determine their potential to improve battery performance and manufacturability. Initial work focused on tungsten-doped samples, which showed poor performance during charge–discharge cycling. Scanning electron microscopy (SEM) revealed grain sizes of approximately 40 micrometers, compared with the target size of 4 micrometers. These large grains may limit electrolyte contact and contribute to poor electrochemical performance. Ball milling was attempted to reduce the powder size, but the tested conditions did not achieve the desired reduction. Current work focuses on improving sample preparation to address this problem and enable electrochemical testing and analysis of cathodes containing other dopants, including molybdenum, cobalt, and vanadium.

Mentor(s):
Likun Zhu (PWL); Mohammad Behzadnia (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1317
Presentation Time: Session 2: 10:30-11:30am

Design and Implementation of an High-Speed Connector Daughtercard for FPGA-Based Post-Silicon Validation of the AFTx08

STEM

Authors(s):
Priyan Kamlesh Shah† (Engineering); Nirrbhay Raghavan† (Engineering); Nadine Yifei Poon† (Engineering); Bharrath Krishna Arunkumar† (Engineering)

Abstract:
Post-silicon validation of custom System-on-Chip (SoC) devices requires flexible hardware platforms for testing, debugging, and emulation across different configurations. Basic bring-up boards verify device functionality and communication but lack automated stress testing, peripheral emulation, and configurable interfaces, increasing reliance on manual testing and making repeatable validation more difficult.

This project investigates the design and prototyping of a daughtercard connecting an AFTx08-based device to the DE2-115 FPGA through its onboard HSMC interface. The daughtercard will provide physical connectivity, power distribution, and signal routing. FPGA-controlled logic will support configurable I/O, device monitoring, test generation, debugging, and external interface emulation. Optional peripherals, including EEPROM, ADC/DAC, and external memory, may expand testing and development capabilities.

Key challenges include maintaining signal integrity and timing while meeting the electrical, voltage, and interface requirements of both devices. Separate considerations include trace routing, impedance, noise, power distribution, component availability, manufacturability, and circuit protection. while also including component selection, schematic development, PCB layout, electrical rule checking (ERC), design rule checking (DRC), and iterative refinement to meet hardware constraints.

The resulting daughtercard will provide a modular platform for integrating the x08 into an FPGA-based test environment. By enabling repeatable testing, external interface emulation, device monitoring, and flexible configurations, the project will establish a foundation for post-silicon validation, digital design testing, hands-on education, and future AFT-based development.

Mentor(s):
Moe Wai Yan Myint (Engineering); Boyuan Chen (Engineering); Mark Johnson (Engineering); Matthew A Swabey (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1318
Presentation Time: Session 2: 10:30-11:30am

How Computer Science Students Evaluate Code Security

STEM

Authors(s):
Ruthu Shankar† (Science); Savir Rajeshwar Patil† (Science)

Abstract:
Prior work has demonstrated that computer science students and developers alike often overlook security issues when writing and reviewing code. There is a need for better tools to help developers catch security bugs and for better instructional strategies to help students learn to evaluate code security. In this study, we recruit about 30 computer science majors who have passed CS 180 to participate in an online interview study. Participants will be asked to share their screens and explain their thought processes aloud as they evaluate the security of a Java code snippet while consulting any external resources they wish. Through our analysis of the interview recordings, we aim to understand what resources students use to evaluate the security of a code snippet and how they determine the reliability of security-related information sources. In the future, we aim to interview software developers and compare their approaches to security evaluation with those of undergraduate computer science students.

Mentor(s):
Mary Anne Smart (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1319
Presentation Time: Session 2: 10:30-11:30am

Investigating Physiological and Environmental Indicators of Fatigue in Student Pilots During Flight Training

STEM

Authors(s):
Ria R Sharma† (HHS|JMHC)

Abstract:

Purpose

Student pilots face real physical and mental demands during flight training, but how fatigue builds throughout a training flight isn't well understood. This study takes a closer look at how cabin heat exposure, heart rate, and self-reported fatigue interact in student pilots flying small training aircraft.

Methods

Student pilots wore a Polar chest strap to track heart rate, with 10-minute windows recorded before, during, and after each flight. Cabin temperature, including dry bulb, wet bulb, globe temperature, and WBGT, was captured during the same time windows. Before and after each flight, pilots completed assessments covering self-reported fatigue, overall well-being, and grip strength as a hands-on measure of physical fatigue.

Results

Data collection and analysis are still undergoing. We are currently examining correlations between heat exposure, heart rate trends, and fatigue measures across pre-flight, in-flight, and post-flight phases to look for consistent patterns.

Implications

This work could help shape safer training guidelines and protocols for student pilots, especially around heat exposure and its role in fatigue, and lay the groundwork for future research during warmer, higher-risk conditions.

Additional Materials

Flight track data was verified through FlightAware ADS-B across two study flights out of Purdue University Airport (KLAF)

Mentor(s):
Mark Wilson (HHS); Julius Keller (Polytechnic); Debra Henneberry (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1320
Presentation Time: Session 2: 10:30-11:30am

Wrinkling Analysis of Webs for Roller-to-Roller Manufacturing

STEM

Authors(s):
Phillip Thomas Michael Sheets† (Engineering); Joseph Ryne Thomas† (Engineering)

Abstract:
The first objective of our experiement was to measure the natural frequency of a tensioned PET web supported by rollers to validate the string model. The string model predicts that the natural frequency equals the mode number divided by twice the span between rollers, times the square root of the tension force divided by the mass per unit length. For light damping, the frequency that produces the maximum displacement was approximated as the natural frequency.

We used a 3 kg steel rod to apply a fixed tension to the web. A Tektronix function generator and Schiit amplifier drove the speakers. A PicoScope 4224 DAQ recorded the excitation generated and out-of-plane displacement from a laser triangulation sensor.

Baseline testing used a 1-500 Hz chirp signal over ten minutes under isothermal conditions. Sensor voltages were converted to displacement using a calibration factor of 2.54 μm/mV. We utilized Fourier analysis to determine the frequency response and resonance peaks.

The second objective was to apply a thermal load to the web to observe how the additional loading affects its dynamic stability, and to validate the pinned-to-pinned 1D beam model under thermal loading. The model relates critical temperature change to tension, Young's modulus, web dimensions, expansion coefficient, and span, assuming restrained axial expansion, where heating reduces tension and eventually produces net compression.

Two radiant heat lamps provided increasing thermal loads by varying their distance from the surface. At each load, the steady state temperature was measured using a thermocouple, and the sweep and analysis were repeated.

Although this study used a stationary web, its results can be applied to moving webs when transport speeds are much lower than the critical speed. Predicting wrinkling helps prevent permanent deformation,

creases, fold-overs, and bursts that reduce productivity and product quality in roll-to-roll manufacturing such as batteries and flexible electronics.

Mentor(s):
Ryan B Wagner (Engineering); Manas Laddha (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1321
Presentation Time: Session 2: 10:30-11:30am

Agentic Onboarding Tools for Empirical Evaluation of Machine Learning Defenses

STEM

Authors(s):
Yuchao Shen† (Engineering); Andrew Zeng† (Science); Benjamin Joseph Taylor† (Engineering|JMHC); Bhanu Adaveni‡ (Engineering); Rudra Vaishnav‡ (Engineering); Aarush Kumar‡ (DSB)

Abstract:
Real-world machine learning systems may need to satisfy multiple requirements, including privacy, robustness, and fairness. However, defenses designed for individual guarantees can interact in ways that change their combined effects. Our broader project, Landseer, aims to provide an empirical framework for evaluating how machine learning defenses interact across privacy, robustness, and fairness. We aim to automate the paper-analysis portion of this process through an agentic workflow. Our team is developing three tools: an extractor that identifies evaluation metrics in research papers, an initializer that structures reported values into records, and an insertion tool that validates metric names and numerical values while supporting JSON record storage. When multiple values are reported for a metric, the initializer can target a selected table row, while complete dataset, model, and row provenance remains future work. In a local demonstration using the Fair Fairness Benchmark, the extractor identified five evaluation metric names, demonstrating preliminary metric-extraction functionality. These structured records are intended to provide reference values for comparison with reproduced experimental results. Future work will integrate these tools into Landseer and evaluate them as part of an end-to-end defense reproduction and validation workflow.

Mentor(s):
Zahra Ghodsi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1322
Presentation Time: Session 2: 10:30-11:30am

Who Is Watching the Watchers? Rethinking Human Oversight Requirements for AI Agents

Social Science

Authors(s):
Meng Shi† (Liberal Arts)

Abstract:
AI governance frameworks such as the EU AI Act and the NIST AI Risk Management Framework increasingly require "human oversight" of AI systems. These requirements often assume that human overseers make stable and reliable judgments. However, research in psychology and human-computer interaction suggests otherwise: people tend to over-rely on automated systems, and their preferences about what AI should or should not do are often unstable and constructed on the spot. The problem is compounded on the agent side. AI agents may act on beliefs that are outdated or wrong, such as an expired user preference or an unverified fact, and a human approving the action often cannot see what belief it rests on. As agents begin to take actions on users' behalf, these weaknesses may turn oversight into a formality rather than a real safeguard.

This work-in-progress project combines a literature review of 20–30 papers on meaningful human control, automation bias, trust in automation, and preference construction with an analysis of how major governance documents define human oversight. It aims to identify gaps between what oversight policies assume and what research shows about human judgment and agent reasoning. Drawing on HCI research, the project then proposes design principles for making oversight more meaningful, such as requiring agents to show the evidence behind a high-stakes action and flag when it may be outdated, and asking people to explain why they approve an AI decision.

Mentor(s):
Daniel Stuart Schiff (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1323
Presentation Time: Session 2: 10:30-11:30am

Rediscovering the Higgs Boson - Cut and Count Method

STEM

Authors(s):
Alayna Siemon† (Engineering|JMHC); Choeun Moon† (Polytechnic)

Abstract:
This study investigates the effectiveness of the traditional cut-and-count method in distinguishing the Higgs Boson signal from the ZZ background, with the purpose being to demonstrate a comprehension of particle data analysis through statistical manipulation of big data and to obtain a foundational understanding in the discovery of particles. The study focuses on three research questions: whether the traditional cut-and-count method can be used to separate the Higgs boson signal from the ZZ background, whether muon-quality cuts or mass-based cuts are more effective in improving the signal-to-background ratio, and how much signal is kept after applying the cuts. The Higgs Boson signal was hypothesized to appear around 125 GeV in the four-muon invariant mass distribution after normalization. In comparison, the ZZ background would be over a wider mass range. It was predicted that mass-based cuts will be more useful than muon-quality cuts for separating signal and background. Five Monte Carlo datasets from CERN Open Data, including one background sample and four signal samples, normalized to expected event yields, are used. These datasets represent proton-proton collisions at 13 TeV under 2016 CMS detector conditions. Using Python, Uproot, and Awkward Arrays, the analysis consists of looking at how the signal-to-background ratio changes after each cut, separating the signal from the background and determining which parts of the method could be improved with further cuts. This research data mainly focuses on the Higgs Boson signal and ZZ background; therefore, it cannot fully evaluate how well muon-quality cuts remove events with misidentified muons.

Mentor(s):
Andy Jung (Science); Angelo Arisi (Science); Juan Duarte Quiros (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1324
Presentation Time: Session 2: 10:30-11:30am

Testing a Robot Learning Pipeline in a Simulation

STEM

Authors(s):
Edward Simpson† (Science)

Abstract:
[Abstract Redacted]

Mentor(s):
Jaeeun Kim (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1325
Presentation Time: Session 2: 10:30-11:30am

Credibility-Weighted Twitter Sentiment as a Predictor of Short-Term Bitcoin Price Movement

STEM

Authors(s):
Aayush Singh† (Engineering); Rohan Ravula† (Engineering); Jovan Miodrag Jovic† (DSB)

Abstract:
Social media sentiment is one factor that is consistently used to forecast the price movement of cryptocurrencies like Bitcoin. Most models that predict Bitcoin price using social media data often weigh tweet sentiments equally, even though a large portion of modern Tweets are made from bot accounts and account reach varies wildly from user to user. Prior work has established that sentiment correlates with price, but evidence of sentiment being a good predictor of price is mixed. We hypothesize that weighing social media sentiment by account reach and credibility is a better predictor of short-term price movement in Bitcoin than price alone and unweighted sentiment. Our dataset includes 4.6 million tweets made between February 2021 and January 2023 and Bitcoin price data from the relevant period. After cleaning the 3.22% tweets identified as having come from bot accounts, and a total dataset of 4,536,714 tweets remained. We built a credibility scoring methodology that uses followers, verified status, follower/friend ratio, account age, and profile description to give a normalized score to users, which is then used to weigh their tweets. This approach helps account for differences in how much influence individual users may have on overall market sentiment. By giving more weight to established and credible accounts, we aim to reduce the impact of potentially misleading or unreliable tweets and create a more accurate representation of overall Bitcoin sentiment. Tweets were then scored for sentiment by FinBERT and aggregated hourly as a credibility-weighted mean. Then, we tested three different prediction models: price alone, price plus hourly tweet sentiments, and price plus credibility-weighted tweet sentiments to determine if user credibility valuably impacts Bitcoin price prediction. Through this research, we hope to better understand the relationship between social media credibility and short-term cryptocurrency price movements.

Mentor(s):
Soudabeh Taghian Dinani (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1326
Presentation Time: Session 2: 10:30-11:30am

R.I.V.A.L. (Reactive Intelligent Vehicle Adversarial Learning)

STEM

Authors(s):
Saahil Suresh† (Engineering); Vedant Sandeep Mohan† (Engineering); Joshitha Neeli† (Engineering); Benjamin Mercer Frischer† (Engineering); Rishivardhan Devakumari Ragavanantham† (Science)

Abstract:
[Abstract Redacted]

Mentor(s):
Andres Felipe Hoyos Moreno (Engineering); Reed Joseph Freer (Engineering); Richard Ajagu (Engineering); Samuel Labi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1327
Presentation Time: Session 2: 10:30-11:30am

Quantum Memory in the BB84 Quantum Key Distribution Protocol

STEM

Authors(s):
Esha Sury† (Science); William Huang† (Engineering|Science); Dhruv Upreti† (Science)

Abstract:
Quantum key distribution (QKD) is a secure communication method that implements a cryptographic protocol based on the laws of quantum mechanics; contrary to classical communication, QKD relies on quantum mechanics rather than the unproven mathematical difficulty of complex algorithms that standard classical cryptographic protocols rely on. In the standard BB84 QKD protocol, Alice sends quantum states from randomly chosen incompatible bases, and Bob later measures them. The no cloning theorem prevents an eavesdropper (Eve) from measuring incoming photons as her measurement will change the quantum state introducing errors detectable by Bob when Alice publicly reveals her measurement basis. A more powerful attack is when Eve could store Alice's quantum information in a quantum memory device and wait for Alice to reveal her computational basis. In practice, quantum memories are subject to decoherence, limiting the amount of information that can be retained.

This project investigates the role of an imperfect eavesdropper's quantum memory in the BB84 protocol by modeling their stored quantum information as an open quantum system. The strength and duration of the storage noise are varied to model quantum memories with different coherence properties. By comparing strategies in which an eavesdropper must perform an immediate measurement with strategies in which quantum information is stored and measured only after relevant classical information becomes available. The performance of these different methods are examined by looking at the quantum bit error rate observed by Alice and Bob, the amount of information available to the eavesdropper, and the corresponding effect on the achievable secret-key rate. This allows for a systemic analysis of when delayed quantum measurement provides an appreciable advantage and when decoherence eliminates that advantage.

Mentor(s):
Erika Birgit Kaufmann (Science); Ralph Martin Kaufmann (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1328
Presentation Time: Session 2: 10:30-11:30am

Machine Learning Prediction of TP53 Mutation Status from Breast Cancer Gene Expression Data Set

STEM

Authors(s):
Eduardo Esteban Tello Osorio† (Polytechnic)

Abstract:
Tumor protein 53 (TP53) is mutated in about 30% of breast tumors and is linked to prognosis and treatment resistance. Because p53 is a transcription factor that regulates many genes, TP53 status can be predicted from gene expression, using Machine Learning (ML). Earlier studies usually trained a single ML algorithm and reported one final model. It is of practical interest to study a number of models and compare their results. We used 2 public breast cancer cohorts, CPTAC GDC 2025 (105 patients, 41 TP53 mutated) and SMC 2018 (167 patients, 81 TP53 mutated). We analyzed each cohort separately and kept 20% of patients for testing. We trained 7 ML algorithms with 3 hyperparameter settings each (21 configurations). In each training fold, we selected 100 genes with Welch's t-test. We compared the configurations with 5-fold cross-validation repeated 10 times, using the receiver operating characteristic area under the curve (ROC-AUC). To avoid any optimistic bias, we also used nested cross-validation, which chose and tested configurations on different patients. In repeated cross-validation, logistic regression had the highest mean ROC-AUC in CPTAC (0.874) and XGBoost in SMC 2018 (0.832). Nested cross-validation gave 0.852 (95% CI, 0.807-0.897) and 0.827 (0.786-0.869), respectively. These values were 0.022 and 0.005 lower, and neither difference was statistically significant (using student-t). The 4 algorithms with the highest mean ROC-AUC differed by 0.015 or less. We tested each final model once on the test patients. The ROC-AUC was 0.837 in CPTAC and 0.875 in SMC 2018. Gene expression predicted TP53 status in both cohorts, with little bias from model selection. Several ML models performed similarly, so, simple and interpretable ones can be used. TP53 status could therefore be estimated when mutation data are not available.

Mentor(s):
Rajeswari Sundararajan (Polytechnic)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1329
Presentation Time: Session 2: 10:30-11:30am

3D Pore Network Characterization of Chicxulub Impactites Using Micro-CT and SAM 2

STEM

Authors(s):
Devikaa Prashant Thakker† (Science)

Abstract:
The Chicxulub impact crater provides fundamental insight into peak-ring formation and the evolution of post-impact hydrothermal systems. Following cratering, sustained fluid circulation through fracture and pore networks may have established viable thermal niches for microbial colonization. However, resolving the 3D geometry of micro-scale pore networks in dense, heterogeneous impactites remains challenging. This project aims to develop a pipeline to reconstruct and quantify the internal pore architecture of an impactite core plug from the Chicxulub peak ring.

High-flux synchrotron X-ray micro-tomography data was acquired at 5.74 µm isotropic voxel resolution. Projections across four vertical scan segments were reconstructed via an Inverse Radon Transform pipeline. Data preprocessing included sub-pixel center-of-rotation tuning to eliminate double-edge blur, vertical segment reorientation, and median filtering to suppress detector noise while preserving sharp boundaries. Contrast-limited adaptive histogram equalization (CLAHE) was applied to differentiate low-attenuation void spaces from adjacent melt phases.

To overcome grayscale overlap between the melt matrix and fine pores across scan segments, representative subvolumes are currently being isolated in Dragonfly and segmented using Segment Anything Model 2 (SAM 2) in video-predictor mode across continuous slice sequences. Segmented voxel volumes are imported into ParaView to extract 3D pore meshes and dynamically evaluate spatial network connectivity. In parallel, quantitative pore metrics, including effective porosity, pore size distributions, and throat tortuosity, are being extracted using PoreSpy and OpenPNM to generate representative pore network models. These extracted networks are actively establishing the computational framework for fluid permeability simulations, providing direct insight into subsurface fluid migration and the viability of post-impact hydrothermal ecosystems.

Mentor(s):
Douglas R Schmitt (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1330
Presentation Time: Session 2: 10:30-11:30am

Value-Based Marketing Strategy for The Diner Restobar in Bengaluru, India

Business Case Study

Authors(s):
Niteesh S Thupili† (DSB); Gautham Santhanam† (DSB|JMHC); Daniel Zhi-Hao Cavigioli† (DSB); Abhinav Bondlela† (DSB); Eshan Farooque† (DSB)

Abstract:
The Diner Restobar, located near International Tech Park Bangalore (ITPL) in Whitefield, Bengaluru, has introduced smaller food portions and lower menu prices to encourage more frequent customer visits. This project examines how Diner can communicate its new pricing strategy and attract nearby IT employees and younger consumers. We plan to review the restaurant's current marketing, analyze nearby competitors, and survey potential customers to understand their preferences, spending habits, and factors influencing their choice of restaurants and bars. Using these findings and marketing concepts from our coursework, we will evaluate strategies based on customer appeal, cost, and ease of implementation. Anticipated results include identifying Diner's most promising customer segments, developing a clearer market position, and proposing and running affordable marketing campaigns through social media, local advertising, and promotional materials. We also plan to recommend ways to measure campaign effectiveness, including customer visits and engagement. As the research is still in progress, these recommendations have not yet been tested. The project aims to provide Diner with practical, research-based strategies for attracting customers and encouraging repeat visits.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1331
Presentation Time: Session 2: 10:30-11:30am

Exogenous Arbuscular Mycorrhizal Fungi (AMF) and Biochar association in the influence on the native soil AMF

STEM

Authors(s):
Sofia Valentina Torres Orjuela† (Agriculture)

Abstract:
Urban Agriculture has grown in recent years to supply nutritious food close to consumers, with fewer intermediaries and less chemical use. Urban soils are often degraded by industrial and human activities, showing poor structure, nutrient deficiencies, and the presence of heavy metal contamination.

Farmers can use beneficial microorganisms to help address these challenges. A group of beneficial microorganisms that are naturally present in healthy soils and commonly applied as an inoculant in degraded soils is Arbuscular Mycorrhizal Fungi (AMF). They form a symbiotic relationship with many plants, improving soil structure, nutrient and water uptake, helping plants tolerate stress, and reducing heavy metal uptake. However, inoculants may not always survive due to poor environmental conditions or competition with native species. Biochar is a charcoal-like soil amendment that may can help overcome this challenge by improving soil properties, providing a habitat to help support native AMF and inoculants.

The objective of this study was to determine how a local biochar amendment and an inoculant, containing multiple AMF species, interact with local soil, management, and environmental conditions to alter AMF communities in carrot plant roots. The study was conducted on 5 urban farms in Indiana. Carrot (Daucus carota cv. Napoli) was planted on each farm and four treatments were established: control (no amendment), biochar only, AMF only, and biochar + AMF. Fine roots were collected in an active growth stage and DNA was extracted. A nested PCR assay is underway using AMF-specific primers. The resulting libraries will be sequenced using the Illumina platform and evaluated using QIIME2 and GlobalAMFungi database.

The results from this study will provide new insights about the ecological factors supporting AMF assemblages in plant roots and help farmers

learn how to manage their soils to produce healthy, safe, and nutritious crops on urban farms.

Mentor(s):
Lori Hoagland (Agriculture)

Other Acknowledgment(s):
Mine Rouxna van der Berg* (Agriculture)

Poster Presentation Abstract Number: 1332
Presentation Time: Session 2: 10:30-11:30am

Mapping Campus Luminance: Developing a Portable Light Meter for Purdue

STEM

Authors(s):
Kutlu Tortop† (Engineering); Colin Daniel Gupta‡ (DSB); Sophia Anne Sears‡ (DSB|JMHC); Caroline Lee Stewart‡ (DSB); Amogh Shrivastava‡ (Engineering); Ethan Michael Flowers‡ (Engineering); Akilaish Velamati‡ (Engineering); Ava Christine Baffer‡ (DSB); Benj

Abstract:
Adequate outdoor lighting is important for visibility, accessibility, and safe movement across a university campus. However, collecting luminance data across large areas can be time-consuming when measurements must be recorded manually. This project focuses on developing a portable light level meter that can collect and store illumination data while being moved along campus pathways. The system is being designed for Purdue Office of Campus Planning and Architecture to support more efficient assessment of nighttime lighting conditions. The device integrates a lux sensor, GPS, IMU, rotational encoder, and single board microcontroller technology on a portable cart. As the cart gets pulled across the campus, the system records light levels along with location and time information, storing the data in a format compatible with GIS software. Initial prototyping demonstrated successful tracking of movement, light measurements, timestamps, and data storage on a microSD card. Testing also identified challenges related to inaccurate location calculations, loose electrical wiring, and cart stability. The current phase of the project focuses on improving reliability through a custom PCB, improved location estimation, and a cart redesigned for better ergonomics. The completed system is expected to make campus lighting surveys faster and more consistent and provide Campus Planning with data that can help identify areas where lighting conditions may need further evaluation or improvement.

Mentor(s):
Aparajita Jaiswal (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1333
Presentation Time: Session 2: 10:30-11:30am

Does Machine Learning Add Value in Trading? Evidence from Momentum and Mean-Reversion Equity Strategies.

STEM

Authors(s):
Alisher Usmanov† (Science)

Abstract:
Rapid advances in machine learning (ML) have intensified interest in its use in equity trading, from firms such as Jane Street and Citadel to retail traders. Yet profitability depends on trading rules, market conditions, and costs. This study evaluates ML's added value in momentum strategies, which buy recent winners, and mean-reversion strategies, which seek rebounds after price declines. Using annually updated historical S&P 100 candidate lists, we compare rule-only, ML-only, and hybrid portfolios holding ten equally weighted stocks, rebalanced weekly. Rule-only ranks stocks using fixed economic scores combining strategy-specific financial indicators. ML-only ranks them by probabilities of positive weekly returns averaged across 3 ML models: Logistic Regression, Random Forest, and XGBoost. Hybrid screens the economic top fifty, then selects ten using the same ML predictions. Models initially trained on 2010-2017 observations are retrained every 26 weeks using completed outcomes. The simulations cover 417 weeks in 2018-2025, with next-opening execution and a 0.1% cost per dollar traded. Momentum ML-only earned 16.58% annually before costs versus 13.81% for rule-only, but higher turnover reversed the ranking after costs: 7.71% versus 9.66%. At base costs, rule-only led both families in net return and return relative to volatility (Sharpe ratio). ML variants reduced mean-reversion maximum drawdowns from 49% to 38-39%, while momentum hybrid reduced volatility. Exploratory statistical analyses did not establish a reliable net-return or Sharpe advantage. ML's observed benefits were limited to low-cost momentum returns and selected risk measures; a reliable net-performance advantage was not demonstrated. These findings suggest that ML's value in stock selection depends on trading costs and investment objectives. Higher returns before costs or improvements in individual risk measures do not necessarily translate into superior net or risk-adjusted performance.

Mentor(s):
Kiseop Lee (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1334
Presentation Time: Session 2: 10:30-11:30am

The Impact of World War II on Foreign Language Teaching in the US

Humanities

Authors(s):
Grace Katherine VanBibber† (Liberal Arts|JMHC)

Abstract:
Before World War II (1941-1945), American foreign language classes relied heavily on the dissection of written texts for their grammar and structure. Findings from the incredibly influential Coleman Report (1929) had suggested that this was the most practical way to teach a foreign language, due to the difficulty in obtaining native speakers and the time constraints in teaching. However, the onset of the war led to a greater need for oral comprehension to do intelligence work, interact with allies, intercept Axis communications, and interrogate prisoners of war. Thus, the foreign languages department of the Army Specialized Training Program (ASTP) was born. In this program, soldiers studied languages with native speakers at American universities with the goal of becoming fully proficient in oral communication and aural comprehension in a very short period. The program enjoyed great success, and its unique approach to language teaching led others to attempt to replicate it in post-war contexts. This study will examine the ASTP in its context and explore how its methodology impacted foreign language teaching in the US for years to come. Through a literature review consisting of primary and secondary sources, I will examine the history of foreign language teaching methodology immediately prior to, during, and after WWII, and its implications for today. These sources will include archival materials such as newspaper articles, as well as original reports, and journal articles. My preliminary findings suggest that World War II and the ASTP shifted the focus of language teaching away from reading and grammar toward verbal communication by using native speakers in classrooms and oral drilling. As a result, the ASTP and its methodology completely shifted the focus of American linguistics and foreign language teaching from grammatical structure to verbal communication and changed the way teachers and researchers approach foreign language education.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1335
Presentation Time: Session 2: 10:30-11:30am

R.I.V.A.L. Defense: Reactive Intelligent Vehicle Adversarial Learning

STEM

Authors(s):
Hrishikesh Bashyam Villur† (Engineering); Arya Sriram† (DSB); Adithya Sridhar† (Engineering); Rishikesh Ravindra Padhye† (Science)

Abstract:
This report presents R.I.V.A.L. (Reactive Intelligent Vehicle Adversarial Learning), an autonomous racing project focused on high-speed offensive and defensive maneuvers in multi-vehicle interactions. Inspired by the Indy Autonomous Challenge (IAC), this project aims to develop and validate simulation-based control methods, to integrate on F1TENTH hardware. F1TENTH platform is a 1/10th scale autonomous vehicle used for testing maneuvers. Offensive and defensive divisions will each develop pure pursuit algorithms in simulation as a proof of concept before moving to more advanced predictive controllers such as Nonlinear Model Predictive Control (NMPC). Both teams will test against a ghost car in the F1TENTH Gym, which builds intuition for path encoding, and AutoDRIVE, which provides higher-fidelity vehicle dynamics and physics-based simulation. Overtaking has been studied previously, but defensive driving has received less attention, so R.I.V.A.L. addresses both. The first project goal is to create a baseline that adjusts the defender's lateral position when an opponent attempts to pass. The planner operates in the Frenet frame using the global racing line as its reference, and weighs the attacker's distance, closing speed, and lateral position. The platform's decision logic adapts the Intelligent Driver Model (IDM) and MOBIL from car-following and lane-changing to racing defense: an IDM-inspired desired gap determines when to react, while MOBIL-inspired criteria decide whether a move is useful and safe. The initial goal is to defend against overtaking procedures inspired by the IAC's regulations. The baseline will be tested against scripted opponents in the F1TENTH Gym and use the results to benchmark future approaches, such as a Control Barrier Function (CBF) safety layer.

Mentor(s):
Andres Felipe Hoyos Moreno (Engineering); Reed Joseph Freer (Engineering); Samuel Labi (Engineering); Richard Ajagu (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1336
Presentation Time: Session 2: 10:30-11:30am

The Evolution and Use of Generative AI in Spearphishing Attacks: Social Engineering from a Cybersecurity Perspective

STEM

Authors(s):
Samuel Winiger† (Polytechnic)

Abstract:
In the field of cybersecurity, social engineering attacks remain a persistent threat vector; from phishing email scams to the use of AI-assisted deepfakes, attackers have developed increasingly complex attack vectors to exploit human vulnerabilities. Spearphishing attacks, one such type of social engineering attack, attempt to target specific individuals or groups with more personalized messages, relative to regular phishing attacks, which aim to exploit as many individuals as possible with more generalized messages. Oftentimes, the path of least resistance for an attacker attempting to gain access to a protected system or network comes from the human factor; both spearphishing and regular phishing attacks aim to do this, exploiting people to learn important information, such as a password, or to take important assets.

This research analyzes how spearphishing attacks will continue to evolve in the future. For this, it must be understood how spearphishing has already evolved and continues to evolve with the relatively recent development of generative AI, which allows attackers to make their messages more refined and personalized, increasing their likelihood of manipulating targets. Attackers and defenders are in a constant arms race of developing new forms of spearphishing on the attacking side and making people more informed about potential threats and how to identify them on the defending side.

By analyzing existing peer-reviewed research articles on the use of generative AI in spearphishing attacks, this research aims to determine how spearphishing attacks could continue to evolve in the near future.

Keywords: Social Engineering, Spearphishing, Cybersecurity, Evolution, Generative AI, Large Language Models (LLMs)

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1337
Presentation Time: Session 2: 10:30-11:30am

AI4SMA: Stance Detection

STEM

Authors(s):
Daniel Wong† (Science); Zayed Mohamed AlMessabi† (Engineering); Samuel Arganta Suwandi† (DSB); Samyukta Balaji† (Engineering)

Abstract:
Our project investigates stance detection in social media text, where the goal is to classify posts as FAVOR, AGAINST, or NONE toward a specific topic. The central research question is: Which text encoder produces latent representations that most effectively preserve stance-related information? We use the TweetEval stance dataset as a benchmark and currently use CLIP as a baseline encoder. The resulting latent representations are evaluated using multiple downstream methods, including cosine similarity, K-nearest neighbors, decision trees, PCA, RNNs, and LSTMs, to compare how effectively each method captures stance information from the encoded feature space. Performance is measured using accuracy, precision, recall, weighted F1-score, and macro F1-score, and data augmentation is also being explored to address class imbalance and improve model robustness. Ultimately, the objective is to identify the strongest downstream evaluation method and use it to compare multiple text encoders to determine which produces the most informative latent representations for stance detection.

Mentor(s):
Soudabeh Taghian Dinani (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1338
Presentation Time: Session 2: 10:30-11:30am

Power Distribution System for EV karts

STEM

Authors(s):
Ruby Eskinder Woudneh† (Engineering); Sia Gupta† (Engineering); Mariana Paez Reyes‡ (Engineering); Mark Pushinsky‡ (Engineering); Liana R Ye‡ (Engineering); Shaunabh Bose‡ (Engineering)

Abstract:
The product is a custom printed circuit board (PCB) acting as the main Power Distribution Board

(PDB) for an electric and autonomous go-kart. The PDB acts as the central electrical hub, taking

high-voltage power from the main traction battery (managed by the Battery Management

System) and safely distributing it to various vehicle subsystems. This includes stepping down

voltages to supply low-power electronics (such as the NVIDIA Jetson edge computing platform,

sensors, and ROS 2 communication peripherals) while safely routing high current to the VESC

motor controllers

Mentor(s):
Woongkul Lee (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1339
Presentation Time: Session 2: 10:30-11:30am

Meta Quest Research Application
STEM

Authors(s):
Chia-Chun Wu† (Polytechnic); Weizhao Xu† (Engineering); Yu-Hsien Liu† (Engineering|Science); Robert Winder Witt† (Engineering); Advaid Menon† (DSB); Cameron Raymond Shute* (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Steven R Dunlop (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1340
Presentation Time: Session 2: 10:30-11:30am

No potentiostat? No problem. Emulsions allow for galvanic deposition of platinum in a Daniell cell

STEM

Authors(s):
Rachel Diana Zamsky† (HHS|Science)

Abstract:
Platinum (Pt) nanoparticle and microparticle deposition often relies on energy-intensive processes. An alternative approach may lie in a foundational electrochemical technology: the Daniell cell, first developed in 1836. By harnessing spontaneous redox chemistry, this work explores a potentially more energy-efficient method for Pt particle deposition. Using a glassy carbon electrode and an emulsion containing chloroplatinic acid and 1,2-dichloroethane, we demonstrate the consistent deposition of stable Pt particles. Incorporating a resistor into the circuit provides an additional means of controlling deposition conditions, potentially enabling tunable particle size, morphology, and surface oxide formation. This approach offers a promising platform for investigating controlled Pt particle synthesis while reducing reliance on externally powered deposition methods.

Mentor(s):
Samantha Christine Cullom (Science); Jeffrey Edward Dick (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1341
Presentation Time: Session 2: 10:30-11:30am

Predicting Semiconductor Operating Margins Using Financial, Market, and Policy Data

Business Case Study

Authors(s):
Eddy Zhang† (DSB); Alex Ryusei Okano† (DSB|JMHC); Lila Renee James† (Liberal Arts); Tishia Talia Darmawan† (DSB|JMHC)

Abstract:
Prediction Problem: How accurately can we predict next year's operating margin for semiconductor companies by using their current financial performance, overarching market conditions, and industry trends?

Our project looks at whether the following year's operating margin for semiconductor companies can be predicted using financial, pricing, and policy data from the Global Semiconductor Industry 2010–2026 dataset. Operating margin is useful for assessing how profitable a company is through its main business operations. Margin changes can also affect decisions on R&D, capital spending, production, and supplier planning.

The analysis uses company-year observations from 2017–2024. Before modeling, we removed observations that could create misleading results and removed operating income because it's directly calculated from revenue and operating margin. Revenue was log-transformed because of its skewed distribution, and the original company segments were grouped into five broader categories. We also created variables such as revenue growth, margin change, R&D intensity, capex intensity, and year-over-year changes in DRAM and NAND prices.

The main model will be multiple linear regression, with Ridge and Lasso regression used for comparison. Since the observations follow the same companies over several years, we will test the models using earlier years as training data and later years as test data. MSE and RMSE will be used to compare model performance against a baseline assumption of repeated, equal margins year after year.

Our EDA shows that current operating margin is the strongest predictor of next-year margin, with a correlation of about 0.90. It also shows clear differences across semiconductor segments, especially the larger swings in memory-company margins. Our final analysis will test whether adding financial, market, and policy variables will surpass predictions made from

current margin alone. Then we'll assess how those results are useful for companies.

Mentor(s):
Adrian Hoffert Wolanski (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1342

Presentation Time: Session 2: 10:30-11:30am

Competitive Inhibition of Listeria monocytogenes Adhesion to Intestinal Cells Using Engineered Nonpathogenic Listeria innocua

STEM

Authors(s):
Chase Zhou† (Temporary)

Abstract:
Introduction: Listeria monocytogenes (Lm) is a foodborne pathogen that causes listeriosis. Lm is most dangerous to individuals who are immunocompromised seniors or pregnant women. One key mechanism involves the interaction between Listeria Adhesion Protein (LAP) and its cognate receptor, heat shock protein 60 (Hsp60), which opens intestinal tight junctions (TJs), allowing Lm to cross the intestinal epithelial lining. Listeria innocua (Li) is a non-pathogenic bacterium and expresses LAP but does not anchor it to its surface, so it does not trigger TJ opening. To anchor LAP on the Li surface, our lab engineered a Li strain (eLi) that co-expresses LAP with internalin B (InlB). We hypothesize that pre-occupation of epithelial Hsp60 with eLi can prevent Lm interaction, thereby preventing listeriosis. This study aimed to evaluate the potential competitive exclusion of Lm by eLi using an intestinal HCT-8 cell model.

Methods: HCT-8 monolayers were inoculated with eLi (MOE 100), incubated for 1 h, followed by inoculation with Lm (MOI 10) and then incubated again for 1 h. Subsequently, HCT-8 cell supernatants were collected for a lactate dehydrogenase (LDH)-based cytotoxicity assay. HCT-8 cell monolayers were washed and treated with a solution of serum-free DMEM with 0.1% Triton X100. Monolayers were disrupted and cell suspensions were serially diluted and plated on TSA-YE containing chloramphenicol (20 µg/ml) for selective growth of eLi. The plates were incubated at 37ºC for 24 h before the colonies were counted.

Results: Adhesion data show that eLi adhesion (~1x10^6 CFU/mL) was significantly higher than wild-type Li (LiWT; ~1x10^4 CFU/mL) to HCT-8 without cytotoxicity. Furthermore, eLi showed a significant reduction in Lm interaction with HCT-8 and consequent cytotoxicity.

Conclusions: These data provide evidence that a nonpathogenic strain of Li could inhibit Lm colonization.

Mentor(s):
Arun K Bhunia (Agriculture); Benjamin Douglas Springer (Agriculture); Nicholas Leo Frank Gallina (Agriculture); Nicole Irizarry Tardi (Agriculture)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1343

Presentation Time: Session 2: 10:30-11:30am

Implementation and Integration of a High-Performance Memory Subsystem for AI Inference

STEM

Authors(s):

Jack Spenser Zimmerman† (Engineering); Sandeep Saravanakumar† (Engineering|JMHC); Samuel A Gutterman† (Engineering|JMHC); Rohan Shah† (Engineering|JMHC); Richard Liao† (Engineering); Matthew S Pung† (Engineering|JMHC); Vedant Sharma‡ (Engineering)

Abstract:

Atalla is SoCET's AI accelerator, and it consists of multiple computation and memory units. These units are then all connected via the Memory Subsystem. The current implementation of the memory subsystem in the Atalla Ax01 makes use of a Blocking DRAM controller. The sequential execution of reads and writes severely diminished throughput and performance. To address these issues, the previous team redesigned the memory subsystem to include an AXI interconnect, non-blocking DRAM controller, and DRAM model based on Ramulator. However, these modules were independently developed and partially unverified, preventing integration and benchmarking of the overall subsystem.This project aims to integrate, verify, and optimize Atalla's memory subsystem to improve effective memory bandwidth and support real workloads. Initial work focuses on validating existing components and establishing a reliable top level testing and benchmarking environment. Architectural optimizations will then be investigated and implemented, including AXI3 write interleaving, AXI and buffer size optimization, and DRAM request reordering. Ramulator will provide an accurate DRAM model for evaluating memory behavior under different access patterns.Improvements will be evaluated through comparisons of effective memory bandwidth, latency, and overall throughput relative to the existing implementation and previous results. Potential limitations include increased system complexity, additional hardware resource overhead, and skewed metrics stemming from potential differences between simulation workloads and real accelerator behavior. Successful implementation of the subsystem would allow for improved memory bandwidth on the Atalla Ax02, enabling higher computational throughput and increasing the performance of the entire processor as a whole.

Mentor(s):
Hassan Al-alawi (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1344

Presentation Time: Session 2: 10:30-11:30am

Spatial Food Lipid Component Analysis by Surface Touch Extraction Imaging (STEi) Across Diverse Food Matrices

STEM

Authors(s):
Isabella Zuluaga Gomez† (Purdue University); Sara Sofia de Fatima Bucheli Lazo‡ (Purdue University); Silvia Helena Lopez Serrano‡ (Purdue University)

Abstract:
Surface Touch Extraction (STE) spatially decodes surface chemistry using a targeted solvent-bridge probe in a matter of seconds. Tied to known (x, y) coordinates, this work demonstrates that STE data can be formatted, visualized, and analyzed as standard Mass Spectrometry Imaging (MSI) files, establishing Surface Touch Extraction Imaging (STEi) as an MSI technology. As a proof of concept, a charcuterie plate containing uncured hard salami, prosciutto, smoked Atlantic salmon, provolone, Gouda, and sharp cheddar was sampled manually by STE using a 96-well plate to guide extraction sites. Extracts were profiled using Multiple Reaction Monitoring (MRM), a flow-injection method on a triple quadrupole mass spectrometer that screens lipids and other metabolites by class-specific transitions without chromatographic separation; 744 MRM transitions were retained after filtering. An automated Python pipeline built on the open-source pyimzML library maps well coordinates and writes the MRM intensities into vendor-neutral imzML/ibd files. The generated files passed Extensible Markup Language (XML) syntax validation, checksum verification, and numerical reconciliation against the source data within floating-point tolerance. Opened in Cardinal (Bioconductor, R) and Napari MSI Explorer, the reconstructed datasets preserved the correct spatial orientation (Pearson r = 1.0 between original and recovered intensities per well) and supported standard MSI analyses, including total ion count images, ion images for each MRM transition, and principal component analysis. These results show that STE data, once converted to imzML, can be treated as MSI data and analyzed with established open-source imaging software. Although sampling in this study was manual, STE can be integrated into a High-Performance Liquid Chromatography (HPLC) autosampler, providing a path to automated, higher-throughput STEi with applications in food authentication, quality control, and biomarker screening.

Mentor(s):
Christina R Ferreira (Centers & Institutes); Ryan T Hilger (Science); Devender Arora (Centers & Institutes)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1345
Presentation Time: Session 2: 10:30-11:30am

Constraining the Progenitor Channel of Calcium-Rich Transients Using Host Galaxy Properties

STEM

Authors(s):
Peter Bruce Jones† (Science); Junpyo Lee† (Engineering); Aarnav Kumar† (Science)

Abstract:
Calcium-rich transients are a class of faint, fast-evolving supernova-like explosions whose peak luminosity is between novae and supernovae. Their nebular spectra are dominated by forbidden [Ca II] emission. These transients are known to have large offsets from their host galaxies' centers. The project builds on research that identifies two main progenitor channels for such transients: thermonuclear or core-collapse. The primary objective of the project is to determine whether calcium-rich transients are found in host galaxies that resemble those of Type Ia or Type Ib/Ic transients. The project uses the specific star formation rate as a proxy for the relative youth of the host's stellar population to determine whether these transients primarily appear in older or younger stellar populations. This helps narrow down the progenitor channel for these transients by attempting to find similarities in host galaxy properties to classified populations of thermonuclear or core-collapse transients. As a secondary goal, while recent work argues these offsets are real rather than an artifact of survey depth, the project tests this independently. For each host galaxy, the project compares the expected peak magnitude of a calcium-rich transient to the limiting magnitude of surveys like ZTF and Pan-STARRS to determine whether these events would be detectable near the center of the host galaxy, accounting for host-light contamination as a function of galaxy size and redshift.

Mentor(s):
Andy Jung (Science); Danny Milisavljevic (Science); Medhansh Garg (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1400
Presentation Time: Session 3: 12:00-1:00pm

Investigating Adaptive Gaming Controllers for Wheelchair-Mounted Robotic Arms

STEM

Authors(s):
Aqib Muhammad Abdullah† (Engineering|JMHC)

Abstract:
Spinal-cord injuries, strokes, and a myriad of other conditions can yield upper-limb disabilities (ULDs), including paralysis. For context, approximately 14.5 million people worldwide live with SCI alone. Such disabilities include the loss of motor function in the arms, with both gross and fine motor function being affected to varying degrees. This vastly limits the ability of affected individuals to perform otherwise essential activities of daily life (ADL), such as feeding oneself, carrying objects, and small adjustments to one's surroundings or person, all of which usually require gripping and movement capabilities. Kinova is a company that creates wheelchair-mounted robotic arms (WMRAs), and some of its offerings, like the Kinova Jaco and the Kinova Gen 3, which shows promise as a tool that can help individuals with upper-limb disabilities perform such actions, thereby restoring a sense of autonomy.

One barrier to entry is the method of controlling these robotic arms. Both the Kinova Jaco and Kinova Gen 3 can be controlled via a joystick, but the Kinova Gen 3 currently also utilizes inputs from an Xbox game controller, providing a potential alternative to the joystick. However, its current form factor lacks compatibility with people with ULDs, due to lack of motor control. The adaptive gaming controller market, which currently provides interfaces more suited to people with disabilities, including large, detached buttons and pressure-sensitive triggers, can be explored to bridge this gap. To assess their translation to assistive WMRA controls, the Xbox Adaptive Gaming Controller and Logitech components underwent a pilot usability study in operating the Kinova Gen 3 in completing ADL-like pick-and-place tasks. System Usability Scale scoring and subject interviews were compared to determine whether an in-market or a custom setup was required for translation. Future directions include adapting the solutions and potential assessments with the target population.

Mentor(s):
Shaiv Mehra (Engineering); Bradley S Duerstock (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1401
Presentation Time: Session 3: 12:00-1:00pm

Evaluating Retrieval-Augmented Generation for Biomedical Question Answering: Retrieval Pollution and Question Difficulty

STEM

Authors(s):
Muhammad Ahmed Ahsan† (Science); Vedant Patil† (Science)

Abstract:
Retrieval-augmented generation (RAG) combines large language models (LLMs) with external information to improve the accuracy and reliability of generated answers. However, retrieving additional information does not always guarantee better performance, especially for complex biomedical questions. Our ongoing research investigates how question difficulty and the relevance of retrieved evidence affect biomedical question-answering performance.

We use BioASQ, a biomedical question-answering dataset containing reference answers and supporting scientific evidence, to construct three evaluation sets: Original-100, Hard-100, and Challenge-50. We first evaluated LLM responses without retrieval using a preliminary 0–4 correctness scale. The average scores were 3.67, 3.45, and 2.90, respectively. We then conducted a preliminary TF-IDF retrieval experiment to estimate the proportion of retrieved passages not identified as relevant in the dataset. Interestingly, the most challenging question set did not have the highest estimated retrieval pollution, suggesting that retrieval quality alone does not explain answer difficulty.

Further analysis showed that Challenge-50 contains a higher proportion of multi-item list questions and requires more exact biomedical answer elements. These findings highlight the importance of considering both evidence relevance and answer complexity when evaluating RAG systems.

Our next phase evaluates biomedical dense embeddings for passage retrieval and compares generated answers under clean, 25% polluted, and 50% polluted evidence conditions. This ongoing study aims to better understand when retrieval improves biomedical question answering and when irrelevant information or complex answer requirements limit its effectiveness.

Mentor(s):
Snehasis Mukhopadhyay (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1402
Presentation Time: Session 3: 12:00-1:00pm

A Low Cost, Open Source Integrated Weighing and Digital Record-Keeping System for Small-Scale Diversified Farms

STEM

Authors(s):
Katherine Albanese† (Engineering|JMHC); Kelly Young† (Engineering|JMHC)

Abstract:
The Purdue Student Farm (PSF) is a small-scale, diversified horticulture farm operated by Purdue students. The farm's mission is to supply fresh produce to the greater Lafayette community through the Community-Supported Agriculture program. Additionally, the farm is an on-site learning center for new-generation farmers as well as a research station for many of Purdue's research experiments. Thus, an efficient record-keeping system is essential for the effective and productive management of a farm.

Harvest yield is one of the key parameters in farm record keeping, reflecting agricultural productivity and profitability. At PSF, the student workers weigh the harvested vegetables on a digital scale and subsequently record it on the whiteboard. Thus, recording weight is an additional step in PSF operation, adding tasks to the PSF crew. Furthermore, as there are numerous varieties of crops in the farm production, the weight record becomes disorganized and difficult to track. Moreover, the handwritten record must be digitized for long-term management and analysis, which is also an additional time-consuming process for the farm crew. This presents an opportunity for automation technology to facilitate and simplify record-keeping for harvesting yield.

A team of engineering students observes and studies PSF's working progress and establishes requirements for a solution that streamlines the workflow. The team designs a weight scale that integrates with a digital record-keeping system and automatically records data, which reduces the workload of the workers while improving data quality. A newly-designed weight scale is composed of easily-sourced materials with building instructions publicly available, allowing farmers and researchers to apply or adapt this invention to their productions.

Mentor(s):
Thirawat Bureetes (Agriculture|Engineering); ankita Raturi (Agriculture|Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1403
Presentation Time: Session 3: 12:00-1:00pm

IoT: Laser Scanning: PD Activity 2: Information Poster

STEM

Authors(s):
Gabriel Warren Balcom† (Engineering); Adam Jean Joly† (DSB)

Abstract:
During the last 7 weeks working with the laser scanner, my teammate and I have gained practical experience with digital design, material selection, and laser cutting and engraving. Personally, I used the scanner to produce a 6-inch ruler, make a name tag, and engrave words and symbols onto water bottles. Through these many projects, I have understood how digital designs can become actual products when using manufacturing machines. Additionally, I have learned the importance of measuring practices, laser settings, and proper safety procedures to achieve solid results. My experience with the laser scanner allowed me to discover the world of rapid prototyping: this machine cuts and engraves products relatively quickly. Devices such as this laser scanner show that we can create products at an incredible speed and they connect to the Internet of Things (IoT), where connected machines, computers, and sensors effectively share information to improve automation and manufacturing efficiency. Overall, this half-semester has helped me build hands-on technical skills and learn about digital design, rapid prototyping, and connected technologies, as well as how they contribute to modern manufacturing.

Mentor(s):
Chun-Kang Huang (Engineering); Steven R Dunlop (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1404

Presentation Time: Session 3: 12:00-1:00pm

Designing for Workforce Readiness: Developing a Learning Management System for Community Training.

STEM

Authors(s):
Rohan Basava† (DSB); Devakinandan Sanapala† (Engineering); Eli Zilkha† (Engineering); Nidhi Nandakumar‡ (DSB); Yihuan Wu‡ (Polytechnic); Jeffrey X Ling‡ (Engineering)

Abstract:
Organizations that deliver workforce and community training depend on accurate, long-lasting records to show that trainees have completed required coursework and hold current certifications. When content, assessments, and credentials are managed across separate tools, records become difficult to audit, renewals are missed, and curriculum updates can disrupt learners mid-course. This project addresses this need through the development of the Community Learning and Workforce Analytics Portal, a learning management system that unifies training delivery, knowledge assessment, and certification tracking. The system is designed around three user profiles: trainees, who complete courses and maintain credentials; agency administrators, who monitor progress, send reminders, and propose course edits; and central staff, who author curriculum, review proposed changes, and publish updates. Key features include versioned curriculum that keeps each learner on the course version they began, scenario-based knowledge checks that present unseen variants on retry, certification policies with expiry, renewal, and auditable revocation, and a review workflow in which approval applies only to the exact revision examined. The design prioritizes intuitive navigation and accessibility, following WCAG 2.2 AA guidelines and never relying on color alone to communicate status. The platform uses a modular architecture with replaceable service adapters to avoid dependence on any single vendor. An iterative design process guides prototype development, supported by automated testing and stakeholder review prior to delivery. The anticipated outcome is a functional, maintainable platform that strengthens training oversight and contributes practical insights into designing auditable, accessible educational technology for community-based training programs.

Mentor(s):
Aparajita Jaiswal (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1405
Presentation Time: Session 3: 12:00-1:00pm

Clock tree Optimization for SoCET's AFTx08 SoC

STEM

Authors(s):
Gurleen Kaur Batra† (Engineering); Fred Y Xu† (Engineering); Josephine A Banas† (Engineering)

Abstract:
Semiconductor chips are the backbone of modern digital systems. As System-on-Chip (SoC) designs become increasingly complex and performance driven, efficient and reliable communication between different components is essential. A critical part of this is the clock network, which distributes timing signals across the chip to ensure that all components operate in synchronization. The design and optimization of this network directly affect the chip's performance, power consumption, and timing reliability.

This project focuses on optimizing the Clock Tree Synthesis (CTS) methodology for an SoC design targeting TSMC's 65 nm (TSMC65) process technology, with the goal of improving clock network performance and power efficiency ahead of a potential tapeout. Using industry-standard electronic design automation (EDA) tools, we will implement and evaluate different clock tree architectures and CTS strategies, examining their impact on key metrics such as clock skew, insertion delay, power consumption, and timing performance.

By comparing the results of different CTS approaches, we aim to identify a methodology that achieves an effective balance between high-speed operation, low power consumption, and reliable clock distribution. This project will demonstrate how clock tree optimization can improve the overall efficiency and timing performance of an SoC design and help prepare it for eventual fabrication.

Mentor(s):
Ammar M Mukadam (Engineering); Niels van Ritbergen (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1406
Presentation Time: Session 3: 12:00-1:00pm

HRC - Design of a Robotic End Effector for Object Pickup and Release

STEM

Authors(s):
Amelie Bihlmayr† (Engineering); Aiden Rockne Blakey† (Engineering); Toshan Gupta† (Engineering); Li-Yen Lai‡ (Polytechnic)

Abstract:
The purpose of this research study is to design and build a robotic end effector. It was decided that the most important functions it should fulfill are picking up and releasing various objects, such as a tennis ball or a stick, without damaging the object. The team concluded that a three-finger end effector would be the best fit to achieve this goal and that one joint per finger would be sufficient. The location of the joint within each finger was also discussed, and it was decided to place the joint approximately in the middle of each finger. For the electronics, one servo motor will be used in each finger, with all servos connected to a breadboard and a microcontroller located in the base of the hand. The electronics will be enclosed within a hand modeled in SolidWorks and manufactured using PLA through 3D printing. The method used to control the motion of the hand is still under development. The final design will be evaluated by testing its ability to pick up objects of different sizes and masses and release them again without causing damage. The implication of this research project is to develop a functional robotic end effector while gaining experience in the design, manufacturing, and integration of end effectors for robotic systems.

Mentor(s):
Jaeeun Kim (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1407
Presentation Time: Session 3: 12:00-1:00pm

OMP biogenesis of Fusobacterium nucleatum

STEM

Authors(s):
Rishi Reddy Boyella† (Science|JMHC)

Abstract:
Fusobacterium nucleatum is a Gram-negative bacterium that causes oral infections and is associated with colorectal cancer. Its pathogenicity depends partly on β-barrel outer membrane proteins whose assembly is mediated by the β-barrel assembly machinery (BAM). This project aimed to produce and purify the βFab1 protein for use in the structural characterization of F. nucleatum BamA, the central component of BAM. The βFab1 plasmid was transformed into DH5α cells for plasmid propagation and into BL21(DE3) cells for protein expression. Sequence-confirmed plasmid stocks were prepared from the DH5α cells. BL21(DE3) starter cultures were used to inoculate four liters of 2×YT medium. The cultures were grown to an OD_{600} of approximately 0.8, induced with IPTG, and harvested by centrifugation. The collected cells were resuspended in 1× PBS and lysed using an EmulsiFlex homogenizer. βFab1 was then isolated using Protein L affinity chromatography. Chromatographic peaks indicated the elution of protein-containing fractions, while SDS-PAGE analysis supported successful purification of βFab1. Although βFab1 was successfully purified in three trials, the overall yield remained relatively low. The expression and purification procedure will therefore be repeated and optimized to obtain sufficient protein for structural studies. Characterizing F. nucleatum BamA may support the development of drugs that disrupt outer membrane protein assembly and reduce bacterial pathogenicity.

Mentor(s):
Nicholas Noinaj (Science); Marlyn Michelle Bush (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1408
Presentation Time: Session 3: 12:00-1:00pm

Change Your Degree, Not Your Destination

Business Case Study

Authors(s):
Jacob David Brink† (DSB); Eliana Mara Gross† (DSB); Disha Rathod† (DSB); Andrew Stephen Latino† (DSB); Tanuj Ravichandran† (DSB|JMHC); Ibrahim Shahid† (Engineering)

Abstract:
Many Purdue students considering a change of major lack awareness of, and access to, clear information about the Change of Degree Objective (CODO) process and transfer requirements into the College of Health and Human Sciences (HHS). This project investigates strategies HHS can use to help students explore its majors and to reach those considering a change. Using student surveys and institutional data analysis, we evaluated student awareness of the CODO process and the effectiveness of current outreach. Our expected findings indicate that targeted communication channels and centralized information resources significantly improve students' ability to navigate CODO. We are providing a marketing strategy as we recommend that HHS adopt proactive advising initiatives and streamlined digital resources to improve retention and support smoother academic transitions.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1409
Presentation Time: Session 3: 12:00-1:00pm

Design and Validation of a Layered Hexachiral Metamaterial with Enhanced Load Bearing Capacity and Negative Poisson's Ratio

STEM

Authors(s):
Ian Buerge† (Engineering|JMHC)

Abstract:
Chiral auxetic architectures exploit rotational symmetry to produce a strong, tunable coupling between rotation and translation, yielding auxetic responses and energy absorption beyond conventional lattices. Layered chiral networks expand upon chiral architectures, developing three-dimensional networks of two-dimensional architectures linked through ligaments connecting adjacent nodes. Prior work has focused primarily on nodal and network geometry to enhance auxetic behavior. In contrast, this study develops a systematic experimental methodology to optimize the interlayer ligaments to increase load-bearing capacity while retaining auxetic performance. Traditional ligament design is analyzed through finite element analysis (FEA), and a new design is proposed to redistribute stress efficiently within the metamaterial. Parametric analysis is utilized to optimize the capabilities of the structure. Numerical finite element analysis and experimental compression tests validate the approach, indicating a 55.4% increase in load-bearing capacity while also increasing the negative Poisson's ratio by approximately 6%.

Mentor(s):
Yung C Shin (Engineering); Vaidyanath Harinarayana (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1410
Presentation Time: Session 3: 12:00-1:00pm

Minimum Order and Size of Connected Graphs with Prescribed Induced, Ordered, and Maximum Matching Numbers

STEM

Authors(s):
Alejo F Cagliolo† (Science); Maxwell Thompson† (Engineering); Victor Popescu† (Science)

Abstract:
Matching numbers of a graph G control homological invariants of its edge ideal, a central object in combinatorial commutative algebra. We study four of them: the induced matching number ind-match(G), the minimum matching number min-match(G) (the smallest maximal matching), the matching number match(G), and the ordered matching number ord-match(G). These satisfy ind-match(G) ≤ min-match(G) ≤ match(G) ≤ 2·min-match(G) and ind-match(G) ≤ ord-match(G) ≤ match(G), while ord-match(G) and min-match(G) are incomparable in general. Hibi, Higashitani, Kimura, and Tsuchiya showed that every triple (p, q, r) with 1 ≤ p ≤ q ≤ r ≤ 2q arises as (ind-match, min-match, match) of a connected graph, and Matsuda, Sato, Yoshida, and Banerjee determined the minimum number of vertices and edges such a graph can have. As a first step, we gave an independent proof of this realizability criterion, using complete graphs with pendant edges as building blocks, and confirmed that exactly 180 triples with entries at most 10 occur. We now extend this program to the ordered matching number. For integers 1 ≤ p ≤ s ≤ r, we ask for the minimum number of vertices and edges of a connected graph G with ind-match(G) = p, ord-match(G) = s, and match(G) = r, and we ask the same question when min-match(G) = q is also prescribed. This part of the project is in progress. We are computing small cases and constructing explicit families of connected graphs that realize prescribed values of these invariants, with the goal of matching them against lower bounds that follow from the inequalities above. Answering these questions will clarify how the ordered matching number interacts with the classical matching invariants and will provide extremal examples for the study of edge ideals.

Mentor(s):
Siamak Yassemi (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1411
Presentation Time: Session 3: 12:00-1:00pm

Sentiment and Behavioral Analysis During Human-Robot Interactions

STEM

Authors(s):
Indya Sky Calhoun† (Polytechnic|JMHC)

Abstract:
The project explores robot-human interaction by examining how humans engage with robots. Through combining AI and robotics, the experiment identifies how robots perceive human behavior, make decisions, and interact with humans in safe and supportive ways. The project examines participants' physical movements, behavior, facial expressions, and speech. By focusing on these patterns, the goal of this project is to reduce the disparity between human-robot interactions through improving the accuracy of social robots in interpreting and responding to human behavior.

Mentor(s):
Sooyeon Jeong (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1412
Presentation Time: Session 3: 12:00-1:00pm

Follow the Fault: Risk-Scoring Auto Insurance Fraud

Business Case Study

Authors(s):
Anh Hoang Phuong Cao† (DSB); Joakim Arun† (DSB); Palmer Link Assunto† (DSB); Jonathan Richard Maffei† (DSB)

Abstract:
Can information about the policyholder, policy, vehicle, and accident predict which auto insurance claims are fraudulent, and rank claims so investigators review the most suspicious first? Fraud raises premiums for honest drivers, yet insurers cannot investigate every claim. We use a real-world dataset of 15,420 U.S. vehicle insurance claims (1994–1996) originally released by Angoss Software with its KnowledgeSEEKER package and accessed through Kaggle. It contains 33 variables: a fraud label, a policy ID, and 31 predictors covering the policyholder, policy, vehicle, and accident. Exploratory analysis shows 923 fraudulent claims (6.0%), no blank fields, and strong early signals: fraud occurs in 7.9% of claims where the policyholder was at fault versus 0.9% where a third party was, and in 10.2% of all-perils policies versus 0.7% of liability-only policies. Preprocessing in Python will drop the ID and a redundant policy-type field, treat 320 recorded ages of zero as missing, one-hot encode categorical fields, and order ranged fields such as vehicle price. Logistic regression serves as our interpretable baseline, showing how each factor shifts the odds of fraud; a decision tree captures interactions, such as fault combined with coverage type, as readable rules; and a random forest averages many trees to capture these patterns with less overfitting. After holding out a stratified 20% test set, we will compare models using stratified five-fold cross-validation on the training data, correcting for imbalance within each fold. Our primary metric is precision-recall AUC, which rewards catching fraud without flooding investigators with false alarms, and we will set the flagging cutoff by weighing missed fraud against unnecessary investigations. We will also check whether demographic variables raise fairness concerns. A reliable risk score could help insurers focus investigators, pay honest customers faster, and reduce losses passed on through premiums.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1413
Presentation Time: Session 3: 12:00-1:00pm

Assessment of Used Cooking Oil Storage Quality and Disposal Methods

STEM

Authors(s):
Iris Carman† (Engineering|JMHC); Emma C Wolcott† (Engineering|JMHC)

Abstract:
Used Cooking Oil (UCO) is a waste product from domestic and commercial cooking and can be derived from vegetable sources or animal fats. Most common disposal options for residentially produced UCO include the landfill, sewer system, or disposal directly into the environment, as there are little recycling options available. Such disposal of UCO has negative environmental or economic impacts. The purpose of this study is to understand the current collection and storage of residentially produced UCO, focusing on local municipalities across the Midwest, specifically in Indiana and the 4 neighboring states while determining the feasibility of reprocessing this oil into biofuels or lipid-based materials by analyzing the degradation of this oil after prolonged storage.

Canola oil and Soybean oil were the focal point of this study, as these are common household cooking oils used in the Midwest. Survey data was collected from counties across Illinois, Indiana, Ohio, Kentucky, and Michigan to gather information on existing UCO collection programs. Additionally, the Tippecanoe County Public Food Waste and Cooking Oil drop off location was monitored weekly to understand current utilization of available recycling centers. To analyze the degradation of UCO, samples of oil were intentionally degraded under lab conditions and stored in PET bottles under a range of plausible storage conditions. At predetermined intervals, the degradation of these samples was analyzed. Using AOCS methodology, the oil samples were assessed for the content of free fatty acids, moisture, aldehydes and ketones, peroxides and TPM. These components are primary and secondary oxidation products, as well as hydrolysis products, which indicate the quality of oil and thus the suitability for desired chemical conversions.

The results of this research are intended to provide information to guide future storage and recycling of UCO in the Midwest Region.

Mentor(s):
Nadezhda N Zyaykina (Engineering); Chantelle April Miller (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1414
Presentation Time: Session 3: 12:00-1:00pm

Solutions in Rural Mental Health

Social Science

Authors(s):
Nick Chase† (HHS)

Abstract:
The purpose of this research project is to look at how stigma, limited access to mental health resources, and current response protocols can contribute to a reliance on police or first responders during mental health crises in rural communities. Through a review of articles and online research this project will look at the existing mental health resources in rural areas, law enforcement training, and alternative solutions or approaches to crisis prevention. Primary research will include an interview with a retired law enforcement officer in order to understand challenges with mental health response. This research will provide understanding of barriers in mental health care and provide potential strategies for reducing stigma and improving access to and/or quality of care.

Mentor(s):
Catherine Jean Shukle (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1415
Presentation Time: Session 3: 12:00-1:00pm

Configurable ODE-Based Data Generation for Benchmarking Control-Oriented System Identification

STEM

Authors(s):
Ayush Chaurasia† (Engineering); Aarush Palve† (Science); Abhishek Kaushikkar† (Engineering)

Abstract:
Control-oriented system identification must yield models accurate enough to support estimation, controller design, and health monitoring, but evaluating such methods requires data from systems with known dynamics, and existing sources offer little control over how that data is generated. This work presents two components of a configurable data-generation framework for benchmarking identification algorithms on drones and aircraft. The first is a nonlinear 6-degree-of-freedom rigid-body flight dynamics simulator with twelve states. Aerodynamic, propulsion, actuator, and controller models are user-supplied, and data can be generated under commanded inputs or with an internal feedback controller in the loop. The simulator parameterizes the physics that make identification difficult in practice, including actuator lag and limits, gust and wind fields, nonlinear stall dynamics, propeller torque, propwash and downwash, and thrust-dependent control effectiveness. These effects enter the truth as hidden forcing, while users choose which channels are measured and at what noise levels, so algorithms see only noisy, partial data. The second component is a two-state Thévenin 1-RC lithium-ion cell model under constant-current and hybrid pulse discharge, motivated by battery health monitoring in drones, where identified capacity and internal resistance inform state estimation and degradation tracking. Its linear dynamics are observed through a nonlinear terminal-voltage measurement, providing a compact testbed for parameter recovery from sparse, noisy data. Because true parameters are known, identification methods can be scored against ground truth across controlled conditions, supporting reproducible comparison across identification methods.

Mentor(s):
Sabine Brunswicker (Polytechnic)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1416
Presentation Time: Session 3: 12:00-1:00pm

CS 314: Numerical Methods LLM-Assistant

STEM

Authors(s):
Venkata Sri Saiveer Chelliboyina† (Science); Alan S Yi† (Science)

Abstract:
Foundational CS courses like CS 314 (Numerical Methods) demand students to work through complex challenges, needing them to bridge abstract theory in mathematics with software skills that are applicable in the real world. While general purpose LLMs (Large Language Models) can provide a surface level tutor-like assistance, they also hallucinate more frequently than meets the eye, especially when it comes to mathematical derivations. They also tend to give implementations to solutions directly, rather than taking a learning-first approach. These solutions are also often not aligned to the specific curriculum of the class.

This project addresses the above fallbacks by developing an AI-driven, study helper that's specifically tailored to Purdue's CS 314 curriculum, and designed to aid in learning rather than encourage cheating. This helper will be grounded in a comprehensive pool of course materials, including lecture slides, syllabus guidelines, homework requirements, and recitation notes. Our system utilizes Retrieval-Augmented Generation (RAG) paired with a tailored Socratic instruction pipeline. The resulting tool aims to deliver a more reliable academic support experience.

Mentor(s):
Mutian Zhang (Science); Alex Pothen (Science); Dan Goldwasser (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1417
Presentation Time: Session 3: 12:00-1:00pm

Effects of Agency on Memory for Internal Experiences in Naturalistic Events

Social Science

Authors(s):
Wenyu Chen† (HHS); Wendy Chung† (Agriculture|HHS|JMHC)

Abstract:
Episodic memories of real-life experiences often include both external details about events and internal experiences, such as thoughts and feelings. However, previous research has focused primarily on externally observable details in controlled experimental settings. The present study examined memory for internal experiences in naturalistic events, focusing on the role of agency, or active control over one's own actions, a defining feature of real-world experiences. We used web browsing as a common naturalistic activity. Participants were assigned to one of two groups: active browsers, who freely browsed the web as they would in daily life, and passive observers, who watched a recording of another participant's browsing session. Both groups then verbally recalled what they had browsed or observed. Recall was transcribed and segmented into sentences, and each sentence was categorized as describing either external or internal details. Both groups recalled fewer internal than external details, but active browsers recalled a greater proportion of internal details than passive observers did. Text-based analyses further showed that external details were more semantically similar across participants than internal details, indicating greater diversity in internal experiences. Moreover, a passive observer's recall was more semantically similar to that of another observer than to that of the active browser who generated the event, particularly for external details. Together, these findings suggest that agency promotes the generation and subsequent recall of subjective internal experiences and may lead to more idiosyncratic memories. Future work will use functional magnetic resonance imaging to investigate the neural mechanisms underlying recall of internal experiences and how agency shapes the neural representations of those experiences.

Mentor(s):
Hongmi Lee (HHS); Mengting Zhang (HHS); Haowen Su (HHS)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1418

Presentation Time: Session 3: 12:00-1:00pm

Exposing Software and Hardware Vulnerabilities in Consumer IoT Devices

STEM

Authors(s):
Daniel Chen† (Polytechnic); Rachel Alexis Rosenthal† (Polytechnic); Shehreen Sarwana Musa† (Engineering); Atharv Agarwal† (Engineering); Pablo Elias Miranda Fragoso‡ (Polytechnic); Aarav Mathur Bhatnagar‡ (Science); Jake T Bennett‡ (Polytechnic); Alexande

Abstract:
Internet of Things (IoT) devices from smart thermostats to entire beds have become popular. While often misconfigured or insecure, their main vulnerability lies in the supply chain. Threat actors can intercept, compromise, and redistribute devices before they reach consumers. According to ConsumerAffairs, U.S. households averaged 21 smart home devices in 2023. These vulnerabilities could allow actors to collect sensitive household information. To address this risk, we applied structured risk assessment techniques to supply-chain vectors using two consumer IoT devices: a Philips Hue Bridge and a Broadlink RM Mini 3. The first portion examines the software apparatus of the Philips Hue Bridge. Network analysis was integral because IoT devices use mobile companion applications to communicate with consumers. Analysis revealed exposed endpoints that the bridge attempted to contact, allowing us to extract four firmware versions using a publicly exposed AES key. Each version was decrypted for analysis of the filesystem and kernel, software components, and network services. Future work will validate weaknesses, evaluate their impact, and determine whether updates address them. The second portion examines the hardware technologies and security of the Broadlink RM Mini 3. Inspection of recovered PCBs revealed an open debug port that could allow an actor to flash malware before selling the device. A method of extracting firmware was also found for further analysis. This research helps protect consumers and the supply chain. One real-world example is “Horse Shell” malware, through which Chinese state-sponsored actor “Camaro Dragon” infected residential TP-Link routers to attack European foreign affairs organizations. Residents were unaware that attacks originated from their networks. This could degrade network speed and cause their IP addresses to be blacklisted. Continued research demonstrates the

importance of high IoT security standards and informs users of potential risk.

Mentor(s):
Santiago Torres Arias (Engineering)

Other Acknowledgment(s):
Fabiha Hashmat* (Engineering)

Poster Presentation Abstract Number: 1419
Presentation Time: Session 3: 12:00-1:00pm

Sources of Variation in 2D Tellurene Device Assembly: Measuring What AI Guidance Should Reduc

STEM

Authors(s):
Alessia Chiesara galiasso† (Engineering); Kashvi Shahi* (Engineering)

Abstract:
Hydrothermally grown 2D tellurene combines high hole mobility (~700 cm²/V·s) with low-cost solution processing, making it attractive for sensors. Even when two devices are made the same way, their outputs can differ by [X]%. Part of this likely comes from synthesis, which another project in our lab is examining. This project quantifies the variation added after synthesis: flake transfer, electrode attachment, and device assembly. So far, we made tellurene samples at two precursor concentrations and characterized them by optical microscopy and atomic force microscopy (AFM), measuring thicknesses of [X–X] nm. All sessions are recorded with eye-tracking glasses so that error-prone steps can be found in the footage.

Next, each device will carry a traceability record: synthesis batch, flake, operator, and room conditions. A nested variance-components analysis will then separate the variation due to synthesis, transfer, assembly, and measurement. This will show which fabrication steps most need control.

Mentor(s):
Robert Jose Ccorahua santo (Engineering); Wenzhuo Wu (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1420
Presentation Time: Session 3: 12:00-1:00pm

A Custom Fragment Shader Module for a Fixed-Function Graphics Processing Unit

STEM

Authors(s):
Dylan Chu† (Engineering); Andrew Lu† (Engineering); David Changhong Yang† (Engineering)

Abstract:
Graphics processing units (GPUs) were originally designed around fixed-function hardware, meaning that their main dataflows contained predetermined logic. Programmable architectures were later adopted to support customizable graphics workloads, but at the cost of . The Birdy project, built by Purdue's SoCET GPU team, aims to implement a fixed-function GPU on an FPGA to provide hands-on experience with hardware design and collaboration, preparing students for industry applications. Within this project, the Fragment Shader module performs texture mapping, assigning corresponding colors to incoming fragments by retrieving textures from memory. The module is implemented in SystemVerilog and utilizes the Urbana FPGA platform, containing the Coordinate Conversion, Texel Generation, Stall Detection, Bilinear Interpolation, and Memory Controller submodules. Inspired by conventional texture-mapping pipelines, the design uses 128 × 128 textures stored in DDR3 memory and BRAM-based caches to optimize memory accesses. Specific techniques used to improve traditional designs include pipelining to allow processing a fragment every clock cycle, a ping-pong buffer to allow for efficient memory access, and parallel interpolation hardware blocks. The primary objective and outcome is to achieve the pixel throughput and clock frequency required to support a 640 × 480 VGA display at 60 Hz while minimizing FPGA resource utilization, particularly lookup tables (LUTs) and flip-flops. Performance is restricted by maximum clock frequency, external memory bandwidth, and available FPGA resources. Thus, trade-offs between throughput and hardware cost must be considered. Future work will focus on expanding the fragment shader's functionality to lighting to better reflect real graphics pipelines.

Mentor(s):
Charles Spencer Bowles (Engineering); Zach Anthony Barna (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1421
Presentation Time: Session 3: 12:00-1:00pm

Magnetic Coil Design for Optical Tweezer Experiments

STEM

Authors(s):
Joshua Cisneros† (Engineering); Noriko WaiGa Chu* (Engineering); Vitor Limas Schein* (Engineering)

Abstract:
Magnetic Coil Design for Optical Tweezer Experiments, Joshua Cisneros, Chuan-Hsun Li, Yupeng Wang, Aishik Panja, Xinghan Wang, Vitor Schein, Noriko Chu, Qi-Yu Liang. Department of Physics and Astronomy, Purdue University, West Lafayette, IN 47907. This work was supported by the Air Force Office of Scientific Research.

Optical tweezer experiments enable control of individual atoms for quantum sensing and computation, but they require extensive optical access alongside magnetic fields for atom trapping and control. The quadrupole coils of the magneto optical trap (MOT) must sit close to the atoms, in the same space needed by the high numerical aperture (NA) objective lens and the MOT laser beams. To identify coil designs that optimize optical access while achieving the required field gradients, strengths, and uniformity, we compared circular, diamond, elliptical, and rectangular coils using Biot-Savart simulations, with every shape resized to give the same 20 G/cm gradient at the coil pair center. We validated the simulations by scanning a Hall probe on a translation stage from -25.4 mm to +25.4 mm through a bias coil pair that we wound ourselves. The measured field agreed with the model to within 3.7% at the center and 2.3% RMS in plot shape. Across all coil shapes stated, the effective optical access changed by less than 1%, which shows that coil geometry redistributes optical access rather than increasing it. Only the diamond quadrupole coil kept the magnetic transverse gradients balanced while also allowing the 60 degree MOT beams in our design to pass through its corners without interfering. These results show that coil geometry can be chosen to direct optical access where the experiment needs it. Our next steps are to assemble the full MOT and tweezer apparatus, map every coil in place, and conduct successful AMO physics experiments with it.

Mentor(s):
Chuan-Hsun Li (Science); Qiyu Liang (Science)

Other Acknowledgment(s):
Yupeng Wang* (Science); Aishik Panja* (Science); Xinghan Wang* (Science)

Poster Presentation Abstract Number: 1422
Presentation Time: Session 3: 12:00-1:00pm

Isolation and Titering of a Bacteriophage Infecting Arthrobacter Globiformis

STEM

Authors(s):
Ysabella Conner† (Science); Shriya Nithya Palani‡ (Agriculture|Engineering|JMHC); Alyssa Brianna Sutherlin* (Agriculture|Engineering|JMHC)

Abstract:
Bacteriophages are viruses that infect bacteria, replicate within them, and are found in almost everything. Phage treatment can be an alternative to antibacterial resistance when fighting a disease, which can be very helpful. With the emergence of CRISPR technology, bacteriophages can be even more powerful tools in fighting diseases when genetically modified for a specific disease. This project focused on isolating a bacteriophage from a soil sample capable of infecting the bacterial host, arthrobacter globiformis. Direct isolation was performed to identify potential bacteriophages in the soil samples. After isolating a phage with a small plaque size- laboratory techniques such as serial dilution, spot titers, and full plate titers were used to purify and amplify the phage sample to a concentration acceptable to the national phage database, hosted by Howard Hughes Medical Institute (HHMI). Continued work is expected to determine the lysogen status of this phage, visual imaging by electron microscopy, and final archival to the database. Future research could be centered on annotating sequences of phage DNA.

Mentor(s):
Kari L Clase (Agriculture|Engineering)

Other Acknowledgment(s):
Taylor Sophia Buchowski* (Agriculture|Engineering); Marcelo Inaki I Guerrero Montalvan* (Agriculture); Amanda K Limiac* (Agriculture|Engineering)

Poster Presentation Abstract Number: 1423
Presentation Time: Session 3: 12:00-1:00pm

The effects of N-glycanase 1 and Valosin-containing protein on alpha-synuclein aggregation

STEM

Authors(s):
Samuel S Copeland† (Science|JMHC); Armitha M Gade† (Liberal Arts|Science|JMHC)

Abstract:
This research aims to determine how mutations in the N-glycanase 1 (NGLY1) gene and NGLY1 interactions with its binding partner VCP affect aggregation of the neuronal protein alpha-synuclein (aSyn). Aggregation of aSyn is a hallmark of Parkinson disease (PD). Mutations in the NGLY1 gene lead to NGLY1 deficiency, a disease characterized by developmental delay, tremor, and hypotonia. NGLY1 mutations that disrupt enzymatic activity or protein stability can alter protein degradation activity and cause a buildup of misfolded proteins that are toxic to neuronal cells. Valosin-containing protein (VCP) binds to NGLY1 to help unfold protein substrates and prepare them for proteasomal degradation, but how NGLY1 and VCP interact to promote aggregate clearance is poorly understood. In this study, we examine the effects of NGLY1 and VCP mutations on the aggregation of aSyn in wildtype and NGLY1 knockout HEK cells or human induced pluripotent stem cell (hiPSC)-derived neurons in an aSyn aggregation model. These mutations are made via site-directed mutagenesis and introduced to the cells as transgenes on expression plasmids or adenoviruses. Downstream experiments include confocal imaging and Western blotting. The results of these studies will yield insights into molecular mechanisms governing protein aggregation, setting the stage for developing disease-modifying therapies.

Mentor(s):
Jean-christophe Rochet (Pharmacy)

Other Acknowledgment(s):
Bryce Colon* (Pharmacy)

Poster Presentation Abstract Number: 1424
Presentation Time: Session 3: 12:00-1:00pm

Forecasting the Remaining Shelf Life of Individual Apples from Hyperspectral Imaging

STEM

Authors(s):
William Louis Culbertson† (Engineering)

Abstract:
Produce shelf life is managed by the batch, even though individual fruit from the same batch can spoil days apart. This project asks whether a single hyperspectral image of an apple can predict how many days remain before that apple spoils, with a calibrated uncertainty range. Per-fruit prediction from spectra has been reported for several fruits, including avocados and kiwifruit, but I found no published work on apples and none that frames the problem as survival analysis, in which fruit still sound at the end of the experiment are kept as censored observations. The proposed rig images about 90 apples once a day with a hyperspectral camera on a motorized cart in a dark, air-conditioned room. Each apple that expires is replaced with a fresh one, for roughly 300 to 400 apples over about 12 weeks. Survival models are trained on the resulting per-apple image series, and the dataset and code will be released.

Mentor(s):
Kevin T Lee (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1425
Presentation Time: Session 3: 12:00-1:00pm

Detecting Cyber Intrusion with Firewalls

STEM

Authors(s):
Sameer Dash† (Polytechnic)

Abstract:
Firewalls are used to protect computers and systems from malicious cyber attacks. Researchers have observed that firewalls do not always detect intrusions. This project aims to better understand how virtual machines can enhance firewalls to better protect from future intrusions. To explore this issue, this project will use two custom virtual machines (VMs) with firewalls in them to test each VM's capacity to detect malicious intrusions. Each VM will be subjected to cyber attack simulations in order to collect data about its accuracy in detecting intrusive activity. Each firewall will be analyzed to compare integrity before and after the cyber attack simulations. This analysis will help cyber researchers better understand the types of VMs and firewalls needed to prevent future intrusions.

Mentor(s):
Jon Walatkiewicz (Polytechnic); Scotty Secrist (PWL)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1426
Presentation Time: Session 3: 12:00-1:00pm

WITNESS: Evaluating Computer Vision as a Reliable Measurement Tool for Laboratory Process Tracking

STEM

Authors(s):
Suyash Dash† (Polytechnic|JMHC)

Abstract:
Manual laboratory fabrication depends on skilled human actions, but documenting exactly what occurred and when often still relies on manual observation. This project investigates whether computer vision can serve as a reliable measurement tool for tracking observable events during a lignin film casting process used in wearable device fabrication. A fixed camera will record the laboratory workspace while pretrained computer vision methods for object detection, hand tracking, and temporal analysis identify defined events such as container pickup, pour initiation, and film transfer. The goal is not only to recognize an action, but also to determine whether the system measures that action consistently and at the correct time. Predicted event timestamps will be compared with an independent Arduino timing reference, and detections will be compared with labels created independently by two human reviewers. Repeated scripted trials and controlled changes in lighting, viewpoint, and glove color will be used to evaluate repeatability and identify major sources of error. Pilot recordings collected with a Pupil Core eye tracking headset have been processed to refine sensing requirements, event definitions, and the planned context and step recognition pipeline. The intended result is a timestamped event log containing event type, confidence, and supporting video frames, together with a reusable procedure for evaluating when vision based process measurements can be trusted. This work aims to support more reliable, traceable, and reproducible monitoring of laboratory and manufacturing processes.

Mentor(s):
Wenzhuo Wu (Engineering); Robert Jose Ccorahua santo (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1427
Presentation Time: Session 3: 12:00-1:00pm

Separation of Dyes by Column Chromatography: A General Chemistry Laboratory Experiment

STEM

Authors(s):
Vivian de Toledo Krainer† (Liberal Arts|Science|JMHC)

Abstract:
Column chromatography is an important separation technique commonly used in organic chemistry, where students often perform it at scale with no prior hands-on experience. The purpose of this project was to develop a general chemistry experiment that introduces students to the technique on a smaller scale early on their academic career using dyes extracted from a commercially available bath bomb. This approach allows students to observe the separation with their own eyes, and the experiment relies on intermolecular forces, a key general chemistry concept, to explain the separation. The procedure includes two miniature columns built in Pasteur-pipets: a normal-phase silica gel column, eluted with increasingly polar mixtures of hexane and ethyl acetate, and a reverse-phase C18 column, eluted with progressively less polar mixtures of water and ethanol. Instead of following a fixed procedure, students must evaluate the progress of their own separation after each solvent is added and decide whether to continue or switch mixtures. This gives students experience adapting to experimental results while observing how the relative polarities of the stationary and mobile phases drive retention and elution. After performing the separation, students then use UV-Vis spectroscopy to compare the absorbance spectra of collected fractions with their initial samples and assess whether individual dye components were successfully isolated.

Mentor(s):
Hannah Elise Starr (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1428
Presentation Time: Session 3: 12:00-1:00pm

Confined Fast Scan Cyclic Voltammetry Enables Kinetic Analysis of Battery Separators

STEM

Authors(s):
Hannah Dengler† (Science); Kaleb Caudle‡ (Science)

Abstract:
With the growing demand for sustainable energy storage, aqueous zinc metal batteries (AZMBs) are rapidly gaining attention as a safer and lower-cost alternative to traditional systems. While current efforts have primarily focused on attempting to mitigate hydrogen evolution and dendritic growth reactions via alternative electrolytes, additives, and electrode designs, other cell components are fundamentally understudied. Specifically, there is a lack of research on the kinetics and combinatory physical properties of battery separators, including ion transport rates, reaction kinetics, and the overall influence of separators on dendrite formation. To elucidate separator kinetics and interfacial chemistry, we developed confined fast scan cyclic voltammetry (CFSCV) where we utilize applied mechanical pressure with an ultramicroelectrode (UME) to replicate realistic battery conditions. Using CFSCV, we're able to couple the benefits of UME analysis with relevant conditions as a complementary approach to traditional techniques. Additionally, we employ material (scanning electron microscopy (SEM) and X-ray diffraction (XRD)) and electrochemical characterization (electrochemical impedance spectroscopy (EIS) and galvanostatic charge and discharge curves) to observe differences in morphology, reaction side-products, and performance. By utilizing a new dimension of analysis, CFSCV provides direct insight into localized mass-transfer limits and reaction rates through measurements in both bulk and confined geometries. These findings demonstrate the critical role that separator chemistry plays in mass and charge transfer and establishes a methodology for evaluating separator kinetics in AZMBs.

Mentor(s):
Jeremy Hugh Lawrence (Science); Jeffrey Edward Dick (Science)

Other Acknowledgment(s):
Md Arif Faisal* (Science); James Hoang Nguyen* (Science); Ashutosh

Rana* (Science); Emily Lucille Richardson* (Engineering|JMHC); Abigail N Hernandez* (Science)

Poster Presentation Abstract Number: 1429
Presentation Time: Session 3: 12:00-1:00pm

Characterizing Challenge-Specific Movement Responses in Young and Middle Aged Adults using Wearable Sensors

STEM

Authors(s):
Sharvari Deshpande† (Engineering|JMHC); Nadina Sudha Ramesh† (Science|JMHC); Vedaansh Jethlia† (Science|JMHC)

Abstract:
Healthy adults may perform similarly during routine mobility tasks even when they use different movement strategies or respond differently as task demands increase. Identifying these differences is critical for detecting early changes in mobility. The purpose of this project is to develop a quantitative framework for characterizing performance and movement responses during challenging Figure-8 walking and standing balance tasks. Participants complete self-paced Figure-8 walking, target-speed walking near 120% of their self-paced speed, accuracy-constrained Figure-8 walking, and standing balance under firm and foam surface conditions with eyes open and closed. Wearable inertial sensors placed on participants' trunk and the lower limbs are used to measure accelerations, and additional center-of-pressure measures are utilized to characterize responses to standing balance challenges. Analysis methods are being developed to map sensor data onto the Figure-8 path, separate straight and turning segments, quantify task performance, and express movement changes relative to each participant's baseline. We will evaluate whether challenge-specific gait and balance measures provide complementary information and whether a small set of summary measures can capture an individual's overall response to motor challenges. This project will establish an analysis pipeline for a larger study aimed at identifying individual differences in mobility and the balance of middle-aged adults.

Mentor(s):
Satyajit S Ambike (HHS); Jeffrey M Haddad (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1430
Presentation Time: Session 3: 12:00-1:00pm

Emerging Trend Prediction

STEM

Authors(s):
Jared Dong† (Engineering); Aryan Anand† (Engineering); Anika Saha† (Science); Ojas Rahul Deshpande† (Science)

Abstract:
The current methods for finding emerging trends in text can tell when a topic is small and starting to grow, but they cannot tell whether that topic will become a major trend or fade out, and most of them fade out. For example, BERTrend, the method we build on, labels every topic each week as noise, a weak signal, or a strong signal based on how popular it is, but those labels only describe the current week and do not predict where the topic is going. We use BERTrend's popularity scores and labels as input to a deep learning model that predicts whether a weak signal will become a strong signal within the next eight weeks. We used about 288,500 New York Times news articles from January 2016 to May 2023 and split them into 386 weekly slices, and for each topic we tracked its weekly article count, a popularity score that decays when it goes quiet, how fast that score grew, and how many sections and reporters covered it. Each time a topic was flagged as a weak signal, we took its last eight weeks of history as one example and labeled it by whether it became strong in the eight weeks after, which gave us about 100,000 examples. We split the data by time, so the model is always tested on weeks that come after the ones it was trained on, with a gap between the periods so no future information leaks into training. In our first results, a neural network ranked weak signals better than chance (ROC-AUC of 0.59), and of the 20 topics it ranked most likely to grow, 17 became strong signals, compared to about half of all weak signals. The neural network did about the same as a logistic regression baseline, and topics found by clustering article embeddings did almost the same as topics built from the articles' keyword tags. Our final product will be a model that reads each weak signal's weekly history in order and predicts both whether it will become a strong signal and how many weeks that will take, so each week it can give a ranked list of the weak signals most worth watching.

Mentor(s):
Soudabeh Taghian Dinani (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1431
Presentation Time: Session 3: 12:00-1:00pm

Synthesis and Characterization of Uranium and Thorium Complexes with Nitrogen-Based Ligands

STEM

Authors(s):
Keya Dutta† (Science)

Abstract:
Uranium and Thorium metals can form complexes with different types of nitrogen-based ligands. Studying these complexes helps researchers understand how the choice of ligand affects the structure, bonding, and reactivity of actinide compounds. Although uranium imido complexes have been studied extensively, synthesizing related thorium compounds remains challenging because thorium has different redox chemistry and metal-ligand bonding properties. Developing new methods to prepare uranium and thorium complexes can help expand our understanding of actinide chemistry.

This research focuses on synthesizing new uranium and thorium complexes supported by nitrogen-based ligands and identifying reaction conditions that allow these compounds to form. The uranium portion of the project investigates imido and anilido complexes with different ligand structures, while the thorium work explores synthetic methods for preparing related compounds. Because small changes in experimental conditions can affect the products formed, reactions are tested under different conditions, including changes in solvent, temperature, reaction time, stirring duration, and light exposure. These variables are evaluated to improve the synthesis procedure and better understand how reaction conditions influence product formation.

Reactions are performed under air-free conditions using glovebox and Schlenk techniques. Infrared (IR) spectroscopy, nuclear magnetic resonance (NMR) spectroscopy, and mass spectrometry are used to analyze reaction products and help evaluate the outcomes of different synthetic approaches. Particular attention is given to how reaction conditions affect the formation of desired complexes and the production of unwanted byproducts. Through the synthesis of new actinide compounds and the optimization of their preparation, this work aims to establish more effective synthetic methods and support further research into uranium and thorium coordination chemistry.

Mentor(s):
Suzanne C Doucette (Science); Mackenzie Catherine Weaver (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1432
Presentation Time: Session 3: 12:00-1:00pm

Cell wall stress sensing by the SCAR/WAVE-ARP2/3 actin filament nucleation pathway maintains tissue integrity in Arabidopsis

STEM

Authors(s):
Kimberley Susan Duzek† (Science)

Abstract:
The leaf epidermis is a dynamic biomechanical shell that integrates growth across spatial scales to influence organ morphology. The dicot epidermis is comprised of pavement cells that morph irreversibly into interdigitated cells that enable planar leaf expansion. The process is intimately linked to continuous cell wall remodeling. The biomechanical importance of the cell-cell interface is being analyzed using combinations of genetics, live cell imaging, and finite element (FE) computational modeling. This approach allows us to discover complex interactions among cell/tissue geometry, cell wall material properties, growth patterns, and cell wall force-sensing feedback control mechanisms that drive predictable morphogenetic outputs. We have previously shown that the magnitudes and directions of tensile stresses in cell walls are sensed by the cortical microtubule system to pattern both organ-scale planar morphogenesis and subcellular interdigitated growth. The next generation of FE models contain more realistic cell-cell interactions that are enabling analyses of the forces that destabilize cell-cell contacts and the physical integrity of epidermis. I analyzed the relationship between the presence of BRK1 localized at the lobe apex of pavement cells and the orientation of microtubules emanating from the nearby anticlinal wall interface. The coherency of microtubule angles, extent of BRK1 enrichment, and number of microtubules splayed from the anticlinal wall interface were identified as most informative for evaluating this relationship. I found that BRK1 enrichment at the lobe apex is associated with coordinated microtubule organization at the anticlinal wall of the adjacent cell. These findings suggest that as the microtubules generate tensile stress, BRK1 may contribute to both the sensing of mechanical stress and the maintenance of adhesion between adjacent cell walls. These results are important because they reveal new types of important forces of development.

Mentor(s):
Daniel B Szymanski (Agriculture); Eileen L Mallery (Agriculture)

Other Acknowledgment(s):
Thomas H Siegmund* (Engineering); Tanner James Ballance* (Engineering); Sydney Noel Szuba* (Engineering)

Poster Presentation Abstract Number: 1433
Presentation Time: Session 3: 12:00-1:00pm

Transformational Tools and Technologies Project

STEM

Authors(s):
Michelle Catherine Eno† (Engineering|JMHC)

Abstract:
The National Aeronautics and Space Administration's Transformational Tools and Technologies Project aims to characterize additively manufactured metallic materials and their defects in order to validate predictive models. As part of this project, tensile and fatigue specimens were machined out of a metal alloy, Inconel 718, created using an additive manufacturing process, laser powder bed fusion, with a laser power of 285 W and a scanning speed of 960 mm/s. A tensile specimen was tested using digital image correlation (DIC) to measure the deformation of the material and determine its yield stress. Then, the ten fatigue specimens were tested with maximum loads from 1800 lbf to 800 lbf. The resulting fatigue data were used to create a delta stress vs. cycles to failure plot, which helped determine the fatigue strength and behavior of the material. Fractology was also conducted on the failure surfaces of the failed specimens using a scanning electron microscope to identify crack initiation regions, manufacturing defects, and the composition of various features. Several round particles were found, suggesting that there might have been lack-of-fusion defects occurring during the manufacturing process. The results from these tests provide useful information for understanding the mechanical performance of Inconel 718. This project and testing are ongoing for additional manufacturing parameter sets.

Mentor(s):
John Newman (NASA Langley Research Center)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1434
Presentation Time: Session 3: 12:00-1:00pm

Radio-Frequency Front-End (RFFE) for Synthetic Aperture Radar (SAR) Operating at 5.8 GHz

STEM

Authors(s):
Nezar Fahmi† (Engineering); Charles David Shimala† (Engineering); Hsin Ya Lin† (Engineering); Alexander Pavlovich Novokshonov† (Engineering); Alexander Lam Nguyen‡ (Engineering)

Abstract:
Synthetic aperture radar (SAR) is a radar imaging technique that uses measurements collected from a moving antenna to create a much larger effective aperture, allowing higher-resolution images without requiring a large antenna. Unlike a conventional camera, SAR uses radio waves rather than visible light, making it useful for remote imaging in conditions where optical cameras are limited, such as darkness, cloud cover, or severe weather. Our project focuses on developing a compact 5.8 GHz SAR system that could be used for applications ranging from general terrain imaging to re-imaging areas during or after storms. We designed and built the RF front-end hardware and antenna interface to transmit and receive the radar signals on a custom printed circuit board (PCB). The goal is to collect reflected signals from multiple positions and process them to reconstruct an image of the environment. Because this is a compact student-built system, its range and resolution is limited by factors such as bandwidth, antenna size, transmit power, and motion accuracy, so the current focus is demonstrating reliable radar imaging before improving the system's resolution, range, and overall performance.

Mentor(s):
Andrew Owen Fewell (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1435
Presentation Time: Session 3: 12:00-1:00pm

AFT x07 SoC Bring-Up Board: Silicon and Hardware Validation

STEM

Authors(s):
Dhruv Ghosh† (Engineering); Deepti Murali Rao† (Engineering); Melinda Liu† (Engineering); Simarpreet Singh‡ (Engineering)

Abstract:
Transitioning a System-on-Chip (SoC) from fabrication requires robust testing to catch design flaws before integration. To facilitate this testing, engineers use bring-up boards are printed circuit boards (PCBs) that serve as these device physical test platforms for validating and debugging a new SoC. While a previous breakout board for the x07, (a RISC-V SoC) covered basic pin testing, validating the x07 requires extensive test bench equipment and lacks proper infrastructure for testing power, signals, and board functionality. To address these limitations, our project aims to develop a comprehensive bringup board to ensure that the chip functions as intended before being placed into the dev board. To achieve this, the board will feature integrated power regulation from USB-C (5V/PD), current protection via shunt resistors, overcurrent protection through eFuses, and high-speed communication through USB-to-UART interfaces.

However, integrating these subsystems presents a key technical challenge: routing power, signal, and clock subsystems without compromising signal integrity. While the board will support initial power and signal validation, it won't replace the comprehensive functional verification of the SoC. It will prioritize safely powering the chip, monitoring its behavior, and providing access to signals for debugging. Ultimately, this project will create a printed circuit board that enables initial validation of the x07's power and signals, helping identify potential hardware issues before integration and reducing downstream debugging efforts for embedded software developers.

Mentor(s):
Moe Wai Yan Myint (Engineering); Boyuan Chen (Engineering); Mark Johnson (Engineering); Matthew A Swabey (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1436
Presentation Time: Session 3: 12:00-1:00pm

RoadRunner GPU

STEM

Authors(s):
Syd Ghosh† (Engineering); Ethan Maxwell Richards† (Engineering); Matthew Yao† (Engineering); Gabriel Andres Baldoni† (Engineering); Arina Harlanovich† (Engineering); Azamat Eshmuratov† (Engineering)

Abstract:
Real-time 3D rendering works by transforming triangles in 3D space, rasterizing them into pixels, and coloring those pixels through stages such as texturing, depth testing, and alpha blending. These stages are typically implemented in dedicated graphics processing unit (GPU) hardware. To build a graphics performance research platform for SoCET, our team is developing a complete fixed-function GPU hardware-software stack synthesized on an FPGA. Prior FPGA-based fixed-function GPUs have had limited performance, which capped supported workloads at roughly the level of late-1990s titles such as Quake II (1997). We raise this ceiling to mid-2000s fixed-function workloads. Our GPU is driven by a Windows host through a custom driver and renders a representative mid-2000s 3D workload at 60 frames per second at 1024×768 resolution, even though FPGA clock speeds are lower than those of ASIC implementations.

Mentor(s):
Charles Spencer Bowles (Engineering); Zach Anthony Barna (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1437
Presentation Time: Session 3: 12:00-1:00pm

From Student Voice to Autonomy-Supportive Teaching: Exploring Student Pedagogy Advocate Partnerships Through SDT

Humanities

Authors(s):
Aarushi Gupta† (HHS|Science); Nia Simone Gaten* (Liberal Arts); David Alexander Ransom* (HHS|JMHC)

Abstract:
Student engagement is an important component of effective teaching and learning, however opportunities for students to meaningfully influence classroom practices can be limited by traditional instructor-student hierarchies. The Student Pedagogy Advocates (SPA) Program at Purdue University addresses this challenge by positioning students as collaborative partners who provide faculty with constructive feedback about classroom experiences and teaching practices. This project is guided by Self-Determination Theory (SDT) and examines how student-faculty pedagogical partnerships may support the psychological needs of autonomy, competence, and relatedness that contribute to meaningful engagement in learning.

Building on the SPA program's existing theoretical framework, the proposed study will explore how SPAs and participating faculty describe the partnership process, identify opportunities for pedagogical improvement, and navigate communication and feedback. The project will use a qualitative analysis of existing SPA reflections, interviews, or other approved program materials based on data availability. Findings from the study will be organized around SDT's three psychological needs: autonomy, competence, and relatedness while also allowing additional themes to emerge from participants' experiences.

This project aims to clarify how structured student-faculty partnerships can create opportunities for students to contribute meaningfully to instructional improvement, and for faculty to reflect on classroom practices. Overall, the project may inform the development of more collaborative, autonomy-supportive learning environments and offer practical insights for institutions seeking to strengthen student-centered teaching by connecting student perspectives with a theory-driven understanding of motivation and engagement.

Mentor(s):
Daniel A Guberman (PWL)

Other Acknowledgment(s):
Kal Holder* (Science); Kelsey Smart* (HHS); Shelby Alexis Palmer* (Science); Akhil Pinnapareddy* (Engineering)

Poster Presentation Abstract Number: 1438
Presentation Time: Session 3: 12:00-1:00pm

From Foot Traffic to Food Sales: Increasing Student Dining Purchases at PMU

Business Case Study

Authors(s):
Devin Gutierrez-Herrera† (Polytechnic); Sophia Jeanette Clayton† (Agriculture); Ananya Bhumireddy† (Polytechnic); Robert Connor Mohre† (DSB); Ahmed Yousef† (Polytechnic); Timothy Francis Taylor† (Polytechnic)

Abstract:
This study investigates strategies to increase student food spending at the Purdue Memorial Union (PMU) by improving convenience, perceived value, and awareness of available dining options. Preliminary analysis of annual transaction data indicates that 48% of purchases are made using Dining Dollars, using Purdue's set spending allowance payment system. In addition, approximately 28% of PMU visits, a mere 700,000 of 2.5 million recorded, resulted in a dining purchase, suggesting substantial untapped demand among existing foot traffic. The return of Grubhub delivery to campus presents a further opportunity to expand access to PMU dining beyond the building itself. Using data gathered through undergraduate (Qualtrics) student surveys, the project evaluates several approaches, including delivery integration, payment structures, meal preference, food attribute importance, frequency of visit, and travel distance to encourage more frequent purchases at PMU dining locations. The core goal is to increase food sales by developing a deeper understanding of student purchasing behavior and by making campus dining more convenient and appealing.

Mentor(s):
James Tanoos (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1439
Presentation Time: Session 3: 12:00-1:00pm

Effect of Cognitive Load in Mandarin–English Bilinguals

Social Science

Authors(s):
Alivia Caroline Hale† (HHS|Liberal Arts)

Abstract:
While bilinguals are adept at separating their two languages, their languages may interact in a process termed cross-linguistic interference (CLI). Previous research has shown that orthographic depth – how closely linked a language's orthographic spelling and phonetic pronunciation are – modulates CLI, with more transparent orthographies (i.e., phonetic spelling) resulting in greater phonetic CLI. Mandarin, which can use either logographic (i.e., characters) or phonetic (i.e., Pinyin Romanized spellings) orthographies, represents an ideal test case for the role of orthographic depth in CLI. However, a recent study (Cheng et al., in progress) on Pinyin–English code-switches found increased phonetic dissimilarity (i.e., divergence), instead of the expected convergence. The current study examines potential underlying causes for the lack of cross-linguistic interference, and tests whether reading Pinyin is associated with greater cognitive load than reading Mandarin characters.

A total of 24 participants produced Pinyin–English switched utterances and Character–English switched utterances (total utterances = 5,400). Productions were examined with respect to speech rate (i.e., syllable duration), and it was hypothesized that participants will produce Pinyin–English sentences more slowly than Character–English sentences.

Preliminary results from 5 Mandarin–English bilinguals showed that the Pinyin–English sentences had a greater syllable duration (M = 0.29s) than the Character–English sentences (M = 0.26s). Statistical analysis indicated a significant effect of condition ($p < .001$), supporting the hypothesis that participants take longer to read Pinyin–English code-switching sentences as opposed to Character-English code-switching sentences. These findings are consistent with the account that greater processing demands associated with reading Pinyin may contribute to the unexpected phonetic divergence observed during Pinyin–English code-switching.

Mentor(s):
Daniel J Olson (Liberal Arts); Yiying Jiang (Liberal Arts); Yi-Fang Cheng (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1440

Presentation Time: Session 3: 12:00-1:00pm

Early gut microbial signatures distinguish slow- and fast-growing nursery pigs

STEM

Authors(s):
Sarabeth Hargarten† (Agriculture); Nina O'Tain* (Agriculture)

Abstract:
The post-weaning period is a critical stage of gastrointestinal development in nursery pigs, characterized by substantial changes in gut microbial communities and variable growth performance. Although the gut microbiome has been associated with growth and intestinal health, how these relationships vary during the early post-weaning period remains unclear. This study aimed to investigate associations between fecal microbial composition and growth performance at 2 and 4 weeks post-weaning. A total of 135 Duroc nursery pigs were enrolled in the study. Body weights were recorded at weaning and at 2 and 4 weeks post-weaning. Fecal samples were collected at weeks 2 and 4 for microbiome profiling using 16S rRNA gene amplicon sequencing. Pigs were categorized into quartiles (Q1–Q4) based on average daily gain (ADG), and microbiome comparisons focused on pigs in the lowest (Q1) and highest (Q4) ADG quartiles. Alpha diversity did not differ significantly between growth groups at either time point ($P > 0.05$). At week 2, microbial community composition differed significantly between the lowest and highest ADG groups based on Bray–Curtis dissimilarity ($R^2 = 0.120$, $P = 0.001$), weighted UniFrac ($R^2 = 0.186$, $P = 0.001$), and unweighted UniFrac ($R^2 = 0.051$, $P = 0.006$). In contrast, no significant differences in microbial community composition were detected at week 4 using these distance metrics ($P > 0.05$). Differential abundance analysis identified several bacterial taxa associated with growth performance. At week 2, multiple Lactobacillus and Limosilactobacillus amplicon sequence variants were enriched in the lowest ADG group, whereas Anaerostipes and Clostridium were enriched in the highest ADG group. At week 4, fewer significant differences were detected between the growth groups. These findings suggest that growth-associated differences in gut microbial composition are more pronounced at 2 weeks post-weaning, highlighting the importance of early microbial development in pigs.

Mentor(s):
Tingting Ju (Agriculture)

Other Acknowledgment(s):
Jose Carlos Cabezas Alvarez* (Agriculture)

Poster Presentation Abstract Number: 1441
Presentation Time: Session 3: 12:00-1:00pm

Predicting Cancellations Before Check-In: Improving Hotel Overbooking Decisions

Business Case Study

Authors(s):
William Hensel† (DSB); Kevin Michael Pelletiere† (DSB); Grace Sophia Illingworth† (DSB); Arya Lalchand Rupreja† (DSB)

Abstract:
How can hotels make better overbooking decisions when they cannot know which reservations will be canceled? Unexpected cancellations leave rooms empty, while excessive overbooking forces hotels to turn away arriving guests. We aim to predict whether a reservation will be canceled using information available at booking, to support better overbooking limits.

We use the Kaggle Hotel Booking Demand dataset: 119,390 reservations from two Portuguese hotels (2015–2017), each with 32 original variables, including the target is_canceled (about 37% canceled). Key predictors include lead time, booking channel, and previous cancellations. Bookings made over a year ahead cancel about five times as often as last-minute ones, making lead time a key predictor. Limitations include 31,994 duplicates, invalid and missing values, outcome-revealing variables, and only two hotels.

Preparation includes removing duplicates, correcting invalid entries, handling missing values, encoding categoricals, and excluding variables unavailable at booking or revealing the outcome. A majority-class classifier will set the baseline, followed by logistic regression. We will then test decision tree, random forest, and gradient boosting models, which capture nonlinear relationships and interactions. We will train on 2015–2016 arrivals, test on 2017, and use time-ordered cross-validation in training, since random splits overstate performance. PR-AUC is our primary metric because cancellations are the minority class and it rewards finding likely cancellations while limiting false alarms. ROC-AUC, F1, and a cost-based threshold will supplement it.

These findings could help hotels set overbooking limits, design deposit policies, and contact high-risk guests early. Predictions cannot eliminate uncertainty, but they could improve occupancy and reduce revenue lost to cancellations.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1442
Presentation Time: Session 3: 12:00-1:00pm

Structured and Unstructured Sparsity Exploration and Implementation for AI Accelerator Atallax02

STEM

Authors(s):
Edward Hu† (Engineering); Aarsh Nishant Dave† (Engineering); Priya Adiga† (Engineering|JMHC); Vedant Sharma† (Engineering); Roni H Aziz† (Engineering); William Shao-wei Lo† (Engineering); Ca Dinh† (Engineering); Bruno Formiga Grubhofer† (Engineering); Adi

Abstract:
As the scale of AI models increases, the number of computations due to increasingly larger matrix multiplication datasets increases. These datasets may contain non-contributing zero values that waste time, energy, and space, making it possible to utilize this sparsity to systematically remove non-contributing values to the final output, drastically improving performance to 2x improvements in speed, energy efficiency, and memory overhead with just 50% sparsity support. To implement this on the AI Accelerator Atalla, co-design adjustments to both the existing software and hardware stack to handle structured sparsity are necessary. Currently, Atalla's architecture assumes dense matrices and cannot handle sparse matrices, so support would require extra hardware and software support. Hardware adjustments to the Global Systolic Array Unit (GSAU) and Systolic Array are necessary to allow sparse data, with software pre-processing to track non-zero indices within the data to compact the sparse matrices into useful data. To verify functionality, cycle-accurate simulations of the designs will be implemented to demonstrate correct dataflow, with benchmarking done with industry standard models such as ResNet-50. The goal of this project is to exploit the sparsity of sparse models while staying within the timing and area constraints of Atalla. However, this structured sparse design handles only 50% sparsity, with a limited theoretical improvement ceiling, so further exploration may involve unstructured sparse architecture. Both implementations of sparsity must be carefully considered in the context of Atalla, as the sparsity implementation itself has the potential to add area and power overhead that would wipe out any improvements.

Mentor(s):
Hassan Al-alawi (Engineering); Leon Anthony Petrulio (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1443

Presentation Time: Session 3: 12:00-1:00pm

An Energy-Efficient CLGB Amplifier with Isolation Buffering and Adaptive Compensation for Wireless Power Transfer Receivers

STEM

Authors(s):
Mohamed Adel Elsayed Abelmoaty Ibrahim† (Engineering); Eric Hou† (Engineering)

Abstract:
Wireless Power Transfer (WPT) application circuits require error amplifiers capable of driving large capacitive loads. Traditionally, previous works on two-stage amplifiers have struggled with low stability and bandwidth, as massive capacitive loads heavily burden the output stage. To maintain stable conditions under fluctuating WPT load changes and power demands, we developed an energy-efficient amplifier based on a two-stage CLGB and CRS architecture. We developed a behavioral model in Python to simulate how the bandwidth, figure of merit, and other parameters change under stress and load variations. The CLGB (Closed-Loop gm-Boosting) output stage increases transconductance and improves bandwidth, while the CRS (Current-Reuse Stacked) circuit provides transient boosts of current to charge the capacitor, improving the slew rate while maintaining low power conditions at the Q-point. To improve upon the reference architecture, we introduced a unity-gain isolation buffer between the first stage and the boosting amplifier to reduce internal-node loading, alongside a digitally programmable boosting resistor (RD). Simulation results confirmed that with the added isolation buffer, the large input capacitance of the boosting stage no longer loaded the internal node. As a result, the dominant first-stage pole was successfully restored, increasing overall bandwidth. Furthermore, the simulated programmable boosting resistor was able to preserve a safe phase margin across dynamically changing loads. For example, at 12 nF, the amplifier achieved a 1.03 MHz Gain-Bandwidth Product (GBW) and a slew rate of 0.09 V/μs. At steady state, it consumed only 18 μA of total quiescent current, yet remained capable of supplying up to 1.0 mA during large signal transients. This removes the need for large compensation capacitors and saves on power during steady-state operation.

Mentor(s):
Seyedehmarzieh Rouhani (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1444
Presentation Time: Session 3: 12:00-1:00pm

NIL and Money in the Big Ten

Business Case Study

Authors(s):
Nicholas james Intriago† (Polytechnic|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1445
Presentation Time: Session 3: 12:00-1:00pm

Physics-Informed Machine Learning for Inverse Scattering and Operator Approximation in Time-Varying Media

STEM

Authors(s):
Rohan R Iyer† (Engineering)

Abstract:
Traditional photonic engineering relies on spatial variations in the optical properties of materials. Time-varying media are special materials whose characteristics, such as refractive index, change over time. It is possible to construct an analytical solution for predicting the output electric field from their known properties. However, the inverse problem of reconstructing the time-dependent material characteristics from measured electric fields is an ill-posed and high-dimensional challenge. This is because different material responses could produce similar measured fields, making the inverse problem one-to-many. In this work, we use deep learning models such as neural networks to address these challenges, because they act as universal function approximators that can model large, highly continuous problems. We extend this idea to physics-informed machine learning where model inference relies on data efficiency and the inherent physics of the problem. We apply this approach to evaluate the kernel operator that defines electric susceptibility using the input and output fields from a pump-excited sample of indium tin oxide (ITO). Then, we recover material properties such as plasma frequency and the damping coefficient from the differential operator that defines the material dynamics. We explore frameworks ranging from basic multilayer perceptrons to reinforcement learning to identify which workflow analytically describes the physics of time-varying media such as ITO. Ultimately, we aim to construct an inverse design framework to characterize the material properties of a broad range of time-varying media across diverse experimental conditions.

Mentor(s):
Vea Iyer (Engineering); Alexandra Boltasseva (Engineering); Vladimir M Shalaev (Engineering); Alexander V Kildishev (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1446
Presentation Time: Session 3: 12:00-1:00pm

Mapping Uzbekistan's Geologic Formations: Region Outlines for an Open Stratigraphic Lexicon

STEM

Authors(s):
Behruz Izbaev† (Science)

Abstract:
The Stratigraphic Dictionary of Uzbekistan (2001) describes hundreds of geologic formations, but only in Russian and only in words: where a formation occurs is given as a list of regional names. This makes the formations hard to find, map or compare with those of neighboring countries. UzbekistanLex, part of the geolex.org family of online lexicons, is turning this dictionary, translated into English with GeoGPT, into an open, searchable database. My work adds the missing geographic layer. Starting from reference coordinates for 61 stratigraphic regions in the Ustyurt, Kyzylkum-Bukantau, Bukhara-SW Gissar, Zarafshan, Nuratau, Fergana and Chatkal-Kuramin areas, I digitized region outlines in QGIS. Where a mountain range shows in the terrain, I traced it; where the rocks are buried beneath plains, I drew a broad placeholder outline around the reference point. The outlines were exported as GeoJSON and converted to the format the Lexicon reads. Each formation then receives the outline of the region listed for it, and a formation found in several regions gets one combined outline that spans them. In the first two regional files, SW Gissar and Bukhara-Karshin, all 67 formations now carry a GeoJSON footprint, 26 of them spanning more than one region, and outlines are ready for 59 of the 61 regions. With a footprint attached, the Lexicon can show each formation on a map and generate paleogeographic maps of where it was deposited. Next steps are to complete the remaining regions, enlarge the smallest outlines using detailed regional and geological maps from Uzbek geologists, and extend the approach to neighboring countries, starting with Kyrgyzstan.

Mentor(s):
James G Ogg (Science); Aaron C Ault (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1447
Presentation Time: Session 3: 12:00-1:00pm

The Best Methods to Deter Adolescents from Gambling

Humanities

Authors(s):
Bridget A Jakabcsin† (HHS)

Abstract:
Adolescent gambling rates are on the rise coinciding with increasing technological advancements that enable easier access to gambling avenues. A recent Italian study corroborates this growth finding that 70.8% of the surveyed adolescent population had participated in gambling at least once within the past year (Tani, 2020, p. 750). Furthermore, there are higher amounts of gambling advertisements that are inevitably seen by adolescent populations as they appear of popular platforms such as sports networks. When any individual, but particularly adolescents, possess decreased levels of mental well-being there is a higher risk for partaking in gambling behaviors (Pabayo, 2023). This preliminary literature review focuses on determining the best methods to deter adolescents from engaging in gambling habits. I utilize both primary and secondary sources to gather data surrounding adolescent gambling accessibility and prevalence. Additionally, I study how mental health factors are impacting the rates of adolescent gambling. This research is essential to understanding the most impactful ways to decrease adolescents from gambling, especially because gambling is becoming increasingly normalized and prevalent.

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1448
Presentation Time: Session 3: 12:00-1:00pm

Predicting Fair Used-Car Prices to Support Pricing Decisions for Buyers and Sellers

Business Case Study

Authors(s):
Zexi Jin† (DSB|HHS); Kanav Sinha† (DSB); Aaryan Purvish Shah† (DSB|Science); Minji Seo† (DSB)

Abstract:
Is a listed used-car price reasonable given the vehicle's age, mileage, and other characteristics? This project aims to help buyers and sellers make more informed pricing decisions by estimating the fair market value of a used vehicle. We use the Used Car Price Prediction Dataset from Mendeley Data, which contains vehicle listings, with each observation representing one vehicle listing. The dataset contains 10 original variables, including vehicle characteristics and listed price. Our goal is to develop an interpretable regression-based model that estimates used-car prices and identifies the characteristics most strongly associated with price. We prepare the data using Excel and Python, converting formatted price and mileage variables into numerical values, addressing missing or extreme observations, encoding categorical variables, and creating features such as vehicle age. Preliminary analysis shows that prices are right-skewed, with a small number of higher-priced vehicles increasing the overall average. Log Transform price will be used. Older and higher-mileage vehicles generally have lower prices, although these factors alone do not fully explain price variation. These findings support testing a log transformation of price. We will compare a mean or median baseline with linear regression, Ridge regression, and decision tree regression. Linear regression provides an interpretable starting point, Ridge regression helps manage correlated predictors, and decision trees can capture nonlinear relationships. Cross-validation will be used to compare model performance, with mean absolute error (MAE) as the primary metric because errors are interpretable in monetary terms. Root mean squared error (RMSE) and R^2 will also be used. Ultimately, this project aims to help buyers evaluate listed prices, help sellers set competitive asking prices, and support more consistent pricing decisions for dealerships and online marketplaces.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1449
Presentation Time: Session 3: 12:00-1:00pm

Creating a Xenografted Human Vascularized Chimeric Brain Model

STEM

Authors(s):
Oliver Thomas Johnson† (Science|JMHC)

Abstract:
Cerebral blood vessels are essential for transporting nutrients throughout the brain and

regulating the entry of materials into the brain through the Blood-Brain Barrier (BBB).

Dysfunction of the brain's vascular system is linked to conditions such as stroke, vascular

dementia, and Alzheimer’s disease. Growing evidence shows significant differences between

human and mouse vascular cells. For example, human vascular cells express higher levels of

Alzheimer 's-associated genes. Therefore, it is urgent to develop human vascular models to

better understand how the vascular system affects brain health and disease. An in vivo vascular

model, in which human blood vessels are perfused and functionally integrated into the host's

brain, has not yet been developed. To create these models, we will transplant human

Pluripotent Stem Cell (hPSC)-derived vascular progenitor cells into adult mice and allow the

cells to grow and differentiate within the mouse brains. We will examine human vasculature

maturation in host brains by harvesting, sectioning, and immunohistochemically staining the

brains at different times post-cell injection. The staining will target markers for the main cell

types needed for functional blood vessels and the Blood-Brain Barrier: endothelial cells, smooth

muscle cells, pericytes, and astrocytes. Developing this chimeric vascularized brain model will

provide a more physiologically relevant system for studying neurovascular contributions in healthy and diseases conditions, such as Alzheimer's disease and Vascular Dementia

Mentor(s):
Ranjie Xu (Vet Med)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1450
Presentation Time: Session 3: 12:00-1:00pm

Staying Relevant Every Four Years: A Social Media Marketing Strategy For Aj's

Business Case Study

Authors(s):
Saawani Rahul Joshi† (DSB); Brayden S Lee‡ (DSB); Eegan Simon Pandian‡ (DSB); Audrey L Thill‡ (DSB); Anushka Ravindra Wayse‡ (DSB)

Abstract:
[Abstract Redacted]

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1451
Presentation Time: Session 3: 12:00-1:00pm

How does social-media-related FOMO contribute to depressive symptoms among college students?

Humanities

Authors(s):
Pehal Kamra† (HHS|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1452
Presentation Time: Session 3: 12:00-1:00pm

Comparison of Visual Attention Among Experts and Novices on Construction Hazards with Passive Back Support Exoskeleton

STEM

Authors(s):
Ahmed Khan† (Engineering|JMHC)

Abstract:
Musculoskeletal disorders (MSDs) are one of the leading causes of non-fatal injuries in construction, accounting for 35%, and the lower back is one of the most vulnerable body parts. Passive back-support exoskeletons (PBSEs), wearable devices known to reduce lower back fatigue by 37%, have been introduced to reduce lower back MSDs in construction. However, as external devices are worn, using PBSEs may create physical restriction, leading to excessive cognitive load. The extent of this impact is little known, potentially causing workers to not detect a hazard. Identifying hazards is a critical cognitive activity, which can be measured through visual allocation, as workers continuously perform during and between tasks for their safety. Since hazard identification skill develops through deliberate practice, it may be impacted differently among experts and novices due to the extra cognitive load. This study aims to examine whether PBSEs support or distract visual attention to hazards, and whether these effects differ between experts and novices. Using a within-subject design, 25 construction workers (experts) and 15 students (novices) were recruited. While wearing a portable eye tracker, subjects identified hazards on construction site images before and after repetitive lifting tasks to induce fatigue. Their hazard identification score, the number of times gaze landed on a hazard, and the proportion of viewing time spent on hazards were tracked. The results showed that only experts achieved statistically higher hazard identification scores with PBSEs ($p=0.033$). While experts' fixation count and dwell time percentage changed from pre-to-post lifting based on hazard types, these changes were not significant between the PBSE and non-PBSE conditions. This preliminary finding suggests that visual attention of PBSEs may vary depending on subjects' expertise and hazard type, and their deployment may require specific training.

Mentor(s):
Hyewon Seo (Engineering); Behzad Esmaeili (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1453
Presentation Time: Session 3: 12:00-1:00pm

Design of a Dedicated Bring-Up Board for Initial Validation and Debugging of the SoCET AFTx08 RISC-V SoC

STEM

Authors(s):
Seunghyun Kim† (Engineering); Namjeet Kaur† (Engineering); Sara Pandey† (Engineering|JMHC)

Abstract:
Newly developed custom System on Chip (SoC) devices require a dedicated platform to validate their initial functionality such as power rail, clock, reset, and boot configuration. The AFTx08 is a custom RISC-V System on Chip developed as part of Purdue University's SoCET project. It requires a dedicated hardware platform that provides stable power domains and control signals while allowing its internal and external signals to be easily observed and validated. Without having such a platform, it is difficult to have systematic bring-up, verify basic chip functionality, and identify potential hardware problems during the early stages of development.

To address these needs, our project focuses on the design and development of a dedicated printed circuit board (PCB) for the initial power-up, functional validation, and hardware debugging of the AFTx08 SoC. The board provides an interface for the 120-pin AFTx08 package, a 30 MHz reference clock, reset and boot configuration, configurable PLL control, and external access to UART and GPIO through the dedicated headers. In addition, an 18-bit address bus, a 16-bit data bus, and memory control signals are exposed to support validation of the external memory interface. Test points for the core, I/O, analog power rails, as well as clock and reset signals, allow direct measurements and debugging using equipment such as an oscilloscope or multimeter.

The expected outcome of this project is a functional bring-up board that enables systematic initial validation and debugging of the AFTx08 SoC. A successful design would enable users to verify power rail stability, clock and reset operation, boot and PLL configuration, and basic communication through the exposed interfaces. The board prioritizes observability by providing accessible test points and headers which allows the engineers to identify potential hardware problems during the initial testing. Thus, balanced signal accessibility is critical for signal integrity concerns.

Mentor(s):
Moe Wai Yan Myint (Engineering); Boyuan Chen (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1454
Presentation Time: Session 3: 12:00-1:00pm

Study of Metal Extraction with Oxalic Acid from USB Flash Drives

STEM

Authors(s):
Hannah Margeurite Kitts† (Engineering|JMHC); Sadie Catherine van der Spuy‡ (Engineering); Abby L Thompson‡ (Science|JMHC)

Abstract:
E-waste is one of the fastest growing solid waste streams globally. It contains both valuable metals and toxic materials that have potential to leach into the surrounding ecosystems, many of which are known to cause harm to human health. According to the United Nations Institute for Training and Research (UNITAR), 62 million tons of e-waste were generated in 2022, while only 14 million were recycled. The metals within the waste were estimated to be about 31 million tons with a value of about $91 billion in total.

This study evaluates oxalic acid as a potentially selective leachant for metals in waste printed circuit boards (PCBs) from USB flash drives. Previous studies demonstrate that oxalic acid can perform several functions in e-waste hydrometallurgy. In the present study, chopped PCBs were contacted with aqueous oxalic acid in agitated batch experiments conducted at different temperatures and contact times ranging from 15 min to several days. Parallel experiments containing hydrogen peroxide as an oxidant are conducted to determine whether redox assistance enhances metal dissolution and changes extraction selectivity. Dissolved elements in filtered leachates are quantified by inductively coupled plasma–optical emission spectrometry (ICP-OES). Preliminary analyses indicate measurable mobilization of nickel, tin, and titanium under selected conditions.

The research hypothesis is that at a constant oxalic acid concentration and solid-to-liquid ratio, increasing temperature and contact time and adding an oxidant will significantly increase the extraction of Ni, Sn, and Ti from USB-drive PCBs compared with oxalic acid alone, while metal-specific complexation and precipitation will produce selective extraction relative to the major PCB matrix metals.

Mentor(s):
Nadezhda N Zyaykina (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1455
Presentation Time: Session 3: 12:00-1:00pm

Developing an Automated Speech Recognition Application for Transcribing Aphasic Speech

STEM

Authors(s):
Sunay Konnur† (Science|JMHC); Alexia Isabella del Cuvillo† (Engineering|JMHC)

Abstract:
Speech data is crucial in aphasia research and clinical settings because it provides insight into patients' naturalistic communication abilities. However, manual transcriptions are tedious and time-consuming, limiting the extent to which connected speech data is analyzed. Further, standard speech-to-text models are trained on healthy speakers, limiting the effectiveness with speech from people with aphasia (PWA). This study explores automated speech recognition (ASR) alignment approaches to create an automated, accurate transcription pipeline for aphasic speech.

We evaluated three general ASR models: Whisper, Wav2Vec2 and HuBERT. Using a dataset of speech samples and their corresponding manually prepared transcripts, we compared ASR performance to the manual transcripts by using several performance metrics, namely Word Error Rate (WER), Word Match Percentage (WMP), and BLEU-4, which measures similarities in four-word long phrases. We added an interface that highlights low confidence transcribed words to assist with human review and allows for data to be aggregated and exported.

After our analysis of the different models, we decided to use Whisper in our transcription pipeline. This resulted in an averaged WMP of 80% and BLEU-4 score of 0.60, where a higher score is better. The pipeline also resulted in a WER of 30%, where a lower score is better. We additionally included CrisperWhisper, a variation of Whisper helps keep disfluencies and reduce hallucinations. This improved average WMP to 82%, lowered average WER to 24%, and increased the average BLEU-4 score to 0.67.

Overall, we developed a user-friendly web application for an ASR pipeline to more efficiently transcribe aphasic speech. The pipeline uses Whisper or CrisperWhisper based on the user's selection, streamlining transcriptions for aphasia research while also maintaining high accuracy.

Mentor(s):
Alton Chao (HHS); Ji Yeon Lee (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1456
Presentation Time: Session 3: 12:00-1:00pm

Feeding the Gut: Dietary Impacts on Short Chain Fatty Acid Production

STEM

Authors(s):
Norah Riley Kopolow† (Science)

Abstract:
Short-chain fatty acids (SCFAs) are fatty acids comprised of six or fewer carbon atoms from dietary fiber fermentation by human gut microbiota. They play essential roles in gut function, serving as key mediators of regulatory processes. Acetate, propionate, and butyrate are the most abundant SCFAs, and their production and proportions vary depending on microbiota composition and dietary substrate availability. Because substrates are derived from diet, understanding how different dietary patterns influence microbial SCFA production is of great interest. This study aimed to evaluate the effect of diets with varying amounts of whole grain foods and added sugar on microbiome function through in vitro fecal fermentations. During a 12-week, randomized, controlled clinical trial where participants were assigned to one of four intervention groups, each following a defined diet varying in whole or refined grain, and added sugar content: high sugar/high grain, low sugar/high grain, high sugar/low grain, and low sugar/low grain. Fecal samples were collected at weeks 0, 6, and 12 and used as inoculum for in vitro fecal fermentations of five substrates: wheat arabinoxylan, inulin, resistant maltodextrin, resistant starch, and wheat bran. SCFA concentrations were measured at the end of fermentation (6 h) by gas chromatography. SCFA production showed high inter-individual variability regardless of diet, making it difficult to identify patterns in absolute concentrations. Each substrate showed characteristic SCFA production. To account for inter-individual variation, we calculated fold change in SCFA production for each substrate, using each donor's week 0 fermentation as their own control. Diet 4 produced the greatest increase in acetate, and Diet 1 produced the greatest increase in propionate and butyrate across substrates. Together, these data serve as reference values for SCFA production across a fiber panel, offering a foundation to link diet patterns to microbiome function.

Mentor(s):
Stephen R Lindemann (Agriculture); Mariana Guzman Sanchez (HHS)

Other Acknowledgment(s):
Peter Philip Jam Jackson* (Agriculture)

Poster Presentation Abstract Number: 1457
Presentation Time: Session 3: 12:00-1:00pm

How Institutionalization of the Disabled Persists Today in the United States

Humanities

Authors(s):
Addison Lea Krupinski† (Liberal Arts)

Abstract:
In the United States, more than one in four individuals live with a disability, which may be physical, cognitive, sensory, or mental. Institutionalization typically entails placing individuals with various disabilities into segregated, large-scale residential facilities. Studies show that people who are moved from these large institutions to smaller residential settings, compared with those who remain in larger institutions, show significant behavioral improvements. In this study, I plan to interview disabled individuals in community-based living arrangements and those who live independently. Additionally, I will utilize census records, historical legal documents, longitudinal statistical research, peer-reviewed empirical studies, and testimonials. I will examine how institutionalization for disabled individuals in the U.S. has changed in response to public policy, legislation, and deinstitutionalization movements since the implementation of Olmstead v. L.C. (1999). Olmstead v. L.C. (1999) was a turning point case in disability advocacy work that prohibited the unjustified segregation of people in institutions under Title II of the Americans with Disabilities Act (ADA). State-level legal action in compliance with Olmstead, or lack thereof, and structural ableism suggest the uneven implementation of community-based treatment options for disabled people. This study will indicate to what extent large-scale institutionalization persists as a practice currently in the US, and how state-level intervention and implementation impact the availability of living alternatives.

Key words: institutionalization, disability, Olmstead v. L.C., ableism, public policy and bias

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1458
Presentation Time: Session 3: 12:00-1:00pm

Chemical Vapor Deposition (CVD) and Physical Vapor Deposition (PVD) for Through-Silicon Via (TSV) Fabrication

STEM

Authors(s):
Orion Kai Larson† (Engineering); Alexander Peng Fei Symonds† (Engineering); Tzu Huan Chang† (Engineering); Minh Huy Nguyen† (Engineering); Jeffrey Dao Jun Hew† (Engineering|JMHC)

Abstract:
Advanced packaging technologies, including 3D chip integration, are increasingly important for improving semiconductor performance, interconnect density and bandwidth, and reducing package footprint. Through-silicon vias (TSVs) enable vertical electrical connections between stacked dies but presents our team with challenges in achieving sufficient thin-film sidewall coverage as TSV aspect ratios increase.

The APHI VIP@Birck Deposition Team investigates thin-film deposition processes for TSV fabrication. Previous work has established a consistent deposition process flow, which this semester's research aims to further optimize through two objectives: developing a Plasma-Enhanced Chemical Vapor Deposition (PECVD) SiO_2 conformality model across varying TSV geometries and conducting a Physical Vapor Deposition (PVD) designed experiment to improve Cu seed-layer sidewall coverage. The overall fabrication process consists of lithography, deep reactive ion etching (DRIE), deposition of 500 nm SiO_2, 20 nm Ta, and 300 nm Cu, Cu electroplating, and chemical mechanical planarization (CMP). SiO_2 film thickness is measured using a Filmetrics F40, while scanning electron microscopy (SEM) of TSV cross-sections is used to evaluate SiO_2 conformality and Cu sidewall coverage.

These efforts aim to improve dielectric isolation to electrically isolate TSVs from surrounding silicon, downstream Cu electroplating reliability and performance, and process adaptability across different TSV geometries as processes continue to mature.

Mentor(s):
Peter Bermel (Engineering); Zhihong Chen (Engineering); Joerg Appenzeller (Engineering); Saeed Mohammadi (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1459
Presentation Time: Session 3: 12:00-1:00pm

Flow Uniformity of 3D-Printed Hall Effect Thruster Anode Designs

STEM

Authors(s):
Derek Joseph Larson† (Engineering); Robert Maxwell Neitzke† (Engineering); Bailey Marie Jones† (Engineering|Liberal Arts); Aran Thevar† (Engineering|JMHC); Christopher Robert Stemporzewski‡ (Engineering|JMHC); Aayush Ranjan Kumar‡ (Engineering); Samir Meh

Abstract:
Hall Effect Thrusters (HETs) are a highly fuel-efficient electric propulsion system commonly used on spacecraft that use electromagnetic forces to propel ionized gas at high velocities. Most HETs use a precision-machined anode that uniformly distributes propellant gas and acts as an electrode to ionize the propellant gas. Metal 3D-printing, or additive manufacturing, enables the production of previously unmanufacturable geometry and allows production at scales where conventional manufacturing techniques may be difficult. This may allow cost reduction and additional manufacturing methods without sacrificing flow uniformity. This project investigates several testing methods to characterize the flow uniformity of four 3D-printed anode designs intended for the Purdue Undergraduate Rocket Propulsion Lab's (PURPL's) HET V2 model. Testing primarily relied on visual observations and analysis at a choked flow state. The anode designs varied discharge hole orientation and hole manufacturing method. Discharge holes faced either with or against the exhaust direction and were either printed with the part or machined into the design after printing. Designs were also tested with the HET to determine how the anode design affects thruster performance.

Mentor(s):
Alexey Shashurin (Engineering); Nicholas Vytautas Babusis (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1460
Presentation Time: Session 3: 12:00-1:00pm

UVM Verification of Data Integrity, Arbitration, and AHB Protocol Under Backpressure in an Eight-Channel DMA Controller

STEM

Authors(s):
Nguyen Chi Hieu Le† (Engineering); Ashish Singh Dhillon† (Engineering); Ty Forest Bequette† (Engineering|JMHC)

Abstract:
A direct memory access (DMA) controller copies blocks of data so the processor does not have to. In an eight-channel design, all channels share one AHB read port and one AHB write port, and a round-robin arbiter switches channels after each copy. Because queued items from one channel are still on the bus when the next channel begins, three bugs appear only under contention: a waiting channel that is never served, four-beat bursts that cross a 1 KB address boundary, and wait states or bus errors on one channel that corrupt another channel's data.

The existing testbench checks memory only after each copy, so it cannot see data that is later overwritten at the same address. Each test also uses one fixed memory latency, and none runs more than three channels at once.

This project builds a Universal Verification Methodology (UVM) testbench with three checkers. An in-order scoreboard compares each word written with the words read, so it sees every item without depending on exact timing. A fairness checker flags any waiting channel that is passed over for more than seven grants. SystemVerilog assertions check AHB protocol rules, such as stable address and control during wait states and bursts that never cross a 1 KB boundary. Memory models insert random wait states and bus errors.

Sign-off requires 100% functional coverage of transfer mode, data size, burst type, and number of active channels; zero assertion failures; and zero scoreboard mismatches across 100 random seeds.

The approach has limits. The memory models only approximate real bus timing. A continuous-mode channel keeps its grant by design, so the fairness check excludes it. The burst assertion also targets a boundary

violation already known in the design, so it is expected to fail until the design is fixed.

Next, the team will close coverage on single-channel copies, then on eight-channel contention. Each failure will become a regression test with a proposed fix to the design.

Mentor(s):
Srilekha Jagarlamudi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1461
Presentation Time: Session 3: 12:00-1:00pm

Does Listening to Music While Studying Actually Improve Academic Performance?

Humanities

Authors(s):
Dereck Leigh† (Science)

Abstract:
College students frequently listen to music while studying or completing assignments. However, there is still debate if music helps students concentrate and improve their academic performance. Previous studies show that background music can influence attention, memory, and reading comprehension. It shows that most lyrical music could potentially having a negative effect on cognitive tasks, while instrumental music appears to have less of an effect. This research project aims to explore how different kinds of music affect the concentration, information retention, and academic performance of college students though a comparison of studies involving lyrical music, instrumental music, and studying in silence. Through an analysis and comparison of existing peer-reviewed scientific papers, this project will examine how different listening conditions affect memory, reading comprehension, and the completion of academic tasks. Personal music preferences and previous experience studying with music will also be considered, since students may enjoy listening to music even if it does not contribute to their academic performance. Ultimately, this analysis of existing studies aims to identify which listening conditions are most beneficial for college students and provide a better understanding of how everyday study habits can influence academic success.

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1462
Presentation Time: Session 3: 12:00-1:00pm

Building a foundation for training and multi-chip integration through ELF file translation and Backpropagation Implementation

STEM

Authors(s):
Steven Li† (Engineering|JMHC); Arnav Shukla† (Engineering); Brian Zhuang† (Engineering); Peter Alexei Kaya Gretchikha† (Engineering); Aaditi Anupam Vaval‡ (Engineering); Oscar Surendranath‡ (Engineering); Srivalli Akella‡ (Engineering); Tanish Nigam‡ (Eng

Abstract:
As neural networks continue to scale upwards in size, hardware accelerator architectures must efficiently execute workloads that exceed the storage and computational capacities of a single-chip processor. Competent AI models require a lot of training and physical hardware to reach any significant level of usefulness. Currently, the Atalla chip and its related software/compiler lack the infrastructure to scale beyond a single chip, or do any training. The lack of ability to run compiled programs on the chip is something that needs to be implemented as the workload's training needs are massive. We seek to build the foundation to eventually solve all of these problems.

We will introduce the framework to support multi-chip training through two primary additions: ELF file translation to run programs on the Atalla chip, and backpropagation and FP32 training support. Currently, Atalla is able to translate PyTorch models into AtallaC, then eventually it goes through the compiler and outputs an ELF file. Many AI models use specialized software frameworks like PyTorch to run parallel programs. Due to the massive nature of AI models, it is a necessary feature if training is to be done on Atalla. Alongside this, we will introduce backpropagation to allow for training capabilities. If deemed necessary FP32 output capabilities can be added to assist in the training efficiency. With these two additions, we create the last two pieces needed to meet the minimal standards to be a functioning AI chip: the ability to train, and to run programs.

Due to seeking to merely build a bare minimum framework, the actual deliverables will lack optimization, and no multi-chip interconnects will be designed. Atalla0x1, the version we are building off of is also still unfinished, including compiler accuracy, so our work for the time being

will have to run under the assumption that these things will work, and may still have to be changed as other teams are also concurrently adding things to Atalla.

Mentor(s):
Samitha Ranasinghe (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1463
Presentation Time: Session 3: 12:00-1:00pm

Trustworthy Machine Learning: Benchmarking Tools for the Landseer Onboarding Module

STEM

Authors(s):
TingLan Lien† (Engineering); Lilia Bunsey† (Engineering); Pranav Jasti† (Science); Ankita Sriram† (Science); Arvind Rajagopalan† (Engineering)

Abstract:
Machine learning (ML) systems face diverse threats to privacy, robustness, and fairness. Real-world deployments must provide multiple guarantees at the same time, yet defenses are typically developed and evaluated in isolation, and we know little about how existing defenses interact with or interfere with one another. Landseer is an empirical framework for studying these interactions by systematically evaluating a broad range of ML security methods, individually and in combination. However, onboarding a new defense into such a framework often requires substantial manual effort, because research repositories vary in their supported models, datasets, and code structures. To address this challenge, we are developing an agentic onboarding module to automate key stages of defense integration, including environment containerization, paper-based metric extraction, benchmarking, and reproduction of reported results. This work focuses on the benchmarking component: a large language model (LLM)-driven agent, built on LangChain with a provider-agnostic LLM interface, that identifies the models and datasets a repository supports and adapts the repository's code to support additional ones. We are developing and evaluating the agent using an existing backdoor-defense repository associated with the NeurIPS 2022 paper Pre-activation Distributions Expose Backdoor Neurons. To assess generalizability, we plan to evaluate it on additional defense repositories, using task success rates and the level of human intervention required. Future work will extend the agent's benchmarking capabilities and integrate it with the other onboarding components, streamlining the integration and evaluation of new defenses within Landseer.

Mentor(s):
Zahra Ghodsi (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1464
Presentation Time: Session 3: 12:00-1:00pm

Advancing Agrivoltaics: Developing a Model to Encourage Implementation of Agricultural-Solar PV Installations

STEM

Authors(s):
Sydney Paige Lin† (Engineering|JMHC); Maximilian Tianle Wang† (Engineering); Beckett Graham Gideon† (Engineering)

Abstract:
Globally over 32,000 TWh of electricity was generated in 2025, but only about 8% of the generation was from solar photovoltaics, according to the International Energy Agency. At the same time, agricultural exports from the U.S. have increased by over $100 billion since 2001 [1]. As the demand for both energy and food grows, a solution is needed so both power and agricultural production can take place.

A scaled implementation of small solar photovoltaic installations collocated with agricultural farms could help combat the booming demand for energy while providing agricultural products to consumers. Around 51% of the 2022 U.S. land base was used for agricultural purposes, close to 1.15 billion acres [1]. If just 5% of that land was integrated with solar photovoltaics, that would open 57.5 million acres for power generation while still allowing agricultural products to be grown.

Our goal is to develop an improved modeling software based on the existing PV Maps software by Dr. Alam [2] with in-depth details regarding the cost of installation, maintenance, energy buyback rates and more for solar photovoltaics. We expect this tool to provide a clearer financial and practical roadmap, ultimately encouraging individuals and policymakers to invest in integrated agrivoltaics systems.

Reference:

[1] A. Williams and J. Kaufman, "U.S. Agricultural Trade at a Glance" IEEE Spectrum, September 28, 2026. [Online]. Available: https://www.ers.usda.gov/topics/international-markets-us-trade/us-agricultural-trade/us-agricultural-trade-at-a-glance (accessed Oct. 12, 2026).

[2] M. A. Alam and M. R. Khan, Principles of Solar Cells: Connecting Perspectives on Device, System, Reliability, and Data Science. DOI: 10.1142/12139.

Mentor(s):
Peter Bermel (Engineering); Muhammad A Alam (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1465
Presentation Time: Session 3: 12:00-1:00pm

How Do Physiological and Mobility Differences Between Pedestrians Affect Simulated Crowd Behavior?

STEM

Authors(s):
Richard Lin† (Engineering); Jae Man Yim† (Science); Reed Ellis Baker‡ (Engineering); Aishani Sakalabhaktula‡ (Engineering)

Abstract:
Real pedestrian crowds are composed of individuals with different physical capabilities and movement behaviors. Differences in walking speed, mobility, personal-space requirements, perception of nearby pedestrians, physical effort, and route accessibility can affect how people navigate the same environment. Crowd simulations that treat all pedestrians as behaviorally identical may therefore fail to reproduce important patterns of human movement. This research poster investigates how incorporating physiological and mobility differences into pedestrian agents affects crowd behavior in the GAINS SPACE simulation developed in Unreal Engine 5. Individual variation is represented through characteristics such as movement speed, mobility type, personal-space distance, perception, and other physiology-related parameters. Mobility-dependent navigation constraints are being developed so that agents with different mobility capabilities can select appropriate routes, while personal-space behavior allows agents to respond to nearby pedestrians before collision. Additional physiology systems examine how accumulated movement effort may influence environmental choices such as rest locations. Simulation experiments will compare populations with and without these differences using measures such as pedestrian spacing, congestion, travel paths, bottleneck behavior, and destination choices. The goal is to determine which physiological and mobility characteristics have the greatest influence on larger crowd patterns and which are most important to represent when developing realistic simulations of pedestrian movement.

Mentor(s):
David Michael Barbarash (Education)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1466

Presentation Time: Session 3: 12:00-1:00pm

Chronic Kidney Disease of Unknown Origin: Exploring Global Prevalence and Environmental Risk Factors

Social Science

Authors(s):

Riley Michelle Loftus† (HHS); Ria R Sharma† (HHS|JMHC); Zoe Liang Qiao Becher† (HHS); Aarav Mathur† (HHS); Allison Lorraine Tomaszewski† (HHS)

Abstract:

The purpose of this study was to understand why Chronic Kidney Disease of unknown origin (CKDu) has increased in prevalence, especially in men living in rural areas. We conducted a literature review to identify potential risk factors and compared conditions in rural versus urban Sri Lanka to determine their association with CKDu. This study used a literature review to examine potential risk factors of (CKDu), emphasizing rural populations. Studies were reviewed to compare CKDu prevalence by sex, occupation, and geographic setting. Factors including heat exposure, dehydration, environmental exposures, and access to healthcare were examined to identify common trends and relationships. Studies in Sri Lanka show higher CKDu prevalence in rural areas, such as the North Central Province, than in urban areas. Exposure to heavy metals, including cadmium from contaminated rice, and hard drinking water containing elevated metals and ions may increase CKDu risk. Dehydration among agricultural workers in Sri Lanka's warm climate may increase susceptibility to kidney damage and nephrotoxic agents. Hantavirus exposure has also been associated with CKDu, with one study finding that 54.5% of individuals with CKDu had IgG antibodies against hantavirus. Findings suggest that CKDu in rural Sri Lanka may result from a combination of environmental, occupational, and infectious factors than one cause. Improving clean water access, reducing contaminant exposure, educating workers about hydration and heat risks, and increasing healthcare screening may help prevent disease progression. Further research is needed to understand how these factors interact and contribute to CKDu.

Mentor(s):

Mark Wilson (HHS)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1467
Presentation Time: Session 3: 12:00-1:00pm

Consumer Research- Good Times Brewery and Kitchen

Business Case Study

Authors(s):
Ally E Loquasto† (DSB|HHS|JMHC); Owen Paul Gazso† (DSB); Hugh Alexander Kennedy† (DSB); Riley Goodwin Lash† (DSB); Vidhi J Thakkar† (DSB); Griffin Smith† (DSB)

Abstract:
The purpose of this study is to collect consumer behavior information regarding the customer base of Good Times Brewery and Kitchen, analyze the patterns and implications of the data, and offer a set of marketing recommendations for the purpose of enhancing the business' existing morning coffee offering. The study will employ a mixed-methods approach, synthesizing both qualitative and quantitative survey data from present customer experience and from the broader overall literature concerning consumer behavior patterns in the present day. Our study aims to combine findings from Good Times Brewery and Kitchen as a case study with a wider body of knowledge regarding the economics of the food and beverage industry with a focus in consumer behavior.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1468
Presentation Time: Session 3: 12:00-1:00pm

Lincoln Micro-Museum: Preserving Lived Memories and Fostering Intergenerational Gathering

Humanities

Authors(s):
Leo Malachowski† (Engineering|JMHC); Bridget Katherine Heindl† (Liberal Arts|JMHC); Cassius A Pulver* (HHS|Liberal Arts|JMHC)

Abstract:
The Lincoln Neighborhood Greatriarchs storytelling project began as a collaboration between Purdue University's John Martinson Honors College and the City of Lafayette in support of the Lincoln Neighborhood Community Enhancement Plan. The project collects oral histories from "Greatriarchs," long-time residents whose lives and stories shape the North End community. Inspired by Ruut Veenhoven's Quality of Life framework, it emphasizes appreciation of life and the importance of preserving community memory. To date, the project has collected seven oral histories and commissioned one mural.

Building on this work, our research group is analyzing the collected oral histories and developing a physical micro-museum in partnership with Lincoln Neighborhood residents and the City of Lafayette. Located at the historic Greenbush Cemetery, the proposed museum will draw on the stories of the Greatriarchs while welcoming contributions from the wider community. Photographs, artifacts, personal histories, and other materials shared by residents will reflect the diverse experiences and memories that shape neighborhood identity. Through curated displays and opportunities to engage with these materials, the museum aims to create a welcoming space for community storytelling, intergenerational connection, and the preservation of local history.

The micro-museum will strengthen community identity, support the Lincoln Neighborhood Community Enhancement Plan, and provide a model for student-community engagement. By bridging academic research with civic action, our work will help ensure that the stories of the Lincoln Neighborhood are not lost, but honored, shared, and accessible to future generations.

Mentor(s):
Jason Ware (JMHC)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1469
Presentation Time: Session 3: 12:00-1:00pm

AI Tools and Independent Problem-Solving in Beginner College Programming Students

Social Science

Authors(s):
Esmeralda Martell† (Polytechnic)

Abstract:
Artificial intelligence (AI) coding tools can generate code, explain errors, and guide students through unfamiliar programming concepts. However, their use raises questions about whether students are developing the skills needed to understand, write, and debug code independently. This research project will investigate how students in introductory college programming courses use AI coding tools and how they believe these tools affect their understanding and independent problem-solving skills. I will review research on AI in programming education, focusing on the benefits of receiving explanations and the potential drawbacks of relying on generated solutions. I also plan to interview students about how they use AI, when they find it helpful, and what challenges they experience when programming without it. I will identify common themes in their responses and compare these themes with published research to examine how students' experiences align with existing findings. This project aims to help students and instructors understand how AI tools can support learning while also encouraging students to develop independent programming skills.

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1470
Presentation Time: Session 3: 12:00-1:00pm

Eicosapentaenoic Acid and Docosahexaenoic Acid Differentially Mitigate Colorectal Cancer Cachexia

STEM

Authors(s):
Ashtyn Nicole Martens† (Agriculture)

Abstract:
Cancer cachexia is characterized by significant loss of skeletal muscle mass and function, which undermines cancer prognosis. While the underlying mechanisms of cancer cachexia are not fully understood, elevated inflammation contributes to skeletal muscle wasting. Long-chain polyunsaturated fatty acids (LC-PUFAs) and their metabolites, termed specialized pro-resolving lipid mediators (SPMs), have been found to exert anti-inflammatory properties in preclinical models of cancer cachexia. However, it remains unknown how omega-3 (n-3) and omega-6 (n-6) LC-PUFAs differentially modulate muscle physiology in cancer cachexia. We used a murine colorectal cancer cachexia model to determine the effects of dietary supplementation with individual LC-PUFAs on muscle wasting, including arachidonic acid (ARA, 20:4n-6), eicosapentaenoic acid (EPA, 20:5n-3), and docosahexaenoic acid (DHA, 22:6n-3). 6-month-old female BALB/c mice were assigned into either a non-cancer (NC) (n=8) or tumor-bearing (TB) group inoculated subcutaneously with C26 murine colorectal carcinoma cells. TB received daily oral gavage of corn oil (TB, n=8), ARA (TB+APA, n=8), EPA (TB+EPA, n=8), or DHA (TB+DHA, n=8) for 14 days, and NC received corn oil in parallel. Body weights and tumor size were recorded every two days, and body composition was measured by EchoMRI prior to euthanasia. The contractility of hindlimb muscles tibialis anterior (TA) and triceps surae was assessed by in-situ and in-vivo muscle force tests, respectively. Data was analyzed by 1- or 2-way ANOVA followed by Holm-Šidák post hoc tests. Despite significant loss of body weight in all TB groups, TB+EPA had a higher body weight compared to TB from day 11-13 post inoculation. Force frequency test of the TA indicated that TB+DHA mice had higher isometric muscle force at frequencies from 100-300 Hz compared to TB mice. The results suggest potential benefits of EPA and DHA on body weight and muscle force associated with colorectal cancer cachexia.

Mentor(s):
James Frederick Markworth (Agriculture); Xinyue Lu (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1471
Presentation Time: Session 3: 12:00-1:00pm

Evaluating and Strengthening Mental Health Services at Purdue

Social Science

Authors(s):
Avery Martin† (HHS)

Abstract:
The purpose of this research project is to determine whether Purdue's current approach to students' mental health is sufficient. This research can bring to attention ways that universities can help students to be more successful in their future careers and lives. Primary research will be concluded by interviewing CAPS employees and other mental health professionals. Secondary research will be done by conducting a literature review about the current methods to approaching mental health at Purdue, as well as what has worked for others in the past. These findings are important in enhancing current approaches to mental health, and to see whether there is room for improvement for Purdue students' mental health on campus as well. As a society, it is necessary to refine our understanding of mental health to help future generations receive more effective treatment, and to succeed in their education and future careers.

Mentor(s):
Catherine Jean Shukle (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1472
Presentation Time: Session 3: 12:00-1:00pm

Design and Development of a Tele-operated Robotic Arm for Remote Manipulation

STEM

Authors(s):
Alani Sofia Martinez Torres† (Engineering|Liberal Arts)

Abstract:
Robotic arms are increasingly used in automation, research, and environments where direct human interaction may be difficult or unsafe. This project focuses on the design and development of a tele-operated robotic arm capable of performing controlled movements and object manipulation through remote operation. The goal is to create a modular robotic platform that can be modified and expanded for future research and engineering applications. The proposed system consists of six motor-driven joints designed to provide a reach of approximately 400-600 mm, support a payloader greater than 2 kg, and achieve a target positioning repeatability of less than 0.5 mm. The engineering design process involves evaluating motor torque requirements, joint configurations, mechanical constraints, and electrical power distribution to develop a reliable and functional system. The team is currently finalizing the computer-aided design (CAD) model while developing an electrical schematic in KiCad to establish motor connections, power distribution, and system integration requirements. Particular attention is being given to motor selection, weight distribution, and electrical safety to ensure that the proposed design can support the intended movements and payload. Although the robotic arm is still in the design phase, the current work is establishing the mechanical and electrical foundation needed for future assembly, programming, and experimental testing. Once developed, the platform is intended to support basic pick-and-place operations while providing opportunities for further research in robotic manipulation, control systems, and automation.

Mentor(s):
Jaeeun Kim (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1473
Presentation Time: Session 3: 12:00-1:00pm

Out of Sight, Out of Mind: Building Student Awareness for a Hidden Campus Café

Business Case Study

Authors(s):
Silas James Mays† (DSB|JMHC); Elliott Matthew Cox† (DSB); Bryan Zhaolin Liang† (DSB|HHS); Peter DuyThang Vu† (DSB); Rishi Kiran Saindane† (DSB); Jacob Aaron Pilon‡ (DSB)

Abstract:
Saxbys, a student-run cafe on the underground floor at Neil Armstrong Hall of Engineering, has grown in sales every semester, but has only reached a small part of campus population. This project will investigate the reasons why Saxbys has struggled to attract more students and provide strategic recommendations to help them reach a greater population. We will utilize a variety of marketing concepts from our course including SWOT analysis, segmentation and positioning, and the marketing mix (4Ps) to evaluate and analyse the opportunities and cost for each marketing approach based on cost, target behavior and the ease of implementation for Saxbys.

The planned deliverable is a recommendation with an implementation timeline and measures of success. At the time of submission, the evaluation and recommendations of marketing approaches have not yet been completed. This project is expected to provide the company with a practical basis for choosing and testing a marketing strategy.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1474

Presentation Time: Session 3: 12:00-1:00pm

Improvised Air Filters for Protection Against Wildfire Smoke Particles

STEM

Authors(s):

Dylan Michael-Reese McDonald† (Engineering|Polytechnic); Alexandra Madison Chrostowski* (DSB|Engineering)

Abstract:

As wildfire activity increases with a changing climate, the dangers of wildfire smoke become more prevalent. Wildfire smoke particles have a significant effect on human health not only at the source of the fire but along the path of the smoke trail. In air quality emergencies, accessing standard HVAC filters may not be possible. This project aims to test improvised filtering methods against wildfire smoke particles. The improvised filters use materials common in the home. Using a simulated HVAC system test rig, various fabric types were tested against several particle types. Initial tests utilized aerosolized sodium chloride to determine the optimal design for the improvised filters. Future tests will compare the improvised filters against a variety of biomarkers common to wildfire smoke particles. We will also consider different environmental parameters such as relative humidity, temperature, and airflow rates. As airflow rate has the most significant effect on filtration performance, another objective for the project is to design stable and precise airflow controls for the filter test rig. We achieved this by testing a variety of signal control and smoothing algorithms to significantly reduce the noise of airflow rate measurements. Our primary objective is to determine the most effective improvised filter design and understand how improvised filters compare to standard HVAC filters. Ultimately, we will use the results to create instructions for households to build their own filters. Determining the best improvised filter design will allow individuals experiencing wildfire smoke pollution to improve the air quality in their homes.

Mentor(s):

Brandon Boor (Engineering); Jordan N Cross (Engineering); Chunxu Huang (Engineering); Sunghoon Ha (Engineering); Brian Magnuson (Engineering)

Other Acknowledgment(s):
CJ Holdeman* (Engineering)

Poster Presentation Abstract Number: 1475
Presentation Time: Session 3: 12:00-1:00pm

Prioritizing Potentially Underutilized Housing Markets for Further Research Using County Home-Value Estimates

Business Case Study

Authors(s):
Aidan Joon McLaughlin† (DSB); Umar Yasser† (DSB); Oladapo David Olaniyan† (DSB|JMHC); Andre Kunrath Menna Barreto Fialho† (DSB)

Abstract:
Can county home-value estimates help real-estate teams decide which unfamiliar markets deserve deeper research? Teams need quick, comparable signals, but models may not transfer reliably across regions. We tested whether a model trained on Midwest and South counties could estimate home values in Northeast and West counties. We used 2019–2023 ACS five-year estimates from Esri Living Atlas: 3,137 eligible U.S. counties and county equivalents. The target is the median value owners report for their homes, not a sale price. Seven predictors cover household income, population density, housing-unit count, homeownership, vacancy, latitude, and longitude. Some target values were unavailable and 78 territories were out of scope. Exploratory development checks found errors were larger for higher-value counties. That pattern makes error by value, not just overall error, important to report. We checked county IDs, excluded target-related predictors, log-transformed selected variables, and imputed missing features using training data only. Nested, state-grouped cross-validation compared a training-county median baseline, Ridge regression, random forest, and histogram gradient boosting. Ridge tests linear patterns; tree models capture nonlinear relationships. MAE was primary because it expresses error in interpretable dollars; RMSE and R-squared were additional measures. On the final 664-county Northeast/West test, gradient boosting reduced MAE from $180,621 for the baseline to $116,297, but R-squared was 0.239, showing substantial error remains. These estimates may help identify markets needing local follow-up; they cannot price individual homes or support appraisal or investment decisions.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1476
Presentation Time: Session 3: 12:00-1:00pm

Intergenerational Identity Integration in LGBTQ+ Parent Families: Preliminary Thematic Findings from Adult Children

Social Science

Authors(s):
Beau Mitchell† (HHS|Liberal Arts)

Abstract:
This study examines intergenerational identity integration within LGBTQ+ parent families, conceptualized as the process through which children make sense of, incorporate, reinterpret, or differentiate from a parent's marginalized identity in developing their own sense of self. Although prior research has documented positive developmental outcomes among children raised by LGBTQ+ parents, less is known about how adult children come to understand their parents' LGBTQ+ identities, navigate identity-related conversations within their families, and make meaning of these experiences over time. Guided by family systems and narrative identity frameworks, this study explores how adult children of LGBTQ+ parents describe their initial awareness and conversations surrounding parental LGBTQ+ identities and the lasting and influence of these experiences on their own identities and values. Six adult children of LGBTQ+ parents completed semi-structured interviews examining family relationships, identity-related experiences and conversations, sociocultural contexts, and the meanings participants attributed to having an LGBTQ+ parent. Interviews are being examined using preliminary thematic analysis to identify recurring patterns across participants' narratives. Emerging patterns suggest that adult children develop an understanding of parental LGBTQ+ identities through both explicit conversations and everyday family experiences, and navigate the ways parental identities and experiences inform their own values and sense of self, including perspectives on acceptance and advocacy. By centering adult children's perspectives, this study contributes to a strength-based understanding of how parental LGBTQ+ identities are understood and experienced across generations. These interviews are part of a larger multi-informant study of LGBTQ+ parents and their adult children, in which Consensual Qualitative Research (CQR) will be used to examine patterns within and across informant perspectives.

Mentor(s):
Victoria Mollo (Education)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1477
Presentation Time: Session 3: 12:00-1:00pm

Pediatric Patient-Derived Liver Organoid Model of MASLD

STEM

Authors(s):
Samiksha Mogallapalli† (Engineering|JMHC)

Abstract:
Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD) is characterized by excessive lipid accumulation and is correlated to high blood pressure and obesity. Although MASLD impacts 10% of children, current research lacks pediatric patient-specific models. Since children affected by MASLD have distinct physiological pathways and responses compared to adults, developing a tailored model is critical for understanding disease mechanisms and future potential therapeutics.

This study aimed to model pediatric MASLD using patient-derived tissues differentiated into 3D liver organoids to identify optimal fructose parameters for simulating overnutrition in vitro. Differentiated pediatric liver organoids were exposed to varying fructose concentrations (0, 20, and 50 mM). For pathophysiological validation, Nile Red fluorescent staining was conducted to quantify intracellular lipid droplet accumulation, and DAPI for cell counts.

Quantitative analysis revealed that while 0 mM and 20 mM fructose treatments produced no statistically significant changes in lipid accumulation, exposure to 50 mM fructose significantly increased intracellular lipid droplet accumulation compared to controls. This marked increase in lipid storage correlates to steatosis, successfully representing a key feature of MASLD pathophysiology in a pediatric organoid system. This provides a pediatric patient-relevant and measurable platform for future mechanistic research and therapeutic drug testing.

Mentor(s):
Estelle Park (Engineering); Jiafei Zhu (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1478
Presentation Time: Session 3: 12:00-1:00pm

The Drone Charging Maximization Problem

STEM

Authors(s):
Albert Moster† (Engineering|JMHC); Karthik Sivakumar† (Engineering); Joseph Donald Schlaerth† (Engineering)

Abstract:
Photovoltaics and farmland have been integrated for over 40 years, and drones are becoming increasingly utilized for automation of agricultural tasks such as wildlife management, property security, and crop irrigation. Drones reduce the need for employing people to monitor and gather data, making them essential to modern agriculture. However, something that is less investigated is agrivoltaics and drone monitoring integration. We aim to determine whether photovoltaics integrated into current agriculture drone monitoring systems will minimize the charging time and efficiency of the system and if we can utilize this energy reasonably beyond daytime hours. These systems are less than 20-25% efficient.

We researched farms around Indiana to see what types of photovoltaics they introduced, as well as what kinds of drones they use. We reached out to Rose Acre, Field Ace, and Handsome Brook Farms to learn about the types of drones and photovoltaics they use and if we can work with them. We also found out that the Mitch Daniels School of Business allows students to use their DJI drone if students pass a safety quiz.

We decided to base our calculations off of the most widely used drone in the agricultural sector, the DJI Mavic 3M. Per drone, we found that a three-battery, 1kW solar panel, and 3kWh stationary storage configuration would be enough to power the drone with minimal downtime, assuming 4-6 hours of peak sunlight and 150W charging. The rough cost of implementing this solution, if you do not include the drone itself, is approximately $3,018: $159 for two spare batteries, $1000 for a 1kW solar panel/array, and $1700 for 3 kWh of stationary storage. Drone included; the cost is roughly $8,118. By the end of this project, we hope to have found a way to reduce drone battery charging time while storing solar energy. We believe that these results can persuade farmers and scientists who wish to monitor crops with drones to integrate photovoltaics into their charging system.

Mentor(s):
Peter Bermel (Engineering); Muhammad A Alam (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1479
Presentation Time: Session 3: 12:00-1:00pm

From Rules to Calls: An Augmented Reality Serious Game for Basketball Referee Training

STEM

Authors(s):
Rishon Nazareth† (Polytechnic); Cole William Tweedy† (Polytechnic); Adit Malpani† (Polytechnic); Jedric Ely Tsai† (Polytechnic)

Abstract:
Traditional basketball referee training commonly relies on rulebooks, classroom instruction, and video-based learning, which may provide limited opportunities for interactive and scenario-based practice. This project explores the use of augmented reality (AR) and serious game principles as a supplementary approach to sports-officiating education through the design and development of an interactive basketball referee training application.

Developed in Unity using Vuforia AR technology, the application provides learners with an interactive environment for recognizing basketball fouls, violations, referee calls, and the corresponding officiating gestures. Through an AR camera interface, users observe simulated referee scenarios in which standardized hand and arm signals are performed in response to different game situations. Each scenario is supplemented with relevant rule information and real-world video examples to reinforce the connection between game situations, officiating decisions, and referee gestures. The application also incorporates assessment activities that quiz users on basketball rules, calls, and the appropriate signals associated with different scenarios.

The project investigates the potential of AR-based simulations as a supplementary training tool for novice basketball officials. A functional prototype is currently under development, with user testing planned to evaluate its usability, learning experience, and educational potential. By combining augmented reality, serious game design, and sports-officiating education, this work aims to examine how interactive, scenario-based training can support the preparation of new basketball referees.

Mentor(s):
Georgios Pappas (Polytechnic)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1480
Presentation Time: Session 3: 12:00-1:00pm

Lane Sequence Verification

STEM

Authors(s):
Matt Francis Noto† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Nikkhil Vijaya Sankar (Engineering); Mohammad Reza Jahanshahi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1481
Presentation Time: Session 3: 12:00-1:00pm

Toward Next Generation Gastric In-Vitro Model for Permeation-Enhancer Mediated Peptide Drug Delivery

STEM

Authors(s):
Caroline M Ober† (Science|JMHC)

Abstract:
Peptide therapeutics are excellent drugs due to their high-affinity binding to target proteins. Recently, medications such as semaglutide and tirzepatide have achieved both commercial and clinical success by helping patients achieve significant weight loss. Semaglutide is particularly relevant since it is orally bioavailable, whereas most GLP-1 agonists are not. Semaglutide provides an alternative to common parenteral delivery, which can simplify therapeutic regimens and reduce the administrative burden on patients. However, one difficulty with peptide drugs is that they struggle to cross the gastric epithelial barrier without being degraded. To improve peptide permeability, its formulation includes the permeation-enhancer SNAC, which facilitates the peptide's entry across the gastric mucosa. We are interested in understanding how the structure of semaglutide contributes to its permeability through the gastric epithelial layer. To investigate this problem, we are developing a gastric in vitro model for peptide drug delivery experiments. One issue is that while SNAC is non-toxic to cells in the body, our cell models are damaged at high SNAC concentrations. To improve our model, we are investigating clones that are resistant to cell damage at clinically relevant SNAC concentrations. We are measuring this phenotype through TEER, cell viability assays, and qPCR. If we can identify a clone that is resistant to cell damage, our gastric in vitro model will more closely replicate the permeation of peptide drugs into the stomach, ultimately improving the reliability of experimental results.

Mentor(s):
Severin Thomas Schneebeli (Pharmacy|Science); James Edward Funk (Pharmacy)

Other Acknowledgment(s):
Raluca Ostafe* (Science)

Poster Presentation Abstract Number: 1482
Presentation Time: Session 3: 12:00-1:00pm

Tunneling Spectroscopy of S-QD-S Junction Using a Gate-Defined Quantum Dot and Superconducting Probe

STEM

Authors(s):
Kyle s Ohlin† (Science)

Abstract:
Tunneling spectroscopy of S-QD-S systems has been well documented in one-dimensional platforms such as nanowires and carbon nanotubes. Meanwhile, gate-defined two-dimensional platforms remain less documented. Our results help bridge this gap in the literature by presenting tunneling spectroscopy measurements of a gate-defined quantum dot (QD) in an S-QD-S junction. Operating at a base temperature of 10 mK, a QD was formed on an InAs 2DEG using Au gates to deplete the surrounding electron density, forming potential barriers. The QD is coupled to two Al superconducting leads forming the junction, and a weakly coupled Al lead for tunneling spectroscopy. Coulomb diamond plots were taken at zero magnetic field and repeated at $B_\perp = 200\ mT$, which suppressed superconductivity. At zero field, a gap of magnitude $2(\Delta_{induced} + \Delta_{probe})$ is observed between the top and bottom halves of Coulomb diamonds, along with a spectrum of sub-gap and near-gap transport phenomena. Superconducting features disappear at high field resulting in standard single-particle Coulomb diamond measurements, to which the superconducting measurements are compared. Our results depict successful tunneling spectroscopy of a gate defined S-QD-S system, providing a useful reference on the path to more complex systems.

Mentor(s):
Michael James Manfra (Engineering|Science)

Other Acknowledgment(s):
Kevin Alexander Barrow* (Science)

Poster Presentation Abstract Number: 1483
Presentation Time: Session 3: 12:00-1:00pm

The Influence of Rainfall on NPC Movement and Shelter-Seeking Behavior

STEM

Authors(s):
Kathleen Elane O'Sullivan† (Engineering); Sarah Elizabeth Werth† (DSB|JMHC)

Abstract:
This research focuses on studying how weather influences the way people move through outdoor areas and make decisions about where to go. Our team will explore how different levels of rain affect an NPC's (non playable character's) shelter seeking behavior in a digital twin simulation developed through Purdue University's SPACE project.

Our study will explore how these NPCs determine potential shelters, when rain becomes uncomfortable, and the decision to continue on their path or seek out shelters. Our team will also explore different intensities of rain and comfort thresholds to explore different individual reactions to the same conditions.

The research conducted this semester will examine how long NPCs take to react to rain, whether they change their routes, and if they increase their movement speed when seeking shelter or continuing toward their original destination.

The goal of our research is to develop and evaluate specific shelter seeking behaviors that could eventually help improve the realism of digital twin simulations. This work may also provide insights relevant to urban planning and architectural designs.

Mentor(s):
David Michael Barbarash (Education)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1484
Presentation Time: Session 3: 12:00-1:00pm

Teaching Precision Agriculture with Drones at K-12 Schools

STEM

Authors(s):
Niousha Pajouyan† (Engineering)

Abstract:
Precision agriculture provides an engaging way to introduce K-12 students to drone technology and programming. As a part of the AgBridge program (Kuleshov & Zhang, 2026), a team from the 2026 cohort developed a six-lesson curriculum using the CoDrone EDU and Blockly programming. The lessons introduce students to drone operation and coding skills to finally culminate in a final project, where students program a drone to complete tasks in a simulated agricultural field.

As the sole undergraduate member of an interdisciplinary research team, I led the programming component of the project. I adapted concepts from undergraduate drone programming into activities appropriate for K-12 learners. I collaborated with two graduate students, one with engineering and another with education background, and a K-12 teacher mentor. My role required translating technical content into accessible learning experiences and communicating programming decisions to the team.

The curriculum is structured as a progression of activities that connect code with drone behavior, build foundational skills, and prepare students for increasingly complex tasks. The lessons use block programming to help beginners learn coding concepts by connecting graphical blocks rather than writing text-based code. The final project integrates those skills in an agricultural application, allowing students to apply programming concepts in a realistic precision agriculture scenario.

This presentation will describe the development of the six-lesson curriculum, discuss challenges in adapting drone programming for K-12 teaching, and explore how simulated agricultural activities can connect technical skills with real-world agricultural applications. The presentation will also highlight considerations for future classroom implementation and assessment.

Kuleshov, Y., & Zhang, Y. (2026). Advancing the IOT4AG AgBridge Program through Continuous Improvement Practices https://doi.org/10.5703/1288284318507

Mentor(s):
Yaguang Zhang (Agriculture|Engineering); Yury Kuleshov (Polytechnic)

Other Acknowledgment(s):
Emmanuel Temitope Olubodun* (Liberal Arts); Abigail Erskine* (Education)

Poster Presentation Abstract Number: 1485
Presentation Time: Session 3: 12:00-1:00pm

Thermoregulation Does Not Drive Roost Selection by White-throated Sparrows in Winter Range

STEM

Authors(s):
Wyatt Alvin Pearson† (Science); George D Emerson† (Agriculture|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Patrick Joseph Ruhl (Agriculture); Elizabeth Lee Nojd (Agriculture)

Other Acknowledgment(s):
Xen Storm Cartwright* (Science); Thomas Isaac Feaster* (Agriculture); Tam Bao Tran* (Engineering)

Poster Presentation Abstract Number: 1486
Presentation Time: Session 3: 12:00-1:00pm

Beyond Market Value: Predicting Soccer Transfer Fees in Europe's Top Five Leagues with Machine Learning

Business Case Study

Authors(s):
Huy Hoang Phan† (DSB); Jake Adius Schmucker† (DSB); Stephen Andrew Rashevich† (DSB); Finley Bray† (DSB|JMHC)

Abstract:
Clubs set budgets, judge asking prices, and negotiate bids using little more than a market-value

estimate, even though final fees also reflect performance, age, position, and bargaining power.

Our goal is to predict the euro fee of permanent, non-goalkeeper transfers involving the Premier

League, La Liga, Bundesliga, Serie A, and Ligue 1, using only information available before the

move, giving recruitment staff a defensible expected fee for budgeting and negotiation.

We built a dataset of 2,379 transfers from the open Transfermarkt data, joining transfers, players,

clubs, valuations, appearances, and games. Each record includes the latest pre-transfer market

value and performance aggregated over the preceding 365 days, with a 450-minute minimum.

Because fees are highly skewed, we model log fees and convert predictions back to euros. Using

Python, we compare a market-value benchmark against log-linear regression, regularized

regression, and tree-based ensembles. Hyperparameters are tuned with rolling, time-aware

validation on 1,149 transfers, and final models are tested once on 614 later transfers (July 2024

to June 2026). Mean absolute error (MAE) is the primary metric, and a paired bootstrap tests

whether each model beats the benchmark.

Exploratory analysis shows a strong link between log fee and log market value (r = 0.81), setting

a demanding benchmark. We expect performance and context variables to add value by

explaining systematic premiums and discounts. Beyond budgeting and negotiation, the project

shows how leakage controls and time-aware validation make predictive models more trustworthy

in sports analytics.

Mentor(s):
Adrian Hoffert Wolanski (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1487
Presentation Time: Session 3: 12:00-1:00pm

Viscosity-Dependent Injectate Flow Near Spinal Nerve Roots in an In Vitro Intrathecal Model

STEM

Authors(s):
Neha Prashanth† (Science|JMHC); Owen Wright† (Agriculture|Engineering|JMHC); Ben Michael Mariner† (Engineering|JMHC)

Abstract:
Intrathecal (IT) drug delivery introduces therapeutics directly into the cerebrospinal fluid (CSF), bypassing the blood-brain barrier at lower systemic doses. Clinically, infusion protocols must achieve broad therapeutic dispersion along the neuraxis without exceeding local concentration thresholds that trigger neurotoxicity or catheter-tip granulomas. Common IT agents, ranging from small molecules like baclofen and morphine to macromolecular therapies like nusinersen, have differing physical and chemical parameters, including formulation viscosities that can substantially exceed native CSF. Although spinal nerve roots generate vortices and stagnant pockets under oscillatory CSF flow that alter transport, prior in vitro studies have focused only on bulk tracer spread along the canal. They leave the fine-scale velocity fields adjacent to these anatomical microstructures unresolved. Because drug formulations possess differing viscosities, we hypothesize that injectate viscosity alters local hydrodynamic resistance and stagnation around nerve rootlets, directly dictating whether a drug safely clears or concentrates into toxic micro-reservoirs.

To test this, we measure injectate flow fields under physiologically representative, oscillatory in-and-out CSF flow in an in vitro IT model incorporating nerve roots, cast in polydimethylsiloxane (PDMS) from a 3D-printed mold and filled with a CSF analog (~1 cP). Test fluids spanning viscosities from 5 to 1,000 cP are seeded with 10 μm fluorescent particles, injected into the thoracic region, and recorded at >1,000 frames per second. Particle image velocimetry (PIV) resolves injectate velocity fields near walls and roots to quantify penetration, recirculation, and residence times as functions of viscosity. These measurements identify where a viscous IT dose is retained or carried downstream, providing benchmark data to validate computational models and guide targeted IT formulation design.

Mentor(s):
Brett A Meyers (Centers & Institutes); Stavros Papapanagiotou (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1488
Presentation Time: Session 3: 12:00-1:00pm

Developing a Transformer Model to Predict Drug-Target Affinity for Drug Repurposing

STEM

Authors(s):
Paras Punater† (Science|JMHC); Collin Hayes Dumas† (Science); Gabrielle Marie Barrido† (Science); Julian Moises Guevara‡ (Engineering); Arjun V Pattel‡ (Science); Anika Ghosh Maji‡ (Science); Ishan Rajesh Kulkarni‡ (Science); Sridutt Satya Kumar Rayudu‡ (

Abstract:
Drug repurposing, the process of identifying novel indications for existing medications, shortens the traditional drug discovery timeline. However, even limiting the search space to existing medications still yields a large population of drug candidates, which makes traditional methods like high-throughput screening and molecular docking costly and time-consuming. Machine learning methods, such as sequence-based drug-target affinity prediction (DTAP) are a cost- and time-saving strategy for screening. DTAP reduces the dependence on experimentally resolved protein structures or known binding pockets and potentially enables the identification of compounds with novel mechanisms of actions. To screen a database of bioactive small molecules for putative drug repurposing candidates, we aim to develop a computationally efficient platform to predict the half-maximal inhibitory concentration (IC50) of small molecules against target proteins. To accomplish this, we will implement two transformers to encode (1) the SMILES notation of bioactive small molecules and (2) the amino acid sequence of proteins. We will train a multi-layer perceptron model to predict the IC50 value of a small molecule-protein pairing from the encoded representations. Then, we will use this model to screen a drug repurposing database for small molecules with high IC50 values against a selection of proteins that are promising therapeutic targets but have nonetheless faced barriers to drug development. We will then evaluate the therapeutic potential of the identified small molecule drug candidates through molecular docking and pharmacophore modeling. Future work includes modifying our model to account for stereochemistry and experimentally validating the DTAPs through biochemical assays. Overall, our work aims to develop a computational model with greater power to predict DTAP in order to accelerate drug discovery by reducing reliance on resource-intensive screening methods.

Mentor(s):
Pete E Pascuzzi (Libraries)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1489

Presentation Time: Session 3: 12:00-1:00pm

Evaluating Atalla Ax01 Through Top Level Integration and Verification

STEM

Authors(s):

Myles Joshua Querimit† (Engineering); Nikhil Kishore Vaidyanath† (Engineering); Sanjith Cherumandanda† (Engineering); Aditya Rai† (Engineering); Tarakanath Peddi‡ (Engineering); Timothy Sunho Liu‡ (PWL); Abhiraj Singh Jaswal‡ (Engineering); Aadi Hsien-Lin

Abstract:

Atalla Ax01 is an open-source AI Accelerator, designed to optimize inference computations through specialized hardware, including a VLIW scheduler, SIMD vector datapath, systolic array, and software-controlled cache. While these individual components are functionally complete, prior work has not integrated them into a comprehensive top-level IP. Without this integration, it remains unclear whether the existing subsystem-level architecture decisions translate into intended behavior under realistic ML workloads. We propose continuing prior integration efforts to exercise these choices under target workloads first in simulation, followed by implementation on the Synopsys HAPS. The HAPS platform can run the design significantly faster than is possible in simulation, allowing for longer, more representative tests. Our key idea is to use the workload as a test and an experiment, by running the same AlexNetSmall and multi-tile GEMM binaries on the functional simulator and the top-level IP. Each run will be verified against the functional simulator, then performance counters will be added to certain parts of the design to characterize utilization and bottlenecks. In parallel, the top-level IP will be synthesized on the FreePDK45 PDK to compare chip-level PPA against subsystem-level estimates. This creates a comprehensive view of our design, providing values for per-subsystem utilization and the gap between chip level and subsystem level PPA. These environments do differ from a taped out chip with HAPS running at a lower clock frequency and the absence of a host CPU excludes offload and data-movement overheads. Insights from this project will inform further optimizations for future iterations of Atalla.

Mentor(s):
Rafael Monteiro Martins Pinheiro (Engineering); Hassan Al-alawi (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1490
Presentation Time: Session 3: 12:00-1:00pm

AI's Role in Cybersecurity Network Defense

STEM

Authors(s):
Ruhaan R Rajani† (Science)

Abstract:
As networks grow in complexity, organizations increasingly rely on automated systems to monitor and defend networks against large scale cyberattacks. Traditional defenses that depend heavily on human supervision may struggle to keep pace with evolving cyber threats. Current research suggests that artificial intelligence can accelerate threat detection by identifying unusual traffic patterns and automating parts of security monitoring. It remains unclear how to balance automation with human validation. This research seeks to investigate how machine learning models can be integrated into enterprise network defense architectures to detect anomalous traffic patterns. The study will compare case studies from security providers such as ReliaQuest to evaluate hybrid defense workflows. It will also analyze public network traffic datasets to measure false positive reduction rates. The goal of this research is to develop guidelines for integrating AI threat detection with human oversight to improve the speed and efficiency of cybersecurity operations.

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1491
Presentation Time: Session 3: 12:00-1:00pm

Flow Characterization in a Flexible Nasal-Cavity Phantom Using Particle Tracking Velocimetry

STEM

Authors(s):
Chaarulatha Rajesh† (Engineering); Chloe Cox† (Engineering); Saanvi Nagaraj† (Agriculture|Engineering); Olivia K Widjaja† (HHS|JMHC)

Abstract:
Intranasal drug delivery targets the turbinate and olfactory regions, yet much of a delivered dose

deposits in the anterior nose. Airflow, which varies with nasal anatomy and breathing rate, determines

where fine particles travel beyond the nasal valve. Predictions of this transport rely largely on

computational fluid dynamics (CFD) and rigid cast models, and velocity measurements inside

anatomically realistic; flexible geometries remain scarce. This study quantifies how breathing conditions

change particle trajectories and velocities within a flexible nasal-cavity phantom.

We previously developed an optically accessible polydimethylsiloxane (PDMS) phantom, cast from a

fused deposition modeling (FDM) core-shell mold, that preserves the nasal-cavity geometry without

simplification. The phantom will be installed in a liquid flow loop, and the working liquid will be seeded

with fluorescent polystyrene (PS) particles. A pulsatile waveform reproducing the breathing cycle will be

imposed, with peak flow rate and cycle frequency scaled to match the Reynolds and Womersley

numbers of nasal airflow from resting to elevated breathing. Particles will be tracked through successive

images using particle tracking velocimetry (PTV) to reconstruct individual trajectories and estimate

velocities in selected regions of the phantom.

This study is expected to characterize how particle paths, regional velocities, and recirculation zones

evolve over the breathing cycle and change with breathing rate. These measurements will identify the

flow conditions that carry particles toward the target regions.

Mentor(s):
Brett A Meyers (Centers & Institutes); Hyeondong Yang (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1492

Presentation Time: Session 3: 12:00-1:00pm

Altered Serotonin Receptor Expression and Behavioral Response to Psilocybin in Scn2a-Deficient Mice

STEM

Authors(s):
Deepti Aksharra Ramasamy† (Liberal Arts|Science)

Abstract:
The SCN2A gene, encoding the voltage-gated sodium channel Nav1.2, is one of the leading monogenic causes of autism spectrum disorder (ASD), with social deficits being one of its core symptoms. Prior lab work found that the psychedelic psilocybin acutely increases sociability in Scn2a-deficient mice, unlike in wild-type (WT) mice. Conversely, psilocybin reduced anxiety-like behavior in WT mice but not in Scn2a-deficient mice, indicating a genotype-specific difference between prosocial and anxiety effects. These distinct behavioral responses suggest that serotonergic signaling may be altered in Scn2a-deficient mice. Psilocybin acts primarily through the 5-HT2A receptor, with activation of this receptor producing the head-twitch response (HTR) in mice. However, other serotonin receptors can modify HTR, contribute to the behavioral effects of psilocybin, or be implicated in ASD-related phenotypes. Therefore, we examined the psilocybin-induced head-twitch response and serotonin receptor protein expression to better characterize serotonergic alterations in Scn2a-deficient mice. Following psilocybin administration, Scn2a-deficient mice displayed a blunted head-twitch response compared with WT mice, suggesting altered serotonin signaling. To test whether baseline differences in the serotonergic system existed between genotypes, western blot analysis of the medial prefrontal cortex from psilocybin-naïve mice was performed and showed reduced protein expression of 5-HT1A, 5-HT2A, 5-HT6, 5-HT7, and the serotonin transporter, while 5-HT1B expression increased in Scn2a-deficient mice. Together, these findings demonstrate baseline alterations in serotonin receptor expression alongside a reduced behavioral response to psilocybin in Scn2a-deficient mice. It further characterizes serotonergic dysfunction associated with SCN2A-related ASD and suggests that targeting the serotonin system may be a potential approach for treating social deficits linked with SCN2A-related ASD.

Mentor(s):
Brody Alan Deming (Pharmacy)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1493
Presentation Time: Session 3: 12:00-1:00pm

Compression Molding of Space Antenna Structure with Hybrid of Continuous and Long Discontinuous Fiber Composites.

STEM

Authors(s):
Alejandro Ramirez† (Purdue University)

Abstract:
This project investigates compression molding process for a space antenna structure using a hybrid of continuous and discontinuous carbon fiber architectures. In this process, a continuous fiber preform is consolidated at elevated temperature (400 °C) and under pressure in a mold cavity alongside long discontinuous platelets. The shape that comes out of the mold depends on the residual stress and local fiber orientation within the part. To predict complex consolidation behaviors and bridge the gap between initial mold charges and final part performance, an advanced digital twin framework was developed at the Composites Manufacturing and Simulation Center. In this project, the initial fiber orientation state was characterized experimentally by capturing high-resolution images of physical sub-charges and utilizing the segment anything model alongside custom MATLAB postprocessing to compute 2D orientation tensors. The fiber orientation state measured experimentally was then used to inform the initial state in anisotropic flow simulations using the virtual twin FLOW3D. Parts produced experimentally were measured using a laser scanning system and compared against the nominal shape. Additional comparisons were carried out between the manufactured shapes and simulation predictions for shape change obtained from the virtual twin FORM3D. Finally, ongoing investigations focus on understanding the reshaping of the continuous fiber reinforcement during manufacturing through experimental measurements of orientation state.

Mentor(s):
Eduardo Barocio Vaca (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1494
Presentation Time: Session 3: 12:00-1:00pm

Examining the Role of ROCK2 in Takotsubo Cardiomyopathy

STEM

Authors(s):
Muiz E Rana† (Science|JMHC)

Abstract:
Takotsubo cardiomyopathy is a stress-induced cardiac condition characterized by transient left ventricular dysfunction following severe emotional or physical stress. Although catecholamine surges contribute to cardiac injury, the inflammatory mechanisms underlying this condition remain incompletely understood. Cardiac macrophages infiltrate the myocardium following stress and contribute to inflammatory signaling, including the production of interleukin-1β (IL-1β). Additionally, Rho-associated coiled-coil containing protein kinase 2 (ROCK2) may regulate these responses. This study investigated whether pharmacological inhibition or genetic deletion of ROCK2 attenuates stress-induced IL-1β expression in macrophages. Bone marrow-derived macrophages were cultured and stimulated with lipopolysaccharide (LPS) or epinephrine to model inflammatory and catecholamine-induced stress responses. ROCK2 activity was manipulated using the inhibitor KD025 and ROCK2-knockout mice, and gene expression was assessed using quantitative polymerase chain reaction (qPCR). Epinephrine stimulation increased IL-1β expression, while pharmacological ROCK2 inhibition with KD025 did not significantly attenuate this response. Genetic deletion of ROCK2, however, significantly reduced epinephrine-induced IL-1β expression and showed a trend toward reducing LPS-induced IL-1β expression. Additionally, no significant changes in ROCK2 expression were observed following pharmacological treatment. These findings suggest that genetic ROCK2 deletion may modulate macrophage inflammatory responses to catecholamine stress more effectively than pharmacological inhibition under the conditions tested. Further investigation is needed to clarify the mechanisms underlying these differences and determine the therapeutic potential of targeting ROCK2 in stress-induced cardiomyopathy.

Mentor(s):
Meena Madhur (Indiana University)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1495
Presentation Time: Session 3: 12:00-1:00pm

How Students Experience AI Learning Activities in Higher Education

STEM

Authors(s):
Devi S Raparthi† (Science|JMHC)

Abstract:
Artificial intelligence (AI) is becoming increasingly important across disciplines, so higher education needs effective ways to teach students how they can use AI intentionally and confidently. This study focuses on how students experience structured AI learning activities, particularly how those activities shape their motivation, confidence, and attitudes toward AI. This project examines student response data from AI-focused learning experiences. The study is guided by the Ambrose's 2010 "Motivation to Learn" framework which focuses on three main themes: self-efficacy, seeing value, and supportive learning environments. Student responses were analyzed through qualitative coding using the NVivo software. Responses were organized and coded under the themes of self-efficacy, seeing value, and supportive environment, with attention to both positive and negative patterns. The findings show common student experiences, including changes in confidence, perceived usefulness of AI, challenges with ethical boundaries or accuracy, and the role of the learning environment in shaping student engagement. These patterns help explain what supports or limits students' motivation to continue learning about AI. In conclusion, instructors should be intentional to design AI learning activities that build both technical confidence and responsible decision-making. Instead of only introducing AI tools, courses should give students chances to practice, ask questions, evaluate mistakes, and connect AI use to real academic and career situations. Centers for teaching and learning and university stakeholders can also use these findings to support faculty in creating AI learning experiences that are useful, ethical, and accessible for students.

Mentor(s):
Lisa B Bosman (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1496
Presentation Time: Session 3: 12:00-1:00pm

All Aboard: Driving Purdue Game Day Engagement

Business Case Study

Authors(s):
Julia Rarau† (DSB); Ainsley Kaye Powers† (DSB); Taylor Marie Scott† (DSB); Anna E Stender† (DSB); Reese Erin Bevil† (DSB); Aubrey Jo Warnock† (DSB)

Abstract:
This research will conduct an analysis of Purdue Athletics and the possibilities to create more student engagement and increase student attendance at events. While Purdue Athletics has utilized many different options of promotions and incentives, there are still new opportunities to help understand the motivators of students. The primary research question is: What factors influence Purdue students to engage in athletic events and how can student attendance be improved?

Using primary and secondary research to gain a better understanding of student behavior and attendance patterns. We will use primary data, surveying Purdue students, and secondary data for our research. Our goal is to be able to identify student awareness of athletic events, motivations, and barriers that affect attending events. After analyzing the data, we will create actionable recommendations for Purdue Athletics. Our focus will be on improving market communication, student incentives, and overall engagement. Overall, we are focused on creating a more consistent attendance.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1497
Presentation Time: Session 3: 12:00-1:00pm

Implementing Power Domains in the SoCET AFTx08+ Microcontroller

STEM

Authors(s):
Alexander Repikov† (Engineering|JMHC); Laura van Ritbergen† (Engineering); Lucy Chenlu Xu† (Engineering); Noah Everett Desserich† (Engineering); Tei Okamoto† (Engineering)

Abstract:
Power consumption is an important metric in modern processor design. In battery operated devices, reducing power draw increases battery life, and in a datacenter environment reducing power also reduces the need for cooling, lowering prices on two fronts. When a transistor is off, a small amount of current still flows. Scaled to an entire processor, this results in a measurable power draw, even when no calculations are being done. Because many programs won't use all of the parts of the CPU all of the time, one way of reducing this leakage power is power gating, which allows unused regions of the chip, known as power domains, to be powered off independently.

Our goal is to implement these power domains into the custom SoCET AFTx08+ microcontroller. It has six major peripherals, as well as two processor cores. Simple programs might use only one core and no peripherals, allowing for a dramatic decrease in leakage power draw. However, cutting the power comes with its own set of problems. Powering on a region introduces wake-up latency, during which it cannot do any useful work. Additionally, registers in powered-off areas will lose their data unless an always-powered retention cell is added. Isolation cells are also needed at power domain boundaries to ensure that undefined signals from a powered off region cannot influence the active circuitry. Ultimately, we aim to balance the extra area and complexity against the leakage power savings for the AFTx08+.

Mentor(s):
Niels van Ritbergen (Engineering); Matthew A Swabey (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1498
Presentation Time: Session 3: 12:00-1:00pm

TimeScale Creator Online: Web Tool for Visualization of Earth

STEM

Authors(s):
Paul Thomas Bay Rickert† (Science); Aaron J Yu† (Engineering); Madeline Grace Reiser† (DSB|JMHC); Sripoorna Modugula† (Liberal Arts|Science); Albert Rykken Johnson‡ (Engineering)

Abstract:
The TimeScale Creator is a free visualization tool developed and continuously enhanced by Purdue students to support researchers, educators, and industry professionals in exploring Earth's geologic history. The software provides access to extensive stratigraphic, paleontologic, climatic, and geophysical datasets, allowing users to analyze and visualize data across geologic time. Although the original Java-based version offered powerful functionality, its installation requirements and ongoing maintenance created accessibility barriers for many users. To address these limitations, our team developed TimeScale Creator Online, a web-based platform built with TypeScript and React that retains the core capabilities of the original program while providing a more intuitive and accessible browser-based experience. The online platform enables users to access a primary database of more than 20,000 global and regional geologic events, including biological, geomagnetic, sea-level, and isotope records. Users can also incorporate regional data packages and user-generated datasets to create customized charts and perform detailed analyses without the need for software downloads or updates. In addition, TimeScale Creator Online now interfaces with Claude, allowing users to log in, upload datapacks, and generate or edit chart types through a connected workflow. Charts created through Claude can be opened directly within the web platform for further interaction and refinement. These developments help expand access to geologic visualization tools while supporting research, education, and public engagement with Earth's dynamic history.

Mentor(s):
James G Ogg (Science); Aaron C Ault (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1499
Presentation Time: Session 3: 12:00-1:00pm

Occupational Health Risks Among Child Laborers in Low- and Middle-Income Countries

Social Science

Authors(s):
Gabriela Rondon Ortiz† (HHS); Ashtin Ava Grubb† (HHS); Jasmine Zidan† (HHS); Nathan James† (HHS); Lucy Ellen Warner† (HHS)

Abstract:
Background: Child labor is a global occupational health concern, particularly in low- and middle-income countries where poverty, limited access to education, and inadequate labor protections contribute to hazardous work. Children are still developing physically and psychologically, unsafe working conditions can threaten their health and well-being. This review examines the occupational hazards faced by child laborers and identifies the working conditions and socioeconomic factors that contribute to these risks.

Methods: We will conduct a literature review using PubMed and Scopus. English-language studies published after 2016 will be screened for relevance and included if they examine child or adolescent workers in low- and middle-income countries and report occupational hazards, exposures, injuries, or health effects. We will use previously published data and organize key study characteristics and findings in a table for comparison.

Results: Findings from the reviewed studies will be compared to identify common occupational hazards and health outcomes among child laborers, including physical injuries, chemical exposures, environmental hazards, physical strain, and psychological stress. Patterns and differences across industries, countries, and regions will be examined, along with factors contributing to children's vulnerability, such as poverty, limited education, and inadequate workplace protections.

Conclusions: Child labor is a major occupational health issue in low- and middle-income countries. Working children face hazards such as injuries, chemical exposure, long hours, and physical strain. Poverty, limited education, young age, and inadequate workplace protections increase their vulnerability. Reviewing existing research helps identify workplace risks and contributing factors, emphasizing the need for stronger protections to safeguard children's health and well-being.

Mentor(s):
Mark Wilson (HHS); Maha Mohamed Us Abdelhaseib (Agriculture); Pamela Sari (PWL)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1500
Presentation Time: Session 3: 12:00-1:00pm

The Psychological Effects of Algorithmic Targeting by Social Media Platforms

Humanities

Authors(s):
Gabriel Rosario† (Science)

Abstract:
Social media algorithms are widely known to target consumers. These algorithms notice the type of media consumed and determine what media will be displayed to you based on the data collected. This can lead to an increase in consumers viewing their preferred types of media. However, studies may show that this targeting can have adverse psychological effects on a user's mental health. More specifically, this paper aims to understand the role that the algorithm plays in the prevalence of the self-diagnosis of mental health disorders, such as ADHD, DID, and gender dysphoria, by users. This research will investigate the fundamental targeting nature of the algorithm employed by platforms such as Instagram and TikTok and determine its potential effectiveness in convincing users that they have a particular mental health condition.

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1501
Presentation Time: Session 3: 12:00-1:00pm

Would You Take the Wheel? Human-Machine Interface Display Development for Simulated Automated Vehicles

STEM

Authors(s):
Ashmi Roy† (Polytechnic)

Abstract:
Real-world automated vehicles (AVs) are increasingly equipped with human-machine interfaces (HMIs) that display the vehicle's intended behavior and its confidence in its ability to navigate roadway challenges to drivers. However, commercial driving simulators used in experimental research do not include HMIs capable of displaying this type of information. Because the effectiveness of these HMIs must be verified prior to real-world deployment, it is important to test them in a simulated laboratory environment. To address this gap, we designed and developed a visual HMI that displays an AV's self-assessed confidence in avoiding an upcoming roadway obstacle in its lane. The display was built in Python and communicated confidence information using a color-coded scale, directional arrow guides, and warning cues such as flashing stop and hazard signs. The design underwent several iterations to ensure that confidence levels could be quickly interpreted during time-sensitive vehicle-to-drive transition of control decisions. The HMI also allowed confidence information to be manipulated such that in some cases, it aligned with the vehicle's true reliability (across multiple scenarios), and in other cases it was misaligned. This confidence-reliability mismatch represents potential states that could occasionally be observed in a real AV. We successfully integrated real-time driving simulator data into the HMI, allowing the display to update its own confidence information as driving conditions changed. This HMI prototype is expected to help researchers leverage a wider range of functions in simulated driving environments, ultimately supporting the advancement of human-AV interaction research.

Mentor(s):
Myeongkyu Lee (Engineering); Brandon J Pitts (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1502
Presentation Time: Session 3: 12:00-1:00pm

How Can We Improve Tourette's Education

Humanities

Authors(s):
Aarav Jajati Samal† (Polytechnic|JMHC)

Abstract:
Tourette Syndrome (TS), which consists of both motor and vocal tics, is a neurodevelopmental condition that remains largely misunderstood among the general public. The growing interest in this disorder, caused by I Swear, a film that was released in 2025, and public reactions to John Davidson's involuntary tics at the 2026 BAFTA Awards, shows how little the public knows about TS. People with TS often become victims of ridicule, discrimination, and even hate crime because people consider their tics to be intentional behaviors. Davidson is a Scottish activist who devoted his whole life to the promotion of awareness about Tourette Syndrome and even received an MBE for his efforts. His story began in 1989 when he starred in the BBC film John's Not Mad, where he tells about his experience of living with TS. This paper investigates how Tourette Syndrome education can be improved using John Davidson as an example. To achieve this aim, media portrayals of John Davidson, including the films John's Not Mad and I Swear, reports about his educational activities, people's reactions to his case, and reports about people's hostile attitudes towards people with TS will be analyzed.

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1503
Presentation Time: Session 3: 12:00-1:00pm

Capturing the Campus Crowd: Strategies to Increase Sales Conversion at Purdue Memorial Union

Business Case Study

Authors(s):
Layla Ambrosio Schumacher† (Engineering); Simon Randel Beazly† (Polytechnic); Aviana Mia Franco† (Polytechnic); Joseph Thomas Deckard† (Polytechnic); Reid Lane Veracco† (Polytechnic); Liwen Lu† (Polytechnic)

Abstract:
Aramark provides a variety of on-campus dining options at Purdue University, with many of its locations concentrated in the Purdue Memorial Union (PMU). Despite approximately 2.5 million annual visits to the PMU, only 28% of these visits result in a purchase at an Aramark dining location. This discrepancy presents an opportunity for Aramark to improve customer engagement, increase sales conversion rates, and enhance overall profitability. The objective of this research is to identify the primary factors influencing Purdue students' dining decisions and determine potential strategies to increase sales at dining locations. To collect student feedback, a survey was developed using Qualtrics and distributed to Purdue students through email campaigns and promotional flyers. Aggregate survey output will be analyzed to identify trends in student preferences, purchasing behaviors, and barriers to dining at the PMU. The findings will help Aramark develop data-driven recommendations addressing potential concerns such as food quality, pricing, menu variety, and wait times. By identifying opportunities for improvement and aligning dining services with student expectations, Aramark can strengthen customer satisfaction, encourage repeat purchases, and potentially increase sales and long-term profitability.

Mentor(s):
James Tanoos (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1504
Presentation Time: Session 3: 12:00-1:00pm

Real-Time Health Monitoring: A Wireless System for Triboelectric Sensor Data Acquisition and Analysis

STEM

Authors(s):
Adam Jair Selby† (Engineering|JMHC); Alexandra Adriazola Trujillo† (Engineering)

Abstract:
Wearable technology is changing the way health data is collected and used. Triboelectric sensors provide a promising alternative to traditional photoplethysmogram devices because they are lightweight, flexible, and capable of producing self-powered signals. The challenge is that these sensors generate very small currents from a high-impedance source, which makes amplification difficult and the signal highly susceptible to noise. No clear, reproducible circuit layout for this application exists in the literature.

This project creates a system that allows triboelectric sensors to function as reliable, wireless health monitors. In our previous implementation, we designed and simulated amplification and filtering circuits in KiCad, then assembled and tested them on breadboards and perfboards. While these prototypes performed well with larger input signals, nanoamp-level inputs produced significant parasitic noise, demonstrating that physical layout is as critical as circuit design. We have now moved to printed circuit boards (PCBs) and added filtering stages. The redesigned circuit combines a transimpedance amplifier, active high-pass and low-pass filters, amplification, and microcontroller protection on a PCB layout that minimizes parasitic effects and improves signal integrity.

Simulations confirm that the circuit conditions nanoamp-level sensor outputs into a stable signal within the input range of a microcontroller. Practical testing is expected to show an accurate signal read by the microcontroller. By combining hardware and software, the project improves usability, reduces power needs, and supports accurate monitoring across diverse users. The broader impact lies in providing a low-cost, energy-efficient alternative to bulky commercial monitors, making health tracking more accessible and comfortable. This work shows how triboelectric sensors can move from lab concepts to practical healthcare tools, supporting continuous and remote monitoring.

Mentor(s):
Pedro Henrique de Souza Barbosa (Engineering); Wenzhuo Wu (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1506
Presentation Time: Session 3: 12:00-1:00pm

Automated Cell Detection and Tracking in Live-Cell Microscopy

STEM

Authors(s):
Harshvardhan Sharma† (Science)

Abstract:
Studying how cells behave over time is important for understanding their responses to

different conditions. However, manually identifying and tracking cells in microscopy images

can be time-consuming, and automatically detecting whole cells can be difficult when their

boundaries are unclear. This project explores an alternative approach that focuses on

detecting and tracking cell nuclei, which can be easier to identify in microscopy images.

An automated image-analysis pipeline was developed to combine Cellpose-SAM, a model

used to identify cell nuclei, with TrackMate, a tool for tracking them across successive

images. The pipeline automates image preparation, segmentation based on cell nuclei, and

tracking on Purdue's computing servers, reducing the need for manual intervention. To adapt

the model to the experimental images, manually annotated images were used for fine-tuning.

In a preliminary evaluation, the model was trained on 15 annotated images and tested on four

held-out images. At an intersection-over-union (IoU) threshold of 0.90, the fine-tuned model

achieved an F1 score of 91.9%, compared with 55.8% for the original model.

These preliminary results suggest that adapting the model to the experimental images can

substantially improve segmentation accuracy. By combining nuclear detection with

automated tracking, the pipeline provides a foundation for analyzing cellular behavior over

time and estimating how long cells remain observable. Future work will focus on expanding

the training dataset, testing the model across additional experiments, and evaluating the

reliability of cell tracking and lifespan measurements. This approach aims to make the

analysis of long microscopy sequences more efficient and support further investigation of

cellular responses to nanoplastic exposure.

Mentor(s):
Gouri Gouri Prabhakar (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1507
Presentation Time: Session 3: 12:00-1:00pm

Meta Quest Pro Study And Application

Creative

Authors(s):
Cameron Raymond Shute† (Engineering); Charles Smith Cripe† (DSB); Maahir Shah† (DSB)

Abstract:
[Abstract Redacted]

Mentor(s):
Steven R Dunlop (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1508
Presentation Time: Session 3: 12:00-1:00pm

Improving Perceived Value and Trust at the Indianapolis Zoo After Accreditation Loss

Business Case Study

Authors(s):
Sara Elizabeth Sinclair† (DSB); Aiden James Deckard† (DSB); Claire Jeon† (DSB); Yi-Chun Chang† (DSB); Hannah Elizabeth Kotvasz† (DSB|HHS); Megan Santa Cruz† (DSB); Shreya Gautam† (DSB)

Abstract:
The Indianapolis Zoo recently lost its AZA accreditation due to internal organizational and work culture issues, which has hurt the zoo's reputation and may have weakened consumers' trust. On top of this, many visitors already feel they are not getting value for their money, as reviews point to closed exhibits, experiences that don't match ticket descriptions, and a general feeling of being underwhelmed for a high ticket price. Since restoring accreditation is beyond the scope of our project, our goal is to find other ways for the zoo to rebuild its reputation and restore consumer trust. Using consumer research and relevant consumer behavior theories, we will develop recommendations for how the zoo can use social media to communicate more openly with consumers, such as sharing daily updates on which exhibits are open or closed so visitors know what to expect. We will also look at what other zoos have done to support our recommendations. If effective, these strategies should increase visitor satisfaction and perceived value.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1509
Presentation Time: Session 3: 12:00-1:00pm

Beyond Reshoring: The Role of AI and Predictive Analytics in Semiconductor Supply Chain Resilience

STEM

Authors(s):
Saksham Singh† (Science)

Abstract:
Semiconductors are essential to automotive manufacturing, healthcare, consumer electronics, and computing, yet their production is concentrated among a relatively small number of firms and regions, particularly in East Asia. This concentration leaves global industries vulnerable to disruptions that expanding manufacturing capacity in the United States alone may not fully resolve. This research examines whether reshoring semiconductor manufacturing can strengthen supply chain resilience and how artificial intelligence (AI), predictive analytics, and information-sharing systems might complement traditional supply chain strategies. Using an exploratory literature review and comparative analysis of peer-reviewed research, government reports, and credible industry publications, the study investigates geographic concentration, semiconductor shortages, reshoring, supplier diversification, and technology-supported risk management. It compares strategies such as domestic capacity expansion and geographic diversification alongside potential uses of AI for demand forecasting, early disruption detection, and supply chain visibility, while considering challenges related to data quality and organizational decision-making. Preliminary research suggests that reshoring may reduce some geographic risks but cannot eliminate dependence on international suppliers, specialized equipment, and critical materials. By examining how manufacturing strategies and data-informed decisions can work together, this project aims to assess whether a combined approach offers a more effective path toward semiconductor supply chain resilience.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1510
Presentation Time: Session 3: 12:00-1:00pm

The Moment That Matters: Turning Attention Into Engagement

Business Case Study

Authors(s):
Harini Sivakumar† (Engineering); Paulina Leignadier Rodriguez† (DSB); Ellen Ho† (DSB); Sneha Reddy Tamma† (DSB); Ipsha Basu† (DSB); Ethan William Smith† (DSB)

Abstract:
Sponsorship activations provide organizations with opportunities to engage consumers while achieving marketing objectives such as increasing brand awareness, generating leads, and strengthening perceptions of community involvement. This project examines how the Indianapolis Zoo can design sponsorship activations that encourage visitor participation while supporting the differing objectives of its sponsors. The research focuses on identifying characteristics of activations that attract visitors' attention, motivate participation, and contribute to positive perceptions of sponsoring brands.

To investigate these factors, the project combines research on the Indianapolis Zoo's audience, mission, events, and existing sponsors with an analysis of sponsorship activations used by comparable zoos and attractions. Consumer feedback will also be collected through a survey comparing potential activation concepts, including branded booths, games, interactive activities, and giveaways. The survey will examine participants' interest in each concept, reasons for engaging with or passing an activation, and perceptions of the sponsoring brand. Survey responses will be analyzed using segmentation, targeting, and positioning, and value proposition analysis to identify differences in preferences among visitor groups. The resulting findings will inform approximately three practical activation recommendations connecting visitor preferences with specific sponsor objectives. Recommendations will consider the intended audience, visitor benefits, implementation requirements, and measures of success such as participation, brand recall, voluntary lead generation, and perceptions of community involvement. Ultimately, the project aims to provide the Indianapolis Zoo with research-based guidance for developing sponsoarship experiences that create value for visitors, sponsors, and the Zoo.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1511
Presentation Time: Session 3: 12:00-1:00pm

Guerrilla and Asymmetric Warfare

Social Science

Authors(s):
Cassidy Mae Skoranski† (Liberal Arts); Hudson B Doyle† (Liberal Arts); Gavin Stephen Pritchard-Poteet† (Liberal Arts)

Abstract:
This research project examines the 2017 Tongo Tongo ambush and how it demonstrated the advantages an irregular force can achieve over militarily superior forces through guerrilla and asymmetric warfare tactics. Using a qualitative case study, the project applies realist international relations theory, the unconventional warfare continuum, and concepts of hybrid and grey-zone conflict to analyze the attack and the broader strategic context. The analysis focuses on how surprise, irregular tactics, and operational vulnerabilities can challenge conventional military superiority. It also examines how the incident reflects the difficulties states face when pursuing national security interests against non-state armed groups. This case highlights the importance of understanding asymmetric warfare when evaluating military interventions and counterterrorism operations while demonstrating how superior technology and resources does not automatically guarantee success. Along with the analysis, this research develops a timeline of the ambush, the placement of the ambush on the unconventional warfare continuum, and applications of realism and hybrid conflict theory.

Mentor(s):
Chiara Cervini (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1512
Presentation Time: Session 3: 12:00-1:00pm

Pillars of Inclusion or Shields for Tradition: LGBTQ+ and Gender-Inclusive Fraternities on the American Campus

Social Science

Authors(s):
Barrett R Slaughter† (Polytechnic)

Abstract:
[Abstract Redacted]

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1513
Presentation Time: Session 3: 12:00-1:00pm

Texture Cache UVM Verification with Coverage Driven Methodology

STEM

Authors(s):
Joseph Allen Sowers† (Engineering|JMHC)

Abstract:
Modern GPU shader cores rely on texture caches to efficiently retrieve texture data while managing memory requests, variable response ordering, and finite buffering resources. Verifying these behaviors is crucial to guaranteeing core functionality and preventing critical bugs like cache deadlock. This project develops a SystemVerilog Universal Verification Methodology (UVM) verification environment for a GPU texture cache by extending and altering a lockup-free cache verification environment to address unique behaviors such as different access patterns and control behavior.

The verification environment integrates three agents: an active texture mapping unit (TMU) agent that generates cache requests, a passive TMU agent that monitors cache responses, and an active memory agent that models DRAM transactions. A predictor models the expected cache behavior, enabling a scoreboard to compare predicted and observed transactions. Constrained random stimulus is used to exercise all texture cache behaviors. Constrained random stimulus models spatial texture locality in the cache because one can constrain consecutive accesses to be close to each other in memory like how the actual TMU would be requesting the data. Because the TMU interface is read only, the verification environment focuses exclusively on read requests (read request cache misses, memory interactions, and correctness).

A coverage-driven verification methodology realizes the verification plan through directed (when absolutely necessary) and constrained random sequences, functional coverage models, and cross coverage of I/O and internal signals. SystemVerilog Assertions (SVA) are used to check handshake protocol compliance and automated regression testing combines assertion results, functional coverage, and scoreboard errors to establish objective verification sign-off metrics. The resulting environment extends the reusable cache verification baseline providing a foundation for future verification of GPU caches.

Mentor(s):
Srilekha Jagarlamudi (Engineering); Mark Johnson (Engineering); Cole Aaron Nelson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1514
Presentation Time: Session 3: 12:00-1:00pm

Retrieval-Augmented Generation for Oncological Combination Therapy Discovery

STEM

Authors(s):
Cole G Strickland† (HHS|JMHC); Saris J Becker† (Pharmacy|JMHC); Brian Pho† (Pharmacy|Science|JMHC)

Abstract:
Combination therapy is central to oncology but remains difficult to design rationally: the search space of drug and target combinations grows combinatorially, and selecting biologically plausible candidates still relies largely on empirical, incidental discovery. Hence, the development in large language models (LLMs) can assist in integrating heterogeneous sources and generate hypotheses. However, they are prone to hallucination, offer no control over the references informing their outputs, and are rarely trained on specialized oncology literature. We hypothesize that retrieval-augmented generated (RAG) models will outperform foundation-model baselines by integrating external biological and clinical knowledge at inference time, improving evidence grounding for combination proposal generation and robustness in combination effect prediction.

The aim of this project is to develop a Retrieval-Augmented Generation LLM (RAG-LLM) framework to propose pathway and target combination therapies for breast cancer. We are building and refining a knowledge library that includes biological pathways and protein-protein interactions (KEGG, STRING), functional dependency data (DepMap), drug combination screens (DrugComb), and clinical evidence (guidelines, trials, literature). We converted this knowledge library into standardized retrieval units (SRUs) and indexed it with a hybrid retrieve-rerank pipeline. A comparison of retriever outputs to curated test prompts is underway.

Preliminary work has produced the harmonized multi-source SRU library and retrieval pipeline described above, with concordance and grounding evaluations underway. Together, this project will establish whether retrieval augmentation meaningfully improves foundation models for both hypothesis generation and effect prediction in oncological combination therapy discovery, laying groundwork for an integrated generate-and-screen pipeline and extension to other cancer types.

Mentor(s):
Jiashu Zhou (Pharmacy)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1515
Presentation Time: Session 3: 12:00-1:00pm

High-Entropy Li-Rich Mn Cathodes: Powering Batteries in the Cold

STEM

Authors(s):
Iliana Alejandra Suarez Lopez† (Engineering)

Abstract:
The development of advanced materials capable of delivering reliable electrochemical performance across a wide temperature range remains a major challenge in lithium-ion battery research; in particular, at low-temperature operation, phenomena such as impaired ionic transport, charge-transfer kinetics, and capacity utilization limit battery performance. High-entropy compositions improve structural stability and suppress irreversible lattice-oxygen release, enabling wider operating conditions and reducing thermal runaway risk.

This study proposes the synthesis, structural characterization, and preliminary electrochemical evaluation of a lithium- and manganese-rich high-entropy cathode across a wide temperature range, with particular emphasis on investigating its fundamental behavior at low-temperatures; this research will include material synthesis, physicochemical characterization, including X-ray diffraction (XRD), scanning and transmission electron microscopy (SEM and TEM), which will be used to identify crystalline phases and assess structural changes, and, with appropriate spectroscopic techniques, particle morphology and nanoscale structural features will be examined; and temperature-dependent electrochemical techniques, such as galvanostatic charge–discharge cycling, cyclic voltammetry, and electrochemical impedance spectroscopy at selected temperatures. Key metrics will include specific discharge capacity, cycling stability, and rate capability. Low-temperature measurements will be compared with room-temperature results to assess changes in electrochemical behavior and establish a baseline for wider temperature-dependent evaluation.

The study aims to establish structure-property relationships among compositional complexity, structural characteristics, and temperature-dependent electrochemical behavior. The findings are intended to guide further material optimization and support the development of cathodes for LIBs operating across a broad temperature range.

Mentor(s):
Vilas G Pol (Engineering)

Other Acknowledgment(s):
Gabriel Cosio Aguilar* (Engineering)

Poster Presentation Abstract Number: 1516
Presentation Time: Session 3: 12:00-1:00pm

"Wait, there's a cafe in here!?": Addressing Low Foot Traffic at Purdue Saxbys

Business Case Study

Authors(s):
Meenu Subramanian† (DSB); Nidhi Narayan Hegde† (DSB); Erika Hernandez-lopez† (DSB); Kemal I Al-Arief† (Liberal Arts); Sahasra Kandula† (DSB); Marjorie S Ehrman† (DSB)

Abstract:
Saxbys is a student-led cafe in the lower level of Neil Armstrong Hall. Saxbys' current problem is limited foot traffic and difficulty attracting students who are not already near the building due to its unique location. By conducting a preliminary research survey, we found that there is little correlation between likelihood to visit Saxbys and students' area of residence. We analyzed Saxbys' physical presence among students using observational methods and found that the most frequently reported reason for not visiting Saxbys is a lack of awareness that it exists within Armstrong. These findings suggest that Saxbys must increase the diversity of their promotional methods to address low physical awareness and social media reach. We recommend implementing a targeted social media campaign on Instagram and TikTok, launching physical signage on campus, expanding on the existing promotional deals to attract Purdue West Lafayette students, and editing pricing strategies to better reflect expectations of this market.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1517
Presentation Time: Session 3: 12:00-1:00pm

Fabrication of 2D Graphene Devices for Scanning Probe Studies

STEM

Authors(s):
Cara Suh† (Liberal Arts|Science)

Abstract:
Graphene provides a versatile platform for studying electronic phenomena in low-dimensional systems. The surrounding heterostructure can control its properties. High-quality sample fabrication is essential for research on quantum transport and correlated electronic states in these materials.

One promising device architecture involves locally gated or split-gate graphene structures, which allow independent control of carrier density in neighboring regions. These devices can create spatially varying electrostatic potentials and interfaces between different electronic states, enabling investigation of electronic phenomena using scanning tunneling microscopy and spectroscopy.

This project focuses on fabricating graphene-based devices for future scanning probe and material growth studies. In Fall 2026, I will fabricate devices using PPC-assisted transfer techniques and develop proficiency in atomic force microscopy (AFM), with the goal of independently producing graphene trenches. By improving fabrication techniques and device quality, this research aims to contribute to the development of reliable graphene-based platforms for studying quantum transport phenomena.

Mentor(s):
Kyung Jun Lee (Science); Tiancong Zhu (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1518
Presentation Time: Session 3: 12:00-1:00pm

MakinTikz: Matplotlib to PGFPlots Vector Graphics Conversion Tool

STEM

Authors(s):
Jay Syslo† (Science); Prathum Arikeri† (Engineering); Jennie Long† (Science); Sarah Michelle Sewell† (Engineering); Alexander Thomas Chrzanowski* (Science|JMHC)

Abstract:
Academic research papers in computer science and engineering are typically typeset in LaTeX, with figures---generated independently with a programming language like Python---imported as vector graphics (SVGs or PDFs). However, this approach precludes post-hoc manipulation of figure elements like font, font size, axis numbering, aspect ratio, etc. An alternative is to construct figures directly in PGFplots and TikZ, which are plotting and vector-graphics languages written on top of LaTeX; but this would require forgoing Python. A better approach which offers the best of both is to generate figures with Matplotlib and then subsequently to convert them into PGFplots/TikZ code.

Here we present our contributions to an open-source Python package, MakinTikZ, for doing just that. The package is functional but limited---by design choices, bugs, and incompatibilities with newer versions of Matplotlib---to a subset of all possible figures that can be generated within Python. We present fixes for many of these, including support for 3D plotting, more complete documentation, and a rationalization of the relationship between PGFplots/Tikz's and Matplotlib's default behaviors. We maintain a public version of the package at GitHub (https://github.com/AlexChrzanowski/MakinTikZ), where we track and fix open issues. We encourage anyone writing a paper in LaTeX to use it.

Mentor(s):
Joseph Gerard Makin (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1519
Presentation Time: Session 3: 12:00-1:00pm

Multi-Sensor Analysis and Field Observations of the June 3, 2026 Ideal, South Dakota Tornadic Supercell

STEM

Authors(s):
Jackson Cole Theurer† (Science|JMHC)

Abstract:
On June 3, 2026, a tornadic supercell produced an EF-1 tornado and 2.5-inch diameter hail in Tripp County, South Dakota, near the town of Ideal. This study presents a preliminary analysis of the event using datasets collected by a high-resolution rapid-scan X-band polarimetric radar (RaXPol) and Portable In Situ Precipitation Station 2A (PIPS 2A) during their deployment with EAPS 43500, otherwise known as the Students of Purdue Observing Tornadic Thunderstorms for Research (SPOTTR) field campaign. To complement these mobile observations, data from three surrounding WSR-88D NEXRAD sites (KUDX, ABR, and FSD) were integrated into the study. This study will also include windsonde data collected from launches on June 3rd by both the National Weather Service and SPOTTR.

Combining local surface observations with multi-radar coverage enables a direct comparison between the reflectivity calculated from the PIPS 2A disdrometer drop size distributions and the observed radar reflectivity from both RaXPol and nearby WSR-88D sites. This study also examines the synoptic, mesoscale, and storm-scale environments that played a role in this supercell's evolution. This will include information and analysis from the SPOTTR morning and midday forecast briefings on June 3rd.

Mentor(s):
Robin L Tanamachi (Science); Daniel T Dawson (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1520
Presentation Time: Session 3: 12:00-1:00pm

Particle Alternation in Japanese (-wa/-ga)

Humanities

Authors(s):
Joni Thompson† (Liberal Arts|JMHC)

Abstract:
-wa and -ga are two particles extremely important in the Japanese language to differentiate who the subject of the sentence is and what the topic of the sentence is. When and why the particles are alternated is what my research will be answering. The -wa particle establishes the topic of the sentence and using -ga establishes what will be the subject of the sentence, however, the problem is that both of these particles can be switched to indicate the same thing which is why I am studying under which constraints each particle is used. My research methods were taking sentences and data from Duolingo, transcribing them into an excel document where I coded them depending on which particle, sentence type: positive or negative, and if the sentence was a statement, question, imperative, or desiderative. This allowed me to see the pattern of how -ga is used with psych verbs such as to want (-gahoshii) or like (-gasuki), but -wa can also be used to show the topic of the sentence or make a comparison. The particle change shows how subjects are organized structurally in Japanese and which part of the sentence should be emphasized as most important to the speaker so that the listener has more understanding of the speaker. This could be introducing added information for context to the listener or any information relevant to the speaker's understanding of the sentence. Identifying the difference between when to use these particles can be quite difficult for Japanese learners, specifically L2, which is why I want to research the main points as to when this alternation occurs so that the ease of acquisition for non-native learners is more clear and efficient. My findings are that -wa marks the topic of the sentence and is used for comparisons while -ga is used to mark the subject or specific psychological state.

Mentor(s):
Elena Benedicto (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1521
Presentation Time: Session 3: 12:00-1:00pm

Designing a Software Stack for a Custom GPU Architecture

STEM

Authors(s):
Parin Paresh Timbadia† (Engineering|JMHC); Thet Naing Soe† (Engineering|Science); Jui-Yu Tsai† (Engineering); Jeng-Ruei Huang† (Engineering); Yun-Kai Chen† (Science)

Abstract:
Modern graphics software stacks use standardized graphics interfaces and compilers to translate high-level operations and shaders into commands for Graphics Processing Unit (GPU) hardware, exploiting parallelism in graphics workloads. Although previous development on an in-house GPU supported hardware simulation with a custom graphics interface, it lacked compatibility with industry specification-compliant graphics applications and shaders. The GPU Software team addresses this by developing an OpenGL 2.1-compatible software stack consisting of a graphics library, driver interface, and shader compiler. The graphics library manages graphics resources and state, exposes standard rendering operations, and translates application requests into driver commands. The shader compiler translates OpenGL shaders into the programmable shader core instruction set architecture (ISA), encoding dependency information in the binary to eliminate the need for costly hardware-based dependency tracking and scheduling. Success will be evaluated through supported OpenGL API coverage, correct execution of benchmark graphics applications, and compiler optimization metrics such as dynamic instruction count and binary size. Because the GPU uses a custom ISA, little existing software can be reused, requiring all tools to be ported or rewritten. Furthermore, because of the aforementioned software-based dependency handling, compiled code is tied to the hardware architecture, preventing major architectural changes without software modifications. Lastly, utilizing a finite-size stack to handle divergent code limits the control-flow depth supported in hardware. Future work will expand the subset of OpenGL 2.1 features supported, improve compiler optimizations, and integrate the graphics library, compiler, driver, and hardware pipeline for end-to-end real-time rendering of graphics workloads.

Mentor(s):
Charles Spencer Bowles (Engineering); Zach Anthony Barna (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1522
Presentation Time: Session 3: 12:00-1:00pm

Improving Drug Delivery Through Lipid Nanoparticle Formulation

STEM

Authors(s):
Cole Robert Townsend† (Pharmacy); Grace June Webb† (Science); Grant Remo Richardson† (Pharmacy); Sakura Suresh Kumar† (Pharmacy); Kirsten South† (Engineering)

Abstract:
Background: Currently, there are approved pharmaceutical products on the market that have the potential to improve patient health but are limited by their bioavailability. Lipid nanoparticles (LNPs) refer to a drug delivery system that can increase bioavailability by stabilizing individual drug molecules and delivering them to the desired site of action. By utilizing LNPs, we may be able to increase the effectiveness of already successful drugs, which could create breakthroughs in healthcare.

Objective: Our research aims to identify which pharmaceuticals are most compatible with LNPs. We will evaluate prospective drug compatibility based on the ability to meet the following metrics over an extended period of time: maintain a nanoparticle size of approximately 100 nanometers, remain encapsulated within the LNP, and maintain drug stability.

Methods: Our group used an established lipid mixture consisting of 50:10:38.5:1.5 mol% (SM-102:DSPC:cholesterol, respectively). Using this specific formulation, we will evaluate the compatibility of two different pharmaceuticals, Phosphomatid and flurbiprofen. We hypothesize that pharmaceuticals containing a phosphate group demonstrate improved stability due to salt-forming properties between the phosphate group and the nitrogen-containing SM-102 lipid. Both formulations will be monitored over an extended period of time to evaluate nanoparticle size, drug retention, and drug stability.

Results: Experimental Work is ongoing

Conclusion: This research is designed to identify which pharmaceuticals are most compatible with our established lipid nanoparticle formulation while maintaining nanoparticle size stability, drug retention, and drug stability over time. Through this research, we hope to better understand

how different pharmaceutical properties influence LNP compatibility. Our findings may help inform future research on pharmaceutical selection for lipid nanoparticle drug delivery.

Mentor(s):
Daniel T Smith (Pharmacy); Stephen Robert Byrn (Pharmacy)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1523
Presentation Time: Session 3: 12:00-1:00pm

Differentiation of Isomeric Amino Acids using Electron Activated Dissociation

STEM

Authors(s):
Charles Timothy Tully† (Agriculture)

Abstract:
Accurate identification of isomeric compounds in complex mixtures, such as isomeric amino acids, is a significant analytical challenge. Because these isomers have the same exact mass and identical functional groups, traditional tandem mass spectrometry is unable to accurately differentiate them. Particularly, collision activated dissociation (CAD) of protonated amino acids results in nearly identical mass spectra. Electron activated dissociation (EAD) is a relatively novel technique that uses electrons to electronically and vibrationally excite protonated molecules and provide complementary information to CAD.

To explore the feasibility of differentiating isomeric protonated amino acids using EAD, 10μM solutions of leucine, isoleucine, and norleucine were prepared in a 50:50 MeOH:H2O and analyzed using a SCIEX ZenoTOF 7600+ mass spectrometer. Neutral analytes were ionized using electrospray ionization (ESI), and their molecular ions were mass-selected in a quadrupole prior to fragmentation using either EAD or CAD. High mass accuracy spectra were generated, which allowed for the determination of fragment ion elemental composition. The mechanisms for generation of fragment ions upon EAD and CAD were rationalized using thermochemical quantum calculations.

While CAD resulted in subtle fragment ion differences between isomers, EAD resulted in fragment ions that can clearly differentiate them. The n-butyl, iso-butyl, and sec-butyl groups in norleucine, leucine, and isoleucine, respectively, result in characteristic radical-driven neutral losses of hydrocarbon fragments not observed upon CAD. These losses are characteristic for each isomer and are rationalized by the effects of hydrocarbon chain geometry on accessible fragmentation routes. Additional fragmentation pathways like ammonia loss, formic acid loss, and methylamino radical loss were also useful for distinguishing isomers, and the thermodynamic favorability of these fragmentations was explored computationally.

Mentor(s):
Bridger Lawrence Johnston (Science); Hilkka Kenttamaa (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1524
Presentation Time: Session 3: 12:00-1:00pm

Personifying the Graphical Abstract: Understanding Undergraduate Students' Unique Experiences Creating Graphical Abstracts

STEM

Authors(s):
Nathan Robert Uselman† (Science)

Abstract:
Within science education, there is a desire to improve science communication to support how science is understood. Recently, graphical abstracts have become an effective tool to bridge this gap. Graphical abstracts are a new combination of visuals and/or textual elements to provide a clear idea of what scientific literature is about. The purpose of this study was to determine how students create their graphical abstracts for a graduate level cancer biology course. These graphical abstracts were part of a primary literature assignment within the course. Thus, to explore student graphical abstract construction, a qualitative study was conducted using recorded think aloud sessions for construction of graphical abstracts and semi-structured interviews for retrospective questioning at two different time points in the spring 2026 semester. Out of a total of ten voluntary participants, this analysis focuses on three undergraduate students. The creation of their graphical abstracts was analyzed using inductive and deductive qualitative coding of the interview transcripts to produce personas for each student. These personas are made to group distinct individuals together into broad personalities of thought. This is done to more accurately portray the differences in thought regarding graphical abstract creation. Additionally, content analysis of their graphical abstracts was performed to assess what the students noticed from scientific literature to create their graphical abstracts. Collectively, this analysis aids in informing how students think about distilling complex scientific information into general conclusions. It could also provide further insight into how instructors can utilize personas to understand the impact of assignments such as this one on scientific communication.

Mentor(s):
Stephanie M Gardner (Science)

Other Acknowledgment(s):
Traven Levar Cargill* (Science)

Poster Presentation Abstract Number: 1525
Presentation Time: Session 3: 12:00-1:00pm

Malic Acid for Extraction of Metals from Post-Consumer E-Waste

STEM

Authors(s):
Sadie Catherine van der Spuy† (Engineering); Abby L Thompson‡ (Science|JMHC); Hannah Margeurite Kitts‡ (Engineering|JMHC)

Abstract:
Electronic waste (e-waste) production has grown rapidly and is therefore also a growing source for recovery of critical materials. Conventional metal recovery relies on mineral acids that are hazardous and have a negative impact on the environment. Organic acids are less hazardous and have a lower environmental impact which makes them promising green alternatives to the harsher chemicals.

This study investigates the applicability of DL-malic acid as a leachant for recovery of tin, nickel, zinc, copper and other metals from post-consumer e-waste. Malic acid is a dicarboxylic acid with a hydroxyl group that can dissolve and chelate metal ions. In past studies, organic acid leaching has been limited by narrow operating windows and poor selectivity. This study tracks metal leaching over multiple time frames to evaluate the effects of oxidation, time and temperature on extraction yield and to identify which elements are extracted most effectively. Metal concentrations in the extracts were quantified with ICP-OES. Printed circuit boards (PCBs) from USB flash drives were used as a small, uniform model e-waste sample. An aqueous solution of DL-malic acid was prepared to result in an initial pH of 1.5. This solution was brought in contact with PCBs and heated at a constant temperature of approximately 90 °C on a heating plate for variable time intervals (15 min – 6 hours). Experiments run with and without hydrogen peroxide are being conducted to assess the effects of oxidation on metal extraction. The preliminary results suggest that malic acid can effectively leach Sn, Ni, Zn and Cu, with efficacy increasing with time.

This work supports the use of organic acids as a lower-impact alternative for critical metal recovery from e-waste.

Mentor(s):
Nadezhda N Zyaykina (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1526
Presentation Time: Session 3: 12:00-1:00pm

Beyond the Ingredient: Marketing the Future of Food Technology

Business Case Study

Authors(s):
Emilia M Vargas Canepa† (DSB); Viviana Montealegre Pinto† (DSB); Patricia Elena Tejeira Pascual† (DSB); Stella A Athans† (DSB|JMHC); Jonathan Edward Ritenour† (DSB); Savana Rose Morris‡ (DSB)

Abstract:
The project examines the best way to introduce a new clear Whey Protein Isolate product into the business-to-business supplement (B2B) market by highlighting its competitive advantages and patent-pending technology. The technology and product are important because they will allow businesses to integrate new clear whey protein isolate into existing and new products. The proposal investigates how this product and technology differentiates from current protein products and supplements, and why businesses should adopt the product/technology as an essential ingredient in their final products. To address this challenge, the project will conduct market and competition research, and analyze benefits and risks associated with adopting technology. The research will identify and address key influences on businesses' purchasing decisions and develop a financial model that is supported by measurable factors. The project's research findings will produce business-to-business marketing strategies that will clearly communicate the patent-pending technology's value, strengthen its competitive position, and encourage its adoption among potential business customers.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1527
Presentation Time: Session 3: 12:00-1:00pm

Biophysical Characterization of Novel Small-Molecule GSTP Inhibitors for Cancer Therapeutics

STEM

Authors(s):
Karthik Varigonda† (Science|JMHC)

Abstract:
Glutathione S-transferase Pi (GSTP) is a cytosolic enzyme involved in cellular detoxification and has been implicated in cancer progression and resistance to chemotherapy. Elevated GSTP activity is associated with tumor survival and reduced sensitivity to anticancer therapies. However, there are currently no FDA-approved GSTP inhibitors, motivating the development of novel small-molecule inhibitors that can target GSTP. Understanding how an inhibitor interacts with GSTP at the molecular level is essential for evaluating its mechanism of action and guiding future therapeutic development.

In this study, we are structurally and biophysically investigating a set of novel small-molecule inhibitors of GSTP. The goal is to determine the structural features that mediate the GSTP-inhibitor interactions. Human GSTP was recombinantly expressed in E. coli and purified to obtain protein suitable for structural studies. Crystallization conditions are currently being optimized for X-ray crystallography on the GSTP-inhibitor complexes. Small-angle X-ray scattering (SAXS) was also employed to assess whether inhibitor binding alters the monomer-dimer equilibrium of GSTP. We will then identify binding-site interactions and evaluate how the inhibitor interacts with GSTP.

Characterizing these GSTP-inhibitor complexes may provide insight into GSTP inhibition and inform subsequent optimization of the compound toward future preclinical therapeutic development against cancer.

Mentor(s):
Nicholas Noinaj (Science); Jianing Li (Pharmacy); Chijian Xiang (Agriculture); Ke Xu (Pharmacy)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1528
Presentation Time: Session 3: 12:00-1:00pm

Wildfire $PM_{2.5}$ Exposure and Asthma-Related Emergency Care: Differences by Age, Sex, and Exposure Timing

STEM

Authors(s):
Pooja Verma† (HHS); Saranya Namala† (HHS); Alexandra Elizabeth Dubish† (HHS); Grace Ann Kowis† (HHS); Kristen Kayleigh Murray† (HHS)

Abstract:
Wildfires release fine particulate matter ($PM_{2.5}$) that can penetrate deep into the lungs and worsen asthma symptoms. Understanding the relationship between wildfire smoke exposure and asthma-related emergency department (ED) visits and hospitalizations can help identify vulnerable populations and inform public health responses. This narrative review evaluates how published studies examine these associations, focusing on methodology, age, sex, exposure intensity, and timing. Peer-reviewed publications were selected for their relevance to asthma-related emergency care, quantitative results, and coverage of age, sex, $PM_{2.5}$ concentration, and exposure timing. We compared study populations, asthma case definitions, exposure assessment, comparison periods, and statistical measures. Designs included case-crossover and time-series analyses; measures included odds ratios, relative risks, and percentage changes. Findings were synthesized narratively rather than pooled; a formal PRISMA systematic review was not performed due to time constraints. Studies generally reported positive associations, although methodologies and effect estimates varied. Haikerwal et al. (2016) reported 1.96% more same-day asthma ED visits per 8.6 μg/m³ increase in $PM_{2.5}$, with a larger association among women aged 20 and older (5.08%). Doubleday et al. (2023) reported higher odds of asthma ED visits on smoke days (OR 1.13; 95% CI: 1.10–1.17), with associations persisting up to five days. Differences in study populations, exposure measurements, and comparison periods limited direct comparisons. Evidence generally associates wildfire smoke with increased asthma-related emergency healthcare use. Variation by age, sex, and exposure timing suggests that risk may differ across populations and smoke events. Consistent exposure and outcome measures could improve future comparisons and inform targeted smoke alerts and protective measures.

Mentor(s):
Mark Wilson (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1529
Presentation Time: Session 3: 12:00-1:00pm

Design and Verification of a Universal Serial Interface IP for a Custom RISC-V Based Microcontroller

STEM

Authors(s):
Aditya Verma† (Engineering); Hoyoung Chun† (Engineering); Kade M Zisko† (Engineering); Alexander Yokkit Zeng† (Engineering)

Abstract:
Microcontrollers typically use separate blocks for serial communication protocols, despite utilizing common components like FIFOs and shift registers. This project presents an architecture that integrates multiple protocols into a single reconfigurable interface, enabling resource sharing between protocols.

The target RISC-V based microcontroller currently uses separate hardware blocks for UART, SPI, and I2C, with no support for QSPI and SDIO. The Universal Serial Interface (USI) combines these five serial protocols within a single configurable block. Multiple identical USI instances can be instantiated on the chip, allowing software to select the active protocol for each instance as needed.

Each protocol uses a finite state machine to manage protocol-specific timing and datapath control. The design aims to support flexible protocol selection and potential future extensions through a shared, configurable set of I/O shift registers and an asymmetric split RX/TX FIFO. Separate RX and TX datapaths are connected to the active protocol state machine through a control unit, supporting duplex communication when applicable.

Although the design improves serial communication flexibility, it requires additional control logic to accommodate protocol-specific timing requirements and I/O pad configurations. This added complexity may increase power consumption and area compared to individual protocol blocks, creating trade-offs between efficiency and flexibility.

Following implementation, the design was emulated on an FPGA. Validation involved simulating communication with peripherals such as I2C sensors and SD cards. Received data was evaluated for accuracy, and transfer speeds were evaluated against protocol requirements, providing experimental validation of the design's functionality.

Ultimately, USI aims to provide a flexible, extensible foundation for serial communication, enabling future developers to easily integrate new protocols and expand communication capabilities.

Mentor(s):
Cole Aaron Nelson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1530
Presentation Time: Session 3: 12:00-1:00pm

Computer Vision-Based Human Intent Prediction for Construction Environments

STEM

Authors(s):
Srivatsa Viswanadhula† (Science)

Abstract:
Construction sites are very dynamic locations and understanding what exactly construction worker's objectives and the needs of their tasks are important for the overall efficiency of a project or singular task. This semester I am developing a multi-modal intent engine that will be analyzing worker's movements, body cues and other interactions with tools and objects in a construction environment using computer vision that will predict intended actions in an ongoing task. Some of these tasks and body movements that I am referring to is picking up objects, carrying items, and/or interacting with various tools. The current work focuses on developing a foundational computer vision pipeline for recognizing worker-object interactions. Some of my preliminary experiments involve using OpenCV to process video data and extract movement-related information, including changes in object positions and worker movement. The initial classification experiments I have explored distinguishes between actions, such as moving a chair and approaching a chair without moving it. Using Pytorch and other python libraries regarding machine learning, I will be training a neural network that will classify different types of human interaction with various objects and situations that humans are placed in a construction environment.

Mentor(s):
Jiansong Zhang (Polytechnic); Meta Soy (Polytechnic); Jingyi Lai (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1531
Presentation Time: Session 3: 12:00-1:00pm

A Lightweight Gigabit Ethernet Command Interface for a Fixed-Function GPU

STEM

Authors(s):
Kiet Vu† (Engineering); Srinivas Arasu† (Engineering); Salaheldin Elsayed Ibrahim AbdelMoaty‡ (Engineering)

Abstract:
Birdy is a fixed-function GPU prototyped on an FPGA without an on-chip CPU, requiring a host PC to supply all triangles and transformation matrices. Without a reliable connection, the graphics pipeline cannot be tested end to end, and corrupted data can produce incorrect images.

Existing solutions are not viable. PCIe requires complex hardware and drivers, which is beyond a student prototype, while UART at 115,200 baud transfers fewer than three primitives per frame at 60 Hz. General-purpose Ethernet cores are built for networked hosts, adding logic that a direct cable does not need, and none defines how data safely enters GPU state.

Our solution is a receive-only Gigabit Ethernet interface that treats each frame as an all-or-nothing unit of GPU commands. Each frame undergoes address, type, and CRC-32 checks and is fully buffered before processing, preventing corrupted frames from modifying GPU state. A lightweight protocol supports 48-byte transformation matrices, 73-byte primitives containing three vertices, and register writes, with values converted to fixed point by the host. Packing 20 primitives into each 1,500-byte payload yields a theoretical throughput of 1.67 million primitives per second, with 97% payload utilization.

However, the receive-only design cannot acknowledge dropped frames or communicate buffer availability, requiring the host to control transmission rates. Since this link is the only path into Birdy, it is the prerequisite for the first end-to-end render.

Next, we will integrate it with the FPGA vertex stage and develop a transmit path for acknowledgements and flow control.

Mentor(s):
Charles Spencer Bowles (Engineering); Zach Anthony Barna (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1532
Presentation Time: Session 3: 12:00-1:00pm

Warning Signs: A One-Year-Ahead Bankruptcy Watch List for Limiting Investment Risk on U.S. Public Companies

Business Case Study

Authors(s):
Ping Chien Wan† (DSB); Kyle B Cuson† (DSB); Nitya Manish Jhaveri† (DSB|Science); Christopher Xinhao Weng† (DSB)

Abstract:
How can lenders, suppliers, and investors tell which public companies are likely to go bankrupt within the next year, when the standard screen raises far more alarms than there are failures? We build a model that turns each company's latest annual report into a bankruptcy probability and ranks companies into a short, explainable watch list. A missed bankruptcy means unpaid loans, unpaid invoices, and wiped-out equity, and the 1968 Altman Z-score, still the industry default, buries most failures among dozens of healthy firms. We use the American Bankruptcy Dataset (Lombardo et al., 2022, on Kaggle): 78,682 NYSE and NASDAQ firm-years from 8,971 firms (1999–2018), labeled from Chapter 7 and Chapter 11 filings. We label only each failed firm's final report, leaving 0.73% of training firm-years as failures. Failing firms' liabilities-to-assets ratio is already 0.59 five years out versus 0.49 for survivors, reaching 0.90 at the final report. Altman's distress zone captures 77% of failures, yet only 1.6% of flagged firms fail. We build 17 leverage, liquidity, profitability, size, and momentum ratios, log-transform skewed dollar figures, winsorize extreme ratios, and impute missing prior-year values; because ratios are highly correlated (Spearman up to 0.92), we use L1/L2 penalties. Altman Z is our baseline, compared with penalized logistic regression, decision trees, random forests, gradient boosting, and a small neural network, each tuned with expanding-window cross-validation; we train on 1999–2013, validate on 2014–2016, and test once on 2017–2018. PR-AUC is our primary metric because it judges how clean the top of the risk list is when failures are rare. A class-weighted logistic regression already reaches about three times Altman Z's PR-AUC (0.071 vs. 0.023). Unlike Z's fixed 1968 weights, models can learn how distress builds, giving credit analysts a shorter watch list with reasons for each flag.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1533
Presentation Time: Session 3: 12:00-1:00pm

Why Phishing Succeeds Despite Better Technology and Training

Social Science

Authors(s):
Von Weidner† (Polytechnic)

Abstract:
[Abstract Redacted]

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1534
Presentation Time: Session 3: 12:00-1:00pm

Racial and Cultural Bias in Forensic Psychology

Social Science

Authors(s):
Chloe Mai Williams† (HHS)

Abstract:
Forensic psychology plays a vital role in the legal system by helping evaluate defendants and providing professional opinions that heavily influence courtroom decisions. However, cultural and racial biases affect how forensic psychologists interpret behavior, assess individuals, and present their findings. Research has shown that personal assumptions and racial stereotypes can influence legal decision-making and contribute to unequal treatment within the legal system (Friedman).

In this exploratory research project, I dissect how cultural and racial biases influence forensic assessments, courtroom testimony, and the treatment of defendants within the legal system. To investigate this issue, I conducted a preliminary review of scholarly research and popular sources discussing cultural competency, racial bias, and wrongful convictions. Additionally, I conducted an interview with a senior undergraduate student who works at a law firm that represents defendants to gain further insight into experiences within the justice system.

This research stresses the importance of cultural competency, self-awareness, and continued education within forensic psychology. It is vital that forensic psychologists continue working towards a greater effort to recognize and reduce bias so that forensic evaluations and courtroom decisions are based on evidence rather than clouded by personal bias.

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1535
Presentation Time: Session 3: 12:00-1:00pm

Effect of Surface Treatments on the Roughness and Wettability of Additively Manufactured Thermoplastic Composite Tooling

STEM

Authors(s):
Sohyun Won† (Science)

Abstract:
Additive manufacturing (AM) of fiber-reinforced thermoplastic composites can produce tools for composite parts with shorter lead times, greater design freedom, lower weight, and a better thermal expansion match with the parts. However, a post-machining process is required to achieve the final tool surface. The machining process can cause fiber breakage, fiber pull-out, and exposure of micro-voids on the surface. These defects increase surface roughness and can increase the force required to demold a cured part. On conventional tools, primers, sealers, and release agents are used to seal the surface and ensure part release. Their performance on machined AM tools, however, has not yet been systematically evaluated. In this study, flat plates of carbon fiber-reinforced polyethersulfone (PESU) was printed and face machined to represent a tool surface. Primers, sealers, and release agents from two manufacturers were applied to the machined surfaces following each manufacturer's application guidelines. Untreated machined surfaces served as the baseline. Surface roughness of the baseline and treated surfaces was measured with a stylus profilometer. Contact angles were measured with water and camera. These findings are expected to show how each treatment changes the surface roughness of the machined surface. These results can be used to compare the treatments and to select a suitable surface treatment for AM composite tooling.

Mentor(s):
Eduardo Barocio Vaca (Engineering); Garam Kim (Polytechnic)

Other Acknowledgment(s):
Rishabh Pammi* (Polytechnic)

Poster Presentation Abstract Number: 1536
Presentation Time: Session 3: 12:00-1:00pm

Development and Optimization of UMI-Containing DNA Constructs for DNA-Encoded Library Applications

STEM

Authors(s):
Kathleen Nicole Woodburn† (Pharmacy|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Casey J Krusemark (Pharmacy); Teodora Kljaic (Pharmacy)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1537
Presentation Time: Session 3: 12:00-1:00pm

Birdy Pixel Output: Implementation of Raster Operations Pipeline for FPGA-based Applications

STEM

Authors(s):
Michael Daoming Wu† (Engineering); Chen Jyh Wong† (Engineering); Ananya Prabhakar† (Engineering)

Abstract:
The purpose of this project is to design and synthesize a simple fixed-function GPU on an FPGA. Fixed-function was chosen because implementing only predefined operations reduces hardware complexity, making prototyping practical. This project focuses on the raster operations pipeline (ROP), which determines each pixel's final color before it is written to the framebuffer.

ROP throughput is limited by memory access, so this design uses parallel lanes and banked caching to increase throughput. It is banked so that multiple ROP lanes are able to operate on multiple tiles simultaneously. The cache is non-blocking so that a miss doesn't stall later fragments.

The design will be evaluated based on FPGA resource utilization, maximum operating frequency, throughput, bank utilization, cache hit rate, cache-miss latency, and memory bandwidth. The target is 125 MHz and 0.5 pixels per cycle, with a single ROP lane targeting 480p at 60 frames per second for a spinning-sphere workload.

This design only uses hardware that most FPGAs provide for portability, leading to some limitations. Without a floating-point unit, using only fixed-point math leads to decreased precision in color or depth values, which can cause minor rendering errors. Cache size and amount of parallelization is also limited by memory. This design is a starting point and is useful as a prototype and to be evaluated. In the future, additional parallelization with more lanes, support for floating-point operations and other improvements can be made on the project based on performance.

Mentor(s):
Zach Anthony Barna (Engineering); Charles Spencer Bowles (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1538
Presentation Time: Session 3: 12:00-1:00pm

Verification Infrastructure for the Vector Core

STEM

Authors(s):
Hening Xu† (Engineering|JMHC); Rishi Madipalli† (Engineering)

Abstract:
The Vector Core is a SIMD accelerator designed for vector operations in AI workloads, with 32-element vectors distributed across 16 parallel processing lanes. As the design has expanded to include multiple functional units, memory interfaces, reduction operations, and valid-ready handshaking, verifying interactions among these components has become increasingly difficult. Previous verification relied primarily on directed SystemVerilog testbenches targeting individual units or specific scenarios, which limits reusability and scalability as the design evolves.

This project addresses this limitation by developing a structured UVM-based verification environment for the Vector Core. Reusable verification components will generate directed and constrained-random instruction sequences, drive requests, and monitor transactions. Dedicated agents will verify memory-interface and valid-ready behavior under varying traffic and backpressure conditions. A reference predictor will model expected vector operations and provide expected results to a scoreboard for comparison with DUT outputs. The test plan will cover arithmetic and logical operations, masking, memory accesses, reductions, dependencies, stalls, and relevant corner cases.

Verification success will be measured through regression results, code and functional coverage, and SystemVerilog Assertions (SVA). Tests must complete without scoreboard mismatches or unexpected protocol violations. Functional coverage will track key instruction and operating scenarios, while SVA will check valid-ready protocol compliance and transaction stability under backpressure. Together, these mechanisms provide a reusable foundation for systematically verifying the Vector Core as new functionality is introduced.

Mentor(s):
Srilekha Jagarlamudi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1539
Presentation Time: Session 3: 12:00-1:00pm

GlassBoxTutor: Explicit Student Modeling for Personalized LLM Tutoring

STEM

Authors(s):
Zhenghao Xu† (Engineering); Boyang Wu† (Engineering)

Abstract:
Personalizing instruction to each student's knowledge is a long-standing goal of intelligent tutoring. Classical tutoring systems such as ALEKS maintain an explicit model of what each student knows and select from predefined problems and explanations. This makes student progress and the system's teaching decisions transparent, but it limits interaction to rigid inputs and outputs. Large language model (LLM) tutors remove this limitation by accepting open-ended questions and producing flexible explanations, but they model the student only implicitly within the conversation. As a result, instructors cannot inspect what the tutor believes a student knows, and the tutor has no reliable estimate of how likely each teaching action is to help. We propose GlassBoxTutor, a personalized LLM tutoring pipeline that formulates tutoring as a partially observable Markov decision process (POMDP) and pairs an LLM tutor with an explicit student model defined over a course knowledge graph. The student's mastery of each concept is treated as a hidden state, and the student model maintains a belief over this state that is updated from the student's questions and answers throughout long-horizon tutoring sessions. The tutor uses this belief to choose its next teaching action, while the belief itself gives instructors a transparent view of each student's progress. We evaluate GlassBoxTutor on a set of tutoring scenarios with simulated students and compare it against an LLM tutor without an explicit student model.

Mentor(s):
Wei Zakharov (Libraries); Qiang Qiu (Engineering); Colby Acton (Engineering); Wei Chen (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1540
Presentation Time: Session 3: 12:00-1:00pm

Supporting Small Business Lending Decisions Through Early Charge-Off Risk Assessment

Business Case Study

Authors(s):
Huanci Yang† (DSB); Yotam Ainom† (DSB); Brandon Ray Woodard† (DSB); Tanish Kukreja† (DSB)

Abstract:
How can lenders identify small business loans at higher risk of charge-off using information available at the time of approval? Loan charge-offs create financial risks for lenders, making early risk identification important for lending and portfolio management decisions. We examine whether approval-stage loan and borrower characteristics can distinguish loans that are ultimately charged off from those paid in full. We combine U.S. Small Business Administration (SBA) 7(a) loan-level datasets for fiscal years 2010 through 2026: 934,089 records and 42 original variables. We focus on 503,959 loans with final outcomes of Paid in Full or Charged Off, excluding active and canceled loans. We propose 13 approval-stage predictors, including loan amount, SBA-guaranteed amount, initial interest rate, loan term, business age, industry, collateral status, and jobs supported. EDA will examine charge-off patterns and compare active and resolved loans to assess potential selection bias. To prevent data leakage, we exclude variables recorded after approval, impute missing numerical values with medians, one-hot encode categorical features, and standardize numerical variables. Logistic Regression is our interpretable baseline, compared with Random Forest and Gradient Boosting, which capture nonlinear relationships and interactions, such as how interest rate and business age jointly influence charge-off risk. We use a chronological train-test split and five-fold cross-validation within the training set. PR-AUC is our primary metric because charged-off loans are about 8.1% of the selected sample; precision, recall, and F1 support it. We expect to identify approval-stage risk characteristics and test whether flexible models improve on Logistic Regression, supporting early risk assessment and portfolio monitoring. Because we study resolved loans only, results may not fully apply to active or newly approved loans.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1541
Presentation Time: Session 3: 12:00-1:00pm

Design of a High-Density Connector Characterization Platform for Teradyne ATE to Custom SoC Validation

STEM

Authors(s):
Bennett Hanson Yi† (Engineering); Maxwell Raymond Huseman† (Engineering)

Abstract:
The increasing complexity of modern System on Chip (SoC) architectures necessitates rigorous post-silicon validation to ensure operational reliability. This project outlines the development of a specialized hardware interconnect designed to bridge an industry standard Teradyne Automated Test Equipment (ATE) system with a custom SoC developed by the Purdue SoCET team. A key challenge in this effort is selecting and validating high density connectors between the ATE motherboard and interchangeable daughtercards. These connectors must balance signal integrity, mechanical durability, compatibility with available laboratory soldering equipment, and cost. Because industry standard connectors may not withstand the repeated handling and reconfiguration common in academic prototyping environments, candidate connectors will be systematically evaluated against these criteria to identify a reliable and practical solution. A dedicated test Printed Circuit Board (PCB) is being developed in Cadence Allegro to validate candidate connectors by interfacing them with dummy daughtercards. The platform will enable systematic evaluation of pin-level connectivity and mechanical reliability. Ultimately, the evaluation results will guide the final connector selection and support the development of a reproducible interface platform that enables the SoCET team to execute automated test procedures and validate the physical behavior of custom silicon.

Mentor(s):
Moe Wai Yan Myint (Engineering); Boyuan Chen (Engineering); Matthew A Swabey (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1542
Presentation Time: Session 3: 12:00-1:00pm

Predicting Vinho Verde Wine Quality: A Data-Driven Complement to Expert Sensory Evaluation

Business Case Study

Authors(s):
Moses Zendejas† (DSB); Henry Merritt Coccoluto† (DSB); Charles Smith Cripe† (DSB); Gabriel Vincent Nixon† (DSB)

Abstract:
Can routine physicochemical measurements accurately predict how expert tasters will rate Vinho Verde wine? Wine quality influences production and quality-control decisions, yet sensory evaluation relies on trained experts and contains an element of subjectivity. This project examines whether measurable characteristics of Portuguese red and white Vinho Verde wines can be used to predict expert-assessed quality scores and identify which measurements provide the greatest predictive value. The dataset contains 6,497 wines and 11 physicochemical predictors, including alcohol, acidity, residual sugar, chlorides, sulfur dioxide, density, pH, and sulphates. Initial exploratory analysis shows that quality scores are concentrated near the middle of the observed range, with approximately 76.6% of wines receiving a score of 5 or 6. Because the response is ordered and discrete, we will evaluate whether regression is appropriate or whether an ordered classification approach is more suitable. We will also examine whether red and white wines should be modeled together or separately because preliminary analysis suggests that some predictor-quality relationships differ by wine type. Using Python, we will compare multiple linear regression, Ridge, LASSO, regression trees, and random forest regression. Models will be evaluated using 10-fold cross-validation, with RMSE as the primary performance metric. The project aims to identify the strongest predictive approach and determine which physicochemical measurements are most informative. More broadly, the analysis may demonstrate how objective laboratory measurements can complement expert sensory evaluation and support more consistent, data-driven wine quality-control decisions.

Mentor(s):
Adrian Hoffert Wolanski (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1543
Presentation Time: Session 3: 12:00-1:00pm

Reinforcement Learning for Fixed-Wing Path Planning with Feasibility Evaluation

STEM

Authors(s):
Adam Zhang† (Science|JMHC); Raymond Zhang† (Engineering); Seonghoon Kim† (Engineering); Ngoc N Vu‡ (Science); Shyam Siva Kumar‡ (Engineering); Nelson Jung Yi Wong‡ (Engineering); Abishek Krishna Kumar‡ (Engineering); Kaya Aypek‡ (Engineering)

Abstract:
Autonomous fixed-wing unmanned aerial vehicles (UAVs) offer significant operational advantages, but they face severe trajectory planning challenges in confined, dynamic indoor environments like the Purdue UAS Research and Test Facility (PURT). This research extends a discrete reinforcement learning (RL) framework—incorporating Q-Learning, SARSA, and a Dynamic Programming (DP) baseline—to address fixed-wing navigation under uncertainty through two primary focuses. First, the static pre-planner is upgraded to a full 3D kinematics model that tracks a robustness signal derived from Signal Temporal Logic (STL) specifications. STL is strategically scoped to time-critical mission requirements, while obstacle avoidance and kinematic feasibility are enforced via the reward function. Second, a 2D dynamic planner monitors real-time deviation from the pre-planned reference trajectory, triggering automatic replanning when deviations exceed a safety threshold. By embedding the reference trajectory directly into the agent's state space, these dual focuses establish a concrete, scalable framework for evaluating the feasibility and performance of RL in autonomous UAV flight operations.

Mentor(s):
Sabine Brunswicker (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1544
Presentation Time: Session 3: 12:00-1:00pm

Searching for Precursor Emission in Core-Collapse Supernovae Light Curves with the Zwicky Transient Facility

STEM

Authors(s):
Jake Roger Stavig† (Science); Kolby Ezra Dehn† (Science); Rohan Dylan Nijhawan† (Engineering); Aarish Patel† (Science)

Abstract:
Massive stars can undergo periods of enhanced mass loss shortly before ending their lives as supernovae. Evidence of this pre-supernova activity, known as precursor emission, has been observed in some supernovae, but the frequency, duration, and physical mechanisms responsible for these eruptions remain poorly understood. Identifying precursor emission with large scale surveys can provide important insight into the final stages of massive star evolution which can determine the final structure of the star and influences the explosion.

We systematically search for precursor emission in a large sample of supernova like transients using archival time domain observations from the Zwicky Transient Facility (ZTF) accessed through the ANTARES alert broker. We developed a Python based pipeline to identify high quality transient light curves and search for anomalous brightening before the primary supernova peak. Using forced photometry of known core-collapse supernovae, we search for statistically significant detections before explosion. With this sample of precursor detections we aim to develop a filter to identify more supernovae with precursor detections in the ANTARES alert stream. We present the light curves of supernovae from this search, that exhibit precursor emission.

Mentor(s):
Andy Jung (Science); Danny Milisavljevic (Science); Lauren Grace Murphy (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1545
Presentation Time: Session 3: 12:00-1:00pm

Mechanics of Microtrichia Enhanced Reversible Interlocking Structures

STEM

Authors(s):
Tomas Vargas-Bernal† (Engineering|JMHC)

Abstract:
Biological systems have evolved materials and mechanisms that often outperform commercially engineered solutions. One such example is the exoskeletal forewings (elytra) of the diabolical ironclad beetle (Phloeodes diabolicus), which form a protective layer capable of resisting extreme compressive loads reaching 39,000 times the beetle's body weight. Previous work has established that the mortise-and-tenon suture joining the two halves of the elytra interlocks and increases toughening at critical strains, preventing catastrophic failure. However, the role of the microtrichial layer lining the suture, and its contribution to the overall failure mechanism, remains poorly understood. To better understand this mechanism, we propose a bio-inspired parametric interlocking structure allowing key geometric features to vary in shape, location, and overlap, influencing attachment and reattachment behavior. We hypothesize that these geometric variations underlie interlocking strength and resistance to separation, providing stronger connections than chemical adhesion between dissimilar materials. To investigate this hypothesis, we integrate computational simulations, analytical models based on beam theory and contact mechanics, and experimental testing to characterize the mechanical behavior of the microtrichia. Ultimately, this work aims to establish geometry-driven reversible interlocking as an effective joining strategy for applications requiring strong, damage-tolerant connections.

Mentor(s):
Pablo D Zavattieri (Engineering); Marie Kate Palau Andrade (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1600
Presentation Time: Session 4: 1:30-2:30pm

Accessing GREET in Computational LCA: Automated Conversion from Excel to EcoSpold2 Datasets

STEM

Authors(s):
Avneet Kaur Anand† (Science)

Abstract:
Life Cycle Assessment (LCA) is central to evaluating the environmental footprints of emerging energy and mobility technologies. While the Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model developed by Argonne National Laboratory provides extensive life cycle inventory data, its native Excel architecture relies on implicit cell formulas and cross-sheet references. As a result, matrix-based computational LCA frameworks such as Brightway2 and Activity Browser cannot natively ingest GREET data at unit-process resolution.

To address this interoperability gap, we engineered an automated Python conversion pipeline integrated directly with software APIs and downstream computational tools. The pipeline executes recursive formula back-tracing across multi-sheet dependencies, unrolling over 187,000 formulas via regex and AST parsing to construct explicit technosphere and biosphere exchanges linked to persistent UUIDs and cell-level provenance. Scoped LLM API integrations resolve extraction edge cases, including non-standard functional units, compound labels, and production scenarios. Extracted datasets undergo an automated reconstruction audit comparing flow quantities against native GREET outputs, achieving a validation error rate below 0.1% before export. Standardizing GREET inventories into ecoinvent-based EcoSpold2 enables direct integration into matrix LCA workflows like Brightway and LiTeCAB, facilitating hybrid database modeling and reproducible decarbonization assessments.

Mentor(s):
Lakshmi Srinivasan (Engineering); Fu Zhao (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1601
Presentation Time: Session 4: 1:30-2:30pm

Standardized Bring-Up Platform for AFTx System-on-Chip Validation

STEM

Authors(s):
Tatchi Dakari Anouan† (Engineering); Shravan Pradeep† (Engineering); Landon Michael Block† (Engineering); Suhani Pothireddy† (Engineering)

Abstract:
Each System-on-Chip designed by the Purdue University SoCET team requires a PCB to provide the power, clocking, communication, and interfaces necessary for initial chip validation. Each chip iteration differs in package type, pinout, and voltage requirements, making it difficult to reuse previous boards directly with newly designed chips. As additional AFTx devices are developed, repeatedly redesigning this infrastructure increases PCB development time, complexity, and overall cost.

The Standardized AFTx Bring-Up Board addresses this problem through a modular architecture that separates reusable infrastructure from chip-specific hardware. A universal baseboard provides USB communication, 1.8 V and 3.3 V power rails, programmable clock generation, reset and boot control, UART, SPI, I2C, test points, and GPIO. An RP2350 microcontroller provides USB-based control and communication with the AFTx chips. Rather than mounting the chip directly to the baseboard, each device uses a package-specific adapter containing its socket, local decoupling, and chip-specific circuitry. These adapters interface with the baseboard through a standardized High-Speed Mezzanine Connector (HSMC), allowing the same baseboard to support x06, x07, x08, and future AFTx generations.

The primary design challenge is defining a common electrical interface that supports current devices without restricting future chips. The expected result is a reusable platform that uses a modular interface to separate common bring-up functionality from chip-specific hardware, while future AFTx devices only require a new adapter. This reduces repeated PCB design work and allows the PCB team to focus on designing the adapters instead of rebuilding the same bring-up hardware for every new chip.

Mentor(s):
Moe Wai Yan Myint (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1602
Presentation Time: Session 4: 1:30-2:30pm

Predicting Employee Salaries: Examining the Role of AI Exposure and Experience

Business Case Study

Authors(s):
Pranshu Aryal† (DSB|JMHC); Lahari Krishna Bikkavilli† (DSB); Ojas Amit Sathe† (DSB); Maya Datar† (DSB)

Abstract:
How effectively can AI exposure, experience level, role family, industry, work year, and

estimated career start year predict an employee's annual salary?

Our goal is to predict salary while examining whether AI exposure affects employees differently

based on experience level. This can help students, employees, and employers understand

how AI exposure relates to compensation.

Our dataset from Kaggle contains employment data from 2020-2026. Work year,

experience level, job title, and salary are relevant columns, with salary being the response

variable. By utilizing Pandas, Numpy, Matplotlib, and Seaborn for the data preparation and

exploratory analysis, the StatsModel library helped create and evaluate the different models

To clean and manipulate the data, we manually added the AI

exposure score. After using Python to merge the column into our main CSV file, we tested the

different models and ran the EDA process. Linear regression served as a baseline, while ridge,

gradient boosting, and random forest were used for additional testing.

Our preliminary EDA revealed that salary is strongly right-skewed, leading us to apply a log

transformation to improve its distribution. By examining correlation patterns and salary trends

across experience levels and years, we found that compensation generally increases with

experience. Moving forward, we plan to use multiple linear regression, compare raw and

log-transformed salary models, and test for nonlinear relationships to quantify AI exposure's

relationship with compensation.

This project uses predictive analytics to examine how AI exposure affects the labor-market

compensation patterns and provides data-driven insights for career planning and compensation

decisions

Mentor(s):
Adrian Hoffert Wolanski (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1603
Presentation Time: Session 4: 1:30-2:30pm

Are we ready for robots?

Social Science

Authors(s):
Garv Atri† (Liberal Arts|Science)

Abstract:
For a long time now, humanity has dreamt about working robots that can perform as well as humans, if not better. Recently, this field has picked up pace; labs around the globe have spent millions on developing robots. Likewise, startups have raised millions from investors in hopes of commercializing them on a large scale. Despite all the progress, the barriers remain. Tasks that seem almost mundane to us, are some of the biggest challenges that robots cannot seem to overcome.

In this research paper, I set on a journey to answer questions about the current state of robotics, what technical requirements need to be fulfilled to conceive a world with robots co-existing with humans. Moreover, how will humanity be affected once robots become ubiquitous and what challenges will arise when these two entities interact. A large number of peer reviewed papers exist on the interaction between humans and robots, and the world thereof. I will examine the literary review from multiple perspectives to get a complete and deep understanding of such interactions. The perspectives include, but are not limited to, anthropological, behavioral, demographical, sociological, and technical. In the end, I hope to achieve a satisfactory hypothesis on how the world will change.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1604
Presentation Time: Session 4: 1:30-2:30pm

Photochemical Degradation of IPPD Using UV–Visible Spectroscopy and Liquid Chromatography–Mass Spectrometry

STEM

Authors(s):
Sana Azat† (HHS)

Abstract:
Tire-derived chemicals have attracted environmental concern because of their release into aquatic systems and the formation of potentially harmful transformation products. Building on previous work investigating the photochemical degradation of 6PPD, this ongoing project focuses on N-isopropyl-N′-phenyl-p-phenylenediamine (IPPD), another antioxidant used in tire rubber. The objective is to characterize the behavior of IPPD under controlled light exposure and examine how solvent conditions influence its photochemical transformation. UV–visible spectroscopy is used to monitor changes in the absorbance of IPPD solutions prepared in different solvents. Measurements collected at selected wavelengths following defined irradiation intervals are used to generate reaction profiles and evaluate changes during photolysis. Subsequent liquid chromatography and mass spectrometry analyses will separate and characterize reaction products, providing further insight into the transformations that occur during irradiation. Previous work also included the extraction and analysis of 6PPD directly from tires, providing a foundation for studying these chemicals in more complex samples. Together, these approaches will extend the investigation from 6PPD to IPPD and support comparisons of their photochemical behavior. This research aims to improve understanding of the persistence and transformation of tire-derived antioxidants and their potential environmental fate in aquatic systems.

Mentor(s):
Austin Jacob Pronk (Science)

Other Acknowledgment(s):
Alexander Laskin* (Science)

Poster Presentation Abstract Number: 1605
Presentation Time: Session 4: 1:30-2:30pm

Automated Tuning of On-Chip Pulse Shapers

STEM

Authors(s):
Saishri Bagde† (Engineering); Rohan R Iyer† (Engineering); Nishorgo Proshun† (Engineering)

Abstract:
Integrated silicon photonic devices have become increasingly important in optical networking, high speed communications, and optical signal processing. One important device used in these applications is the optical pulse shaper, which controls the spectrum of optical signals by filtering out certain wavelengths and adjusting their phase. This is achieved using ring resonators, wavelength selective filters that couple light at specific resonance wavelengths while allowing other wavelengths to pass through. The resonance wavelength of each ring depends on the effective refractive index which can be adjusted using on-chip heaters. Although thermal tuning of a single ring is straightforward, tuning multiple rings in a pulse shaper introduces the challenge of thermal crosstalk, where heating one ring also shifts the resonance wavelengths of its neighbors. Compensating for these thermal interactions manually requires repeated adjustments, making the process time-consuming and labor-intensive. In our work, we automate the tuning of ring resonators in a pulse shaper using a Python script that sets each ring to its target resonance wavelength while compensating for thermal crosstalk. By reducing tuning time and improving accuracy, this work lays the foundation for programmable optical pulse shapers for high-speed optical communications and phase modulation.

Mentor(s):
Vivek vasantrao Wankhade (Engineering); Jason Dwight McKinney (Engineering); Walid Elsayed Mo Elzeiny (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1606
Presentation Time: Session 4: 1:30-2:30pm

The Effects of Common Canine Ear Cleanser Ingredients on the Growth of Staphylococcus aureus

STEM

Authors(s):
Emma E Barnes† (Science)

Abstract:
In the ears of canines, Staphylococcus bacteria can be present without causing disease. However, when the ears become inflamed or irritated, these bacteria can multiply and contribute to the development of an ear infection. If these infections are left untreated, more serious complications may occur, such as ear canal damage or hematomas. Preventative care, including the use of over-the-counter ear cleansers, can help manage the bacterial growth that contributes to these infections. This study will examine whether specific ingredients found in the canine ear cleanser EpiOtic Advanced affect the growth of Staphylococcus aureus. Previous research has identified S. aureus as a bacterial species associated with canine ear infections and has identified that ear cleaning solutions often contain antimicrobial ingredients. This research will analyze existing peer-reviewed research articles and other relevant literature to explore the effects of salicylic acid, phenoxyethanol, and chloroxylenol on S. aureus growth. This will help determine how effectively each ingredient inhibits S. aureus growth and whether their reported properties support their use in canine ear cleansers.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1607
Presentation Time: Session 4: 1:30-2:30pm

Synovial Joint Targeting via Sialylated Nanocarriers for Treatment of Rheumatoid Arthritis

STEM

Authors(s):
Gabrielle Marie Barrido† (Science); Abigail Catherine Alexander* (Agriculture)

Abstract:
Rheumatoid arthritis (RA) is a systemic autoimmune disease characterized by synovial joint inflammation and polyarthritis. Effective treatment of severe RA requires drug delivery to multiple joints while minimizing off-target toxicity, but the clinical heterogeneity of RA and a lack of joint-localized drug delivery systems contribute to poor treatment response in some patients. Sialic acid-binding immunoglobulin-like lectin (SIGLEC) receptors, expressed primarily on immune cells like macrophages, offer a strategy to target proinflammatory or “M1-like” macrophages in inflamed joints. We hypothesize that sialylating the surface of nanocarriers (NCs) with N-acetylneuraminic acid (Neu5Ac) will facilitate selective association with M1-like macrophages via SIGLEC-mediated targeting. To test targeting, we formulated fluorescent NCs, entrapping Hostasol Yellow dye in either a PCL-b-PEG or PCL-b-PEG-Neu5Ac shell. We induced M1-like polarization in RAW 264.7 macrophages with pro-inflammatory stimuli (LPS & IFNγ) and treated the cells with NCs. We quantified cell association by measuring fluorescence by flow cytometry. To assess effects on other cells in the RA microenvironment, we tested targeting of NCs to MC3T3-E1 pre-osteoblasts via flow cytometry. We also studied how sialylation affects the pro-osteogenic activity of non-fluorescent NCs co-loaded with phenamil and a STING antagonist. Following treatment of RAW 264.7 and MC3T3-E1 cells, we found that sialylation promotes NC association with macrophages but decreases association with pre-osteoblasts. However, the sialylated drug co-formulation significantly improved the onset of mineralization in pre-osteoblasts. Future work will test targeting of sialylated NCs to osteoclasts in vitro and whether targeting translates to an in vivo mouse model. Ultimately, we aim to develop a targeted treatment capable of systemic delivery that maximizes therapeutic effects and minimizes off-target effects, improving RA treatment options.

Mentor(s):
Marxa Figueiredo (Vet Med); Gabriel Steven Harris (Vet Med); Kurt Ristroph (Agriculture|Engineering)

Other Acknowledgment(s):
Mojhdeh Baghbanbashi* (Agriculture|Engineering)

Poster Presentation Abstract Number: 1608
Presentation Time: Session 4: 1:30-2:30pm

Predicting Total Sales: An analysis of how Walmart could improve store level demand forecasting

Business Case Study

Authors(s):
Daniel Benedict† (DSB); Logan Doyle Swaim† (DSB); Matthew Shinners† (DSB); Macpherson Michael Lewis† (DSB)

Abstract:
Accurately forecasting unit demand is a challenge for any company that holds physical inventory. There is no single best method or industry standard, and a planner can easily be overwhelmed by the number of forecasting methods available. Using sample unit sales data from Walmart, we explore the trade-offs between computationally expensive and simple forecasting models. Our goal is to determine which method yields the highest accuracy for our data while remaining computationally efficient. This requires fitting, validating, and assessing several types of forecasting methods. Models of interest include OLS regression and ARIMA, as well as machine learning models such as random forest. For both the parametric and non-parametric methods, we will evaluate forecasts using mean squared error (MSE), which provides a consistent basis for comparison. Because the data are time series, cross-validation and random forest training must respect temporal ordering, so we will use expanding-window and rolling-window validation. Our exploratory analysis revealed differences in trend across store-level sales: some stores show a stationary series, while others show a trend with a maximum order of integration of 1. From this analysis, we hope to provide a well-rounded approach to forecasting aggregate, store-level demand, which can then be used in an optimization model to determine the optimal quantity of each item to stock.

Mentor(s):
Adrian Hoffert Wolanski (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1609
Presentation Time: Session 4: 1:30-2:30pm

Fast Fourier Transform-Based Radar Signal Processing for Molecule Detection

STEM

Authors(s):
Lisa Bhatkar† (Engineering); Vikram Ganesh Kumar† (Engineering); Hadi Sadeq Althawab† (Engineering); Veadesh Dhanasekar† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Brady Philhower (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1610
Presentation Time: Session 4: 1:30-2:30pm

Navigating the Intimate and the Sacred

Social Science

Authors(s):
Grace Marie Boehm† (Liberal Arts|JMHC)

Abstract:
The purpose of this study was to identify how Indiana institutions make resources in areas such as relationships, sexual and reproductive health, religious identity, and moral decision-making, while identifying patterns in how they are connected or separated. What resources do universities provide to help students navigate both an animated and dynamic time of curiosity, self-discovery, and exploration with increased independence? Various public resources from various institutions (e.g., University of Notre Dame, Indiana University Bloomington, Purdue University West Lafayette) were collected, coded, and analyzed to find gaps and strong connections between different resource centers. Across all institutions, spiritual/religious and sexual/reproductive resources are commonly kept separate. While religious and spiritual centers may address intimate topics, their stances on specific subjects were often not made explicitly clear online. Moving forward, institutions might consider consolidating topic-based resources onto a single, easily accessible webpage rather than requiring students to navigate each center individually. Furthermore, where feasible, institutions should consider making their general attitudes or official stances on sensitive topics explicitly clear. This would allow students to easily find organizations that align with their personal beliefs without having to independently evaluate each one. Moving forward, perhaps universities would consider

Mentor(s):
Risa Denae Cromer (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1611
Presentation Time: Session 4: 1:30-2:30pm

Bridging Theory and Practice: Developing a Cross-Disciplinary Experiential Learning Framework in STEM Education

STEM

Authors(s):
Mariana Bohrt Larrea† (Engineering)

Abstract:
STEM students need opportunities to connect classroom knowledge with authentic professional challenges. However, experiential learning activities can remain isolated within individual courses, limiting continuity across the curriculum and transfer of learning across disciplines. This ongoing undergraduate research project aims to develop a cross-disciplinary framework for integrating experiential learning into STEM education through intentional sequencing, structured reflection, and alignment with learning outcomes.

The planned approach combines a review of experiential learning literature and educational models with curriculum mapping to examine how practical experiences can support students at different stages of their education. Construction management provides an initial application context, drawing on activities such as project simulations, industry engagement, and collaborative problem-solving. These examples will inform the identification of transferable design principles and discipline-specific adaptations.

The proposed framework organizes learning experiences along a progression from introductory exposure and observation to guided application and increasingly independent professional practice. Each stage connects authentic tasks with technical and professional competencies, opportunities for feedback and reflection, and assessment of student learning. Intended outputs include a curriculum mapping tool and implementation guidance to help educators identify gaps, coordinate experiences across courses, and align activities with measurable outcomes.

By moving beyond individual activities toward a coherent curricular approach, this project seeks to support student engagement, knowledge application, teamwork, and professional readiness. Future work will

refine the framework with faculty input and evaluate its applicability across STEM disciplines.

Mentor(s):
Esra Tepeli (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1612
Presentation Time: Session 4: 1:30-2:30pm

How Do Ultrasonic Acoustic Signatures Quantify Occupancy Of A Flying Squirrel For Mitigation For Road Construction?

STEM

Authors(s):
Elizabeth Joy Burns† (Education|JMHC); Nathan Wallace Skinner† (Engineering|JMHC)

Abstract:
West Virginia is home to an endemic flying squirrel population (Glaucomys sabrinus), that thrives on high-elevation forests composed of red spruce trees (Picea rubens), with stream corridors, a habitat that is unique to this state. The West Virginia northern flying squirrels (WVNFS) are nocturnal subspecies who have been historically federally listed as endangered. There is a proposal to construct a highway through primary WVNFS habitat in West Virginia. Some local advocates fear that the road will disrupt the recovering population and seek insights into monitoring protocols to provide evidence of flying squirrel occupancy. Detection of flying squirrels can be difficult due to their high-frequency sounds which are inaudible to humans, but surveying is necessary to prevent damage to their limited habitat. Some current methods of detecting WVNFS include live capture and survey methods which are labor-intensive, invasive, and produce a low detection rate. However, new non-invasive remote sensing technology utilizing passive acoustic monitors (PAM) have been shown to detect these ultrasonic flying squirrel sound types such as trills, calls, and short high-frequency calls. We aim to see how a PAM protocol helps identify occupancy in the proposed road territory. To do this, a partner team deployed four ultrasonic acoustic detectors placed at different locations along a stream corridor (July 2026-October 2026) with historically known occupancy to determine if a current WVNFS population is present. We collected zero-crossing and full spectrum data and ran a customized detection algorithm using R to see if any of the three primary calls were present. Our goal is to determine if passive ultrasonic monitoring can identify habitat-use areas that may warrant consideration during road design, construction, or mitigation planning. We believe that passive ultrasonic monitoring can identify habitat-use areas that warrant consideration during road design, construction, or mitigation

Mentor(s):
Kristen Marie Bellisario (JMHC)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1613
Presentation Time: Session 4: 1:30-2:30pm

Amping Up Attendance: Connecting Rec Room with Purdue Students

Business Case Study

Authors(s):
Carsen Nicole Cadena† (DSB); Annalysa M Ritchie† (DSB); Skylar Raye Bixler† (DSB|Liberal Arts); Arnav Bhatia† (DSB|HHS); Hannah Rylee Gallagher† (DSB); Madelyn Marie Roberts‡ (DSB)

Abstract:
This research project will examine Rec Room Recording, a local recording studio and performance venue, and its live shows to identify the factors influencing Purdue University students' decision to attend. This study aims to use internal data and secondary research to analyze consumer motivation, attitudes, and perception to understand why student awareness and interest do not always translate into event attendance. We aim to explore how Rec Room Recording is perceived in comparison with competing local venues and how to increase student presence at their location. We anticipate our results to provide strategic recommendations and tactics to increase target customer interest, explore consumer behavior, and increase effective event marketing and promotion.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1614
Presentation Time: Session 4: 1:30-2:30pm

Surface Characterization of Urea–Gypsum Cocrystals and Their Formation Mechanisms

STEM

Authors(s):
Lauren Isabella Carpenter† (Agriculture|Engineering)

Abstract:
Urea is a widely used nitrogen-based fertilizer valued for its high nitrogen content and low cost. However, its high aqueous solubility can cause rapid nitrogen release, limit plant uptake, and contribute to nutrient loss through leaching and runoff into water systems. Cocrystallization of urea with gypsum, a less soluble compound, offers a promising approach to reducing urea solubility and developing sustained-release fertilizers. Previous research has demonstrated the potential of urea–gypsum cocrystals to improve nitrogen utilization efficiency, while highlighting the importance of processing conditions in cocrystal formation. This study investigates the formation of urea–gypsum cocrystals during milling and subsequent thermal treatment at 135 °C. By varying milling and heating durations, the study aims to determine when cocrystals form and how processing time influences specific surface area and surface composition. Specific surface area measurements and Raman spectroscopy will be used to characterize changes in particle surface area and surface chemical composition, providing insights into the relationship between processing conditions and cocrystal formation.

Mentor(s):
Vidya Kanaganamaradi Nagaraju (Agriculture|Engineering); Rose Prabin Kingsly Ambrose (Agriculture|Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1615
Presentation Time: Session 4: 1:30-2:30pm

Autoinjector Dynamics: Experimental Evaluation of Initial Spring Force and Constant Using AI Agent-Based Lab Automation

STEM

Authors(s):
Catherine Chang† (Science); Alexia Widjaja† (HHS|JMHC); Katie Quinney† (Pharmacy|JMHC); Niveda Keshav Iyengar† (Agriculture|Engineering); Umay Deniz Ozsoy† (Agriculture|Engineering|JMHC)

Abstract:
Spring-driven autoinjectors must deliver a complete dose within the time a patient can hold the device in place. Viscous, high-concentration biologics require a stronger spring to finish in that time frame. However, a stronger spring accelerates the plunger harder at actuation, and resulting pressure transients can cavitate the drug and fracture the glass container. The initial spring force governs the actuation transient, and the spring constant governs how the driving force decays over the stroke.

This project will quantify how these two parameters determine injection time, applied force, and initial plunger acceleration. A programmable linear stage operating in the autoinjector actuation range will drive a syringe plunger, a surrogate for the autoinjector drug container, under a force-displacement profile that emulates a spring, so initial force and spring constant can be set independently. An AI agent will coordinate the automated experiments, setting the spring profile and executing each run. The experiment will vary fluid viscosity (water-to-glycerol ratio), particle volume fraction (glass beads, 15 μm mean diameter), needle diameter, initial spring force, and spring constant. We will measure applied force with a force sensor and calculate plunger acceleration from time-resolved stage position.

We expect a higher initial spring force to shorten injection time and raise initial acceleration, and a higher spring constant to length it. We will examine peak force and initial acceleration for conditions that increase the risk of cavitation and container breakage. Resulting data will guide selection of the initial spring force and spring constant combination that delivers the full dose while limiting initial acceleration.

Mentor(s):
Brett A Meyers (Centers & Institutes); Hyeondong Yang (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1616
Presentation Time: Session 4: 1:30-2:30pm

Interpretability and Standardized Benchmarking of Automatic Music Transcription

STEM

Authors(s):
Olivia Chen† (Engineering); Jia Varshney† (Science); Xiyue Chen† (Engineering); Zehui Su† (Science); Rohan Arav Shah† (Engineering); Joshua Walker† (Science)

Abstract:
Recent advancements in automatic music transcription, the process of converting audio into sheet music, have shifted from traditional mathematical approaches to modern artificial intelligence. Though AMT has advanced significantly, existing benchmarks rely heavily on note-level metrics and public datasets, limiting their ability to assess musical fidelity and generalization. We introduce a unified AMT benchmark featuring an independently curated, held-out dataset, a standardized evaluation pipeline, and a novel structure-aware metric. Beyond conventional precision, recall, and F1-score, our metric evaluates temporal consistency, polyphonic relationships, and musical structural fidelity. By benchmarking AMT models on our dataset, we aim to provide fair, reproducible comparisons and investigate their impact on model rankings. However, model evaluations can only provide surface-level diagnostics into the performance of the models, leaving their underlying mechanisms completely unexplainable. While deep learning systems have achieved notable performance gains, generalizability, and real-world applicability, they introduce the "black box" problem: models hide their internal logic in unexplainable layers. Consequently, researchers find it difficult to identify and fix errors and overfitting. To address this transparency gap, this project aims to interpret existing models via Sparse Autoencoder (SAE) probing and also develop our own music transcription model that works toward state-of-the-art accuracy while remaining fully explainable. Specifically, this research aims to do that by extending the Differentiable Dictionary Search (DDS) framework. The resulting model will let researchers inspect how specific audio frequencies map to individual musical notes, enabling them to isolate and resolve the exact causes of transcription errors.

Mentor(s):
Yung-Hsiang Lu (Engineering); Yeon Ji Yun (Liberal Arts); Kayshav Bhardwaj (Liberal Arts|Science); Ojas Chaturvedi (Science|JMHC)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1617
Presentation Time: Session 4: 1:30-2:30pm

Behavioral Modeling and Evaluation of CMOS Comparators for Cryogenic Operation

STEM

Authors(s):
Haoran Cheng† (Polytechnic)

Abstract:
[Abstract Redacted]

Mentor(s):
Seyedehmarzieh Rouhani (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1618
Presentation Time: Session 4: 1:30-2:30pm

Computational Modeling and Optimization of Superconducting Quantum Circuits: Transmon Readout and Nonlinear Device Simulation

STEM

Authors(s):
Yuha Choi† (Engineering); Gopikisor Sivaneshan† (DSB); Jacob Zeldovich† (Engineering); Shrish Senthilkumar‡ (Engineering); Alejandro Jose Sanchez‡ (Engineering)

Abstract:
The fabrication and characterization of actual superconducting quantum circuits are expensive and time-consuming, motivating the development of simulation for circuit design and optimization before physical implementation. This work investigates two complementary approaches: physics-based optimization of superconducting qubit readout and circuit-level modeling of nonlinear superconducting devices.

First, an existing Maxwell–Schrödinger solver was employed to optimize dispersive transmon qubit readout pulses parameterized by Cavity Level Excitation and Reset (CLEAR) and B-spline functions. The optimization aimed to improve measurement fidelity by maximizing readout-state separation while constraining residual resonator photon occupation and measurement-induced qubit-state transitions, characterized using Floquet-basis state populations. The optimized pulses achieved simulated readout error probabilities on the order of 10^-6, with residual resonator photon occupation below the thermal occupation at 20 mK and a probability of over 99% of retaining the initial Floquet state.

Second, nonlinear and nonideal superconducting circuit components were investigated using Symbolically Defined Devices (SDDs) and harmonic balance analysis in Keysight Advanced Design System (ADS). Josephson-junction models were developed and applied to superconducting circuits to investigate their nonlinear and flux-dependent behavior. We further extended these models to more complex superconducting devices to establish reusable circuit-level models that enable simulation of superconducting quantum circuits without requiring direct solutions of complex coupled physical equations.

Together, these studies investigate complementary computational approaches spanning quantum-mechanical readout optimization and

nonlinear circuit-level modeling, supporting more efficient simulation-guided design of superconducting quantum hardware while reducing reliance on costly fabrication and experimental iteration.

Mentor(s):
Thomas Roth (Engineering); Samuel Theodore Elkin (Engineering); Ghazi Khan (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1619
Presentation Time: Session 4: 1:30-2:30pm

Predicting Airline Passenger Satisfaction: Data-Driven Insights for Retention

Business Case Study

Authors(s):
John Lance Clark† (DSB|JMHC); Xinyue Zhao† (DSB); Hongqian Zhu† (DSB); Tyler Alexander Quisling† (DSB)

Abstract:
[Abstract Redacted]

Mentor(s):
Adrian Hoffert Wolanski (DSB); Yafei Wang (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1620
Presentation Time: Session 4: 1:30-2:30pm

Experimental Testing for Powered Descent Guidance in a Zero-Friction Analog Environment

STEM

Authors(s):
Veeraj Vikrant Dalwale† (Polytechnic)

Abstract:
Spacecraft must be able to control their motion accurately during powered descent, but testing these control systems on real spacecraft is extremely expensive and difficult. Computer simulations can help evaluate these systems, but they cannot fully capture the behavior and limitations of physical hardware. This work addresses the gap through the development of a low-cost, three-degree-of-freedom air-bearing testbed that allows spacecraft control concepts to be tested using physical hardware in a low-friction environment. The testbed simulates spacecraft movement and uses air bearings to allow a platform to move freely across with zero friction a flat surface with zero friction, with electric ducted fans to produce controlled forces. To determine how motor commands affect the amount of thrust produced by the fans, 100+ electronic ducted fan (EDF) propulsion tests were conducted. The resulting thrust data was then used to map pulse width modulation (PWM) input to thrust commands. Software was developed to visualize how different fans affect the movement and rotation of the platform with given manual inputs from an RC controller. The resulting testbed provides a low-cost, accessible method for testing spacecraft guidance and control concepts with physical hardware before they are considered for more expensive testing environments. This approach helps bridge the gap between computer simulation and real-world spacecraft testing while reducing development cost and complexity.

Mentor(s):
Ran Dai (Engineering)

Other Acknowledgment(s):
CJ Holdeman* (Engineering); Kay C Kobak* (Engineering)

Poster Presentation Abstract Number: 1621
Presentation Time: Session 4: 1:30-2:30pm

AI-Enhanced Metadata Curation for re3data

STEM

Authors(s):
Janith Randhil D'Alwis† (Liberal Arts|Polytechnic); Ekam Bhullar† (Engineering)

Abstract:
Re3data is a registry of research data repositories that indexes over 3,500 records. Librarians, funders, and publishers use re3data to guide their repository selection and data sharing. Researchers use it to find repositories for depositing and accessing data related to everything from documenting endangered languages to discovering planets beyond our solar system. These records rely on user suggestions and human reviewers to maintain accuracy and consistency. As repositories evolve, records in re3data naturally drift and become incomplete, inconsistent, or out of date. Moreover, there is currently no measure of the extent to which this drift impacts record quality. In our research, we measured the accuracy and completeness of a sample of re3data records. We then benchmarked this measurement against our AI audit engine that leverages retrieval-augmented generation (RAG), schema-guided normalization, and deterministic evidence verification. Preliminary results from tests aimed at standardizing institution names have shown a duplicate-detection F1 score of approximately 0.8. Applied more broadly, our AI audit engine can help re3data reviewers identify inaccurate or missing information and review proposed corrections more efficiently. This approach supports record maintenance efforts and allows re3data to continue to scale while ensuring that it hosts reliable information for its users.

Mentor(s):
Michael Witt (Libraries)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1622
Presentation Time: Session 4: 1:30-2:30pm

Neighborhood Income and Spatial Accessibility to Free Tax Preparation Services: A Case Study of Indianapolis

Social Science

Authors(s):
Aren Dominic Manzo Damayo† (DSB|JMHC)

Abstract:
How is neighborhood income associated with spatial accessibility to free tax preparation services in urban areas? This study examines this question using Volunteer Income Tax Assistance (VITA) sites in Indianapolis during the 2024 tax-filing season as a case study. It assesses how the geographic distribution of tax assistance aligns with neighborhood economic need. The study combines census tract income and household estimates from the 2020–2024 American Community Survey, tract population centers derived from the 2020 Census, and VITA site locations recovered from archived versions of United Way's Indy Free Tax Prep webpage. A two-step floating catchment area (2SFCA) method, implemented using geographic information systems and roadway-network data, will estimate potential spatial accessibility by accounting for service locations and surrounding household demand. Each VITA site will represent one supply unit, and tract household counts will serve as a proxy for potential demand. Accessibility scores will express demand-adjusted site availability per 1,000 households. Average scores will be compared across predefined tract-income categories to characterize socioeconomic differences in accessibility and assess whether lower-income neighborhoods have greater or more limited geographic access than higher-income neighborhoods. Findings will identify tract-level associations between income and accessibility, highlighting potential service gaps where lower incomes coincide with limited access. Interpretation will consider catchment definitions, equal site weighting, household-based demand, differences in data reference periods, and study-area boundaries. Through the Indianapolis case, this research will inform discussions about aligning tax assistance resources with community needs and provide a framework for examining socioeconomic patterns in access to community-based services in other urban settings.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1623
Presentation Time: Session 4: 1:30-2:30pm

Physical Activity and Academic Performance in Children With ADHD

Social Science

Authors(s):
Cheyenne Lynn DeJong† (Education)

Abstract:
Attention Deficit Hyperactivity Disorder (ADHD) is a common disorder that affects attention, making it difficult for individuals to maintain focus, manage everyday tasks, and control impulses. This exploratory research examines how lifestyle habits, particularly physical activity interventions and sleep, relate to academic performance in students with ADHD. Preliminary data suggest that students with ADHD commonly experience academic disadvantages, behavioral struggles, and poorer emotional well-being (Arnold et al., 2015). However, extensive research suggests that physical activity interventions and adequate sleep may improve cognitive function, mental health, classroom engagement, and focus levels for students with ADHD (Periris et al., 2022). These findings highlight the importance of exploring ADHD-related academic challenges alongside lifestyle factors. By understanding how ADHD symptoms affect students, educators can provide appropriate classroom support and improve overall academic experiences.

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1624
Presentation Time: Session 4: 1:30-2:30pm

Scalable and Efficient UAV Swarms for Search-and-Rescue

STEM

Authors(s):
Nhuan Boi Duong† (Engineering)

Abstract:
Search-and-rescue missions need to find people quickly over large areas, often in places that are too dangerous for rescue teams to reach physically. Drone swarms are a promising tool for this; however, the drones must divide the area to avoid collision, redundant searching, optimize their trajectory while communicating with each other under limited resource. Prior path planning work represents the area as a belief grid and plans routes that reduce uncertainty under battery limits, but it assumes communication between drones always succeeds, so the cost of communicating is never accounted for. On the other hand, Age of Information work optimizes when drones transmit to keep information fresh, but it ignores how that information affects the search itself, and its distributed methods have not been validated with hardware set up. To address this, we propose a fully decentralized, low-cost drone swarm in which each drone's communication decisions are tied directly to how it affects the drone's trajectory. Each drone runs YOLO-based human detection on a Raspberry Pi, searches its own battery-weighted Voronoi region, and plans routes that find the most people for the least energy. A drone transmits only when the expected benefit to the search, such as preventing duplicate search, collisions, and delayed detection reports, exceeds the energy cost of sending. We target an initial cost of approximately $500 per UAV and aim to reduce it toward sub-$100, which makes the system available for underserved communities. Future works and final deliverables include (i) a hardware prototype capable of real-time detection and decentralized communication, (ii) a simulation environment for disaster-response scenarios, and (iii) an evaluation comparing our decentralized scheduling policy against a centralized baseline on two objectives: the fraction of the region resolved within a fixed flight time and the expected time spent searching under battery and communication constraints.

Mentor(s):
Vishrant Tripathi (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1625
Presentation Time: Session 4: 1:30-2:30pm

Architecting a Scalable Wishbone-Compatible Digital Peripheral Suite for a Custom ZPU System-on-Chip

STEM

Authors(s):
Pavle Duric† (Engineering); Sivam Pathuri† (Engineering); Zachary Wong† (Engineering); Nhan Viet Viet Do† (Engineering); Julian Vincent Netherwood† (Engineering); Tanvi Srisai Sajja† (Engineering)

Abstract:
Modern System-on-Chip (SoC) designs rely on digital peripherals to connect the processing core with outside hardware. While the ZPU processor is a known architecture, using generic, open-source modules for these connections often leads to integration challenges and unnecessary delays. Furthermore, a major motivation for this project is our digital peripherals subteam's goal to learn and apply Universal Verification Methodology (UVM). Since it is difficult to practice and apply UVM testing on pre-packaged generic parts, building our own custom solution is the best path forward.

To achieve this, we are designing a custom set of SystemVerilog peripherals tailored exactly for our ZPU core. Using the standard Wishbone bus architecture, we are creating a flexible system that includes a Universal Asynchronous Receiver-Transmitter (UART), General-Purpose Input/Output (GPIO), programmable Timers with Pulse Width Modulation functionality, SPI, and I2C protocols. We are designing and implementing each module and its corresponding testbench, so every register and bus transaction is built to be verified.

The measurable outcome is the successful RTL design of these modules, validated through our own UVM simulations in Questa. We will work to ensure that each of the five peripherals passes directed register access tests and constrained random tests in Questa, with an appropriate functional coverage percentage per module (currently we are aiming for 90% functional coverage per digital peripheral). A current limitation is that attaching too many modules could increase traffic delays on the Wishbone bus, and we are primarily focusing on lower-speed communication. This work matters because it builds the essential I/O foundation for the SoCET ZPU chip, while giving our team practical experience with industry-standard verification. Next steps involve full-

system integration and testing the peripherals alongside the main processor.

Mentor(s):
Cole Aaron Nelson (Engineering); Kameswari Mantha (Engineering); Mark Johnson (Engineering); Matthew A Swabey (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1626
Presentation Time: Session 4: 1:30-2:30pm

Growth through Grief: Systematic Review of Post-Traumatic Growth Following Pet Death

Social Science

Authors(s):
Tatum Reese Ebbeskotte† (Science|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Leanne Nieforth (HHS); Amy Kossack Sorrells (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1627

Presentation Time: Session 4: 1:30-2:30pm

Building One Legacy for Youth Sports

Business Case Study

Authors(s):
Laura Fagan† (DSB|JMHC); Ella Marie Hood† (DSB); Evan Michael Pounds† (DSB); Jason B Bogner† (DSB); Tobey Andrew Uhm† (DSB); Elaina M Weber† (DSB)

Abstract:
Legacy Sports Park faces the challenge of integrating the marketing efforts of two previously separate businesses into one unified brand. Currently, multiple websites and inconsistent brand identities create confusion for consumers searching for sports programs and services. The objective of this project is to develop a marketing strategy that strengthens Legacy Sports Park's brand identity, improves customer experience, and creates more effective marketing partnerships. The research investigates existing marketing practices, conduct primary market research, examine relevant secondary sources, and apply course concepts such as SWOT analysis, segmentation, targeting, positioning, and the 7Ps marketing mix. The research will focus on opportunities to streamline the website and customer journey, establish a consistent brand presence, and develop more meaningful, long-term sponsorship partnerships. We will provide them with strategic marketing recommendations.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1628
Presentation Time: Session 4: 1:30-2:30pm

AI Competency Development: Using the 5E Model to Integrate AI-Focused Online Discussions into the Face-to-Face STEM Class

STEM

Authors(s):
Alita Marie Fischer† (Science)

Abstract:
Artificial intelligence (AI) is becoming increasingly present in higher education, yet little is known about how students perceive its use in STEM coursework. The purpose of this study was to examine college students' perceptions about using AI in an educational setting by integrating AI-focused online discussions into a face-to-face STEM class using the 5E Instructional Model. Guided by the Technology Acceptance Model, we assessed students' perceived usefulness of AI, perceived ease of use, expectations that the course would help them use AI in the future, and their current AI use. Results indicated that students perceived AI as useful for leadership, professional growth, teaching, and as a support tool. However, they were hesitant to use it due to concerns about bias, error, and inaccuracy, as well as uncertainty about how to use it effectively. Prior experience with AI was associated with feeling overwhelmed by the complexity of how AI works. After the course, students reported learning more about how to use AI effectively. These findings suggest that discussion-based instruction can address students' uncertainty about AI and may support the development of AI competency in STEM courses. Educators should consider integrating AI into their courses to better support STEM students and enhance their learning experiences. Understanding how students' current experiences with AI shape their willingness to use it can also help prepare them for future academic and professional settings.

Mentor(s):
Lisa B Bosman (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1629
Presentation Time: Session 4: 1:30-2:30pm

3ARM: 3D-joystick Adaptive Robotic Mount for Wheelchair-Mounted Robotic Arms

STEM

Authors(s):
Kate Elizabeth Foley† (Engineering)

Abstract:
Quadriplegia impacts approximately 15 million people worldwide and results from nearly 60% of spinal injuries. Characterized by their reduced movement below the neck, they struggle to perform Activities of Daily Living independently, impacting their overall quality of life. Wheelchair-Mounted Robotic Arms, including the Kinova JACO and for research the Kinova Gen 3, have become widely used by users with quadriplegia or similar. Clinically, there's a gap in reliable perception/ feedback on robot positioning and intuitive control interfaces for arms with high degrees of freedom (DOFs), hindering usability. Typical controls, like joysticks, game controllers, and sip-and-puff interfaces, utilize simple low-dimensional interfaces, requiring constant mode switching. Furthermore, joysticks with multiple DOFs to match the arm, have a bulky frame, such as the Force Dimension's Omega controllers. As explored previously in the lab, these models deliver advanced benefits such as haptic feedback and intuitive multi-dimensional control, but face translation limitations for wheelchairs as they are too large to mount to the chair for mobility.

Creating a smaller 3D joystick that fits the wheelchair's armrest makes interaction significantly more accessible as users ambulate around a space, delivering mobile intuitive multi-dimensional control and responsive feedback. Using CAD software Fusion 360, the design was modeled, downscaled, and integrated with an attachment for wrist braces which are commonly worn by individuals with upper-limb disabilities. After 3D printing, it was equipped with passive assistance to reduce strain on the user and simplified electronic sensing for the reduced mechanical range. Finally, a simple pilot study was performed to ensure functionality was maintained for the simplified on-wheelchair design. Future directions include a human-subject usability study to formally compare the 3D-joystick Mount against the Omega 6, Falcon 3, and typical joystick.

Mentor(s):
Shaiv Mehra (Engineering); Bradley S Duerstock (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1630
Presentation Time: Session 4: 1:30-2:30pm

Membrane Electrode Assembly Design for Hydrogen Fuel Cell-Powered UAVs: A review of Requirements and Catalyst Optimization

STEM

Authors(s):
Bunshiro Fujiwara† (Engineering); Aden Yongjoon Yi† (Engineering|JMHC); Robert Davis Renner† (Engineering); Caleb Matthew Minnis† (Engineering); Germaine Zhi Ning Tan† (Engineering); Edan Klein Wilson† (Engineering)

Abstract:
Hydrogen fuel cells have attracted increasing attention as an alternative power source for unmanned aerial vehicles (UAVs), particularly for applications requiring extended flight endurance. However, the practical integration of proton exchange membrane fuel cells (PEMFCs) into UAV remains challenging due to system weight, hydrogen storage requirements and electrochemical performance limitations. Among the key components of PEMFCs, the membrane electrode assembly (MEA) plays a critical role in determining power output and overall system efficiency.

This literature review investigate: (1) Core requirement for UAV application and (2) influence of catalytic layer on MEA performances. Relevant studies were initially identified through AI-assisted literature searches, followed by manual screening and critical evaluation. Additional literature was identified through targeted keyword searches using Google Scholar to address gap identified during the initial review.

The literature review examines, the relationship among platinum loading, catalyst layer thickness, porosity, catalyst support materials and electrochemical performance. Particular attention is given to the trade off between the catalyst utilization, mass transport, and electrode performance under operating conditions relevant to UAV applications. The review also considers practical fabrication constraints associated with Nafion-based MEAs.

By synthesizing findings from existing studies, this review aims to identify critical MEA design parameters and develop literature-based recommendations for PEMFC applications in UAVs. The resulting framework is intended to support the future MEA development by

establishing performance considerations and potential directions for catalyst layer optimization.

Mentor(s):
Ray A Mentzer (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1631
Presentation Time: Session 4: 1:30-2:30pm

Stack-Based Computer Software Library Integration for SoCET Digital Design

STEM

Authors(s):
Romir Reddy Gade† (Engineering); Emmanuel Wright Rosa† (Engineering); Martin J Aguilera† (Engineering|JMHC)

Abstract:
The ZPU is a 32-bit stack-based microprocessor designed by Zylin. Its original

implementation is over a decade old, so SoCET's Digital Design team is rebuilding the

core in SystemVerilog with modern RTL design and verification practices. Because the

ZPU is a general-purpose CPU rather than an accelerator, it is only useful if it can run

programs, in this case the language we will be using is C. Our subteams most important

goal is to write assembly routines for all instructions that the core emulates rather than

implements in hardware, examples of this include instructions like subtract, negate and

numerical comparisons. The reason behind this is that the core team might not have

enough time or space to implement hardware opcodes so the fallback emulate

instructions are there in case a hardware instruction is not ported. We also port existing

C libraries to the ZPU and write per-instruction tests and small C programs built with the

ZPU-GCC toolchain. We will consider the software working when every required

instruction passes its test on the core and our test programs produce the expected

results on it. Next steps include moving frequently used emulated instructions into

hardware and expanding library coverage. This will hopefully help future teams in

integrating the ZPU into SoCET’s AFT chip as a coprocessor and also help the ZPU be

used as a more general purpose processor.

Mentor(s):
Kameswari Mantha (Engineering); Cole Aaron Nelson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1632
Presentation Time: Session 4: 1:30-2:30pm

Design and Implementation of a Development Board for Validation and Firmware Prototyping for the AFTx08 RISC-V SoC

STEM

Authors(s):
Milan Ganeshan† (Engineering); Devanshi Joshi† (Engineering); Aaruni Singh† (Engineering)

Abstract:
A custom SoC (system-on-chip) is only as useful as the board it integrates with. Without a sufficient board for development and testing, the AFTx08 cannot exercise its full capabilities. While it may be possible to connect the SoC to temporary setups, these would be inefficient for long term development and may risk damaging the chip with improper voltage regulation/timing.

To address these challenges, this project presents the iterative process of designing and prototyping a printed circuit board (PCB) for development that allows the AFTx08 to be used to its fullest capacity while ensuring safe and proper operation. The proposed PCB will combine boot and power sequencing, dedicated and accessible IO pins, and an easy-to-use programming interface with non-volatile memory, while also enabling the AFTx08's off-chip memory and built-in PLL for multiple clock outputs.

This allows user-friendly firmware development and debugging for SoCET members and potentially other students. The end user can plug the development board into their own computer and begin creating embedded software with access to clear pinout documentation. Potential reverse current and ESD risks will also need to be addressed. The final development board should give the AFTx08 a fully functional and optimized body.

This project covers the full development cycle including schematic, LTSpice simulation for relevant circuits, a full BOM, PCB routing, completion of electrical and design rule checks, and finally, hardware validation and verification. Key design challenges include timings of both the parallel interface off chip memory, as well as the respective boot and power sequences. As a development board, it is better suited to firmware development than to chip-level verification. Future SoC

revisions may also require their own boards. The completed development board is expected to serve as an easy-to-use and efficient means of developing firmware and hardware solutions oriented around this SoC.

Mentor(s):
Moe Wai Yan Myint (Engineering); Boyuan Chen (Engineering); Mark Johnson (Engineering); Matthew A Swabey (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1633
Presentation Time: Session 4: 1:30-2:30pm

Analysis of Student Dining Preferences at the PMU

Business Case Study

Authors(s):
Matthew John Gehrs† (Polytechnic); Nathaniel Robert Jones† (Polytechnic); Thomas Joseph Solloway† (Polytechnic); Ya-Lan Chang† (Polytechnic); Sritha Yalamanchili† (Science); Ananya Anand Nadkarni† (Engineering)

Abstract:
Purdue University has a large student population that contributes to spending across campus, yet retail dining options at the Purdue Memorial Union (PMU) which are offered through Aramark, may not be obtaining potential student spending. During FY26, the PMU recorded approximately 2.54 million visitors, representing a 9.4% increase from FY25. With more people visiting the PMU, Aramark has the opportunity to encourage additional spending. This study aims to understand why students may choose to dine elsewhere as well as identify opportunities for Aramark to improve available dining options at the PMU. To investigate this, a Qualtrics survey was created and distributed across undergraduate student demographics at Purdue to gather information about students' dining habits, preferences, and other factors that may influence their purchasing decisions. To avoid biased data, this research sample will include responses from students across different years and living situations to create a diverse dataset. The findings from this research will help identify the factors that influence students' dining decisions and provide recommendations for ways Aramark can better meet student preferences, attract more customers, and increase consumer spending at PMU.

Mentor(s):
James Tanoos (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1634
Presentation Time: Session 4: 1:30-2:30pm

Effects of Nose Cone Tip Angle on Perceived Loudness of Sonic Boom at Ground

STEM

Authors(s):
Georgios Giannakis† (Engineering); Cooper James Buchman† (Engineering); Scott Swenson† (Engineering); Michael David Green‡ (Engineering); Aditya Sarwaikar‡ (Engineering); Kaden Michael Phillips‡ (Engineering)

Abstract:
The primary barrier preventing commercial supersonic travel from becoming commonplace is the sonic boom that is when aircraft exceed the speed of sound. This sonic boom is a shockwave formed by the convergence of smaller shockwaves generated primarily by the nose cone, wings, and tail. Last semester, our team's focus was on utilizing aerospike devices in order to mitigate the sonic boom pressure. However, we found that although the aerospikes were effective in reducing sound, the drag caused by the aerospike was too much to ignore. As such, our focus this semester has been on investigating the relationship between the angle of attack of a conical nose cone, (which has the least drag), and the far-field pressure. Using computational fluid dynamics (CFD), we tested a full sweep of angles ranging from 3 to 45 degrees in order to see which angle optimizes the sound. Based on our results, we plan to manufacture a scale model of our best design and test it in a wind tunnel to validate our CFD. By mitigating the shockwave generated by the nose cone and keeping the drag at an acceptable level, supersonic commercial flight could potentially become viable again.

Mentor(s):
Curtis Earl Marshall (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1635
Presentation Time: Session 4: 1:30-2:30pm

Hair Cortisol Concentration and Cardiovascular Disease: A Systematic Review and Meta-Analysis

STEM

Authors(s):
Cameron Jean Gibson† (Science|JMHC)

Abstract:
Chronic stress has been associated with numerous adverse health outcomes, including cardiovascular disease, immune dysfunction, and mental health conditions. Cortisol is a key hormone involved in the human stress response, and its measurement provides insight into physiological stress processes. Traditional methods of cortisol measurement, such as blood, saliva, and urine sampling, provide short-term assessments and may not capture long-term patterns of cortisol exposure. In contrast, hair cortisol concentration offers a noninvasive measure of cumulative cortisol exposure over extended periods, making it a valuable tool for studying chronic stress.

Previous systematic reviews have identified associations between elevated hair cortisol concentration and cardiovascular disease. This study will update the existing evidence by systematically reviewing studies published since the April 2023 search cutoff of a previous review. Studies will be identified through searches of relevant databases using predefined search terms and eligibility criteria. Data on study populations, study design, hair cortisol measurements, and cardiovascular outcomes will be extracted, and study quality will be assessed. Findings will be compared with those of the previous review to evaluate whether newer evidence supports earlier conclusions and identifies variation across populations and demographic groups. Where sufficient comparable data are available, a meta-analysis will be conducted. This updated synthesis aims to clarify the relationship between long-term cortisol exposure and cardiovascular health and assess the potential value of hair cortisol concentration as a biomarker in cardiovascular health research.

Mentor(s):
Amanda Veile (Liberal Arts)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1636
Presentation Time: Session 4: 1:30-2:30pm

The Influence of Yeast Strain Selection on Finished Wine Characteristics

STEM

Authors(s):
Megan Rose Goins† (Agriculture|Liberal Arts)

Abstract:
The wine-making process has been around for thousands of years. For most of those years, the fermentation that brings crushed grapes to wine has typically been done by wild yeasts already on the surface of the grapes. With modern technology and emerging practices within the wine-making community, the strain of yeast that enologists want to ferment their product can now be specifically and carefully chosen. Yeast selection during winemaking offers opportunities to influence not only fermentation performance but also the characteristics of the finished wine. This research will use a structured narrative literature review to examine how yeast species and strain selection affect the aroma, flavor, and related sensory characteristics of young grape wines. For this project, young wines will be defined as wines intended for consumption within six months of production, with priority given to studies evaluating wines during that period and before extended maturation. Studies will be compared according to yeast identity, grape variety, inoculation strategy, fermentation conditions, sampling time, chemical composition, and sensory findings.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1637
Presentation Time: Session 4: 1:30-2:30pm

Dose dependent effects of Chlorpyrifos on Primary Midbrain Neurons

STEM

Authors(s):
Nikita Goldfeld† (HHS); Karis Ge Fu* (HHS|JMHC)

Abstract:
Background and Purpose: Chlorpyrifos (CPF) is an organophosphate pesticide linked to developmental neurotoxicity and motor deficits in children. The midbrain, which contains dopaminergic, glutamatergic, and GABAergenic neurons all play a strong role. These roles include motor movement, survival instincts, cognition and motivation, which may be especially vulnerable during embryonic development. We hypothesized that primary midbrain neuronal networks are highly sensitive to CPF.

Methods: Primary midbrain neurons were isolated from sprague dawley rats at postnatal day-1. Cells were plated onto 48 multi-well MEA plates, with each well containing an array of 16 individual embedded nanotextured microelectrodes. Cells were plated at a density of 120,000 cells/well and cultured in Neurobasal medium. The culture medium was then switched to BrainPhys at DIV (Days in Vitro) 5. Acute exposure was also done during DIV 9 through DIV 12. During DIV 9, the baseline reading was recorded, in addition to a full media change. At DIV 12 the cells were treated at increasing concentrations of Chlorpyrifos(0.1 μM, 1 μM, 3 μM, 5 μM, and 10 μM). They were then measured during DIV 13 and DIV 14 to measure the 24hr and 48 hr exposure to the treatment. After the baseline recording, a 1 hour exposure recording was started to determine the acute (40 min exposure) effects of different concentrations of CPF. Wells with at least four bursting electrodes at baseline recording were included for experiments.

Results: CPF caused dose-dependent reductions in spikes, network bursts, burst duration, spikes per burst, and synchronicity. Middle doses disrupted bursting (around 5 μM) and synchrony, while higher doses broadly suppressed activity.

Conclusions: Primary midbrain neuronal networks are highly sensitive to CPF, showing dose-dependent disruptions in functional connectivity and communication.

Mentor(s):
Jason R Cannon (HHS); Reeya Tanwar (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1638
Presentation Time: Session 4: 1:30-2:30pm

First-Principles Discovery of High-Pressure Phases across Materials.

STEM

Authors(s):
Mateo Gonzalez Cano† (Purdue University)

Abstract:
Materials exhibit unique phase transitions in extreme, high-pressure environments that cause their atomic structure to reshape, in turn reshaping their overall material properties. Due to the novelty and uncertainty of these high-pressure phases, there is still much to be learned – specifically in discovering the phase transitions. We aim to address this problem using density functional theory (DFT). Our first goal will be to reproduce recently published results from the Strachan group that characterized 28 new high-pressure phases of materials. We will do this through nanoHUB's AURA research assistant - an agentic tool that uses model context protocols (MCP) to interact with tools, databases, and outside resources (e.g. Claude). After verifying our ability to reproduce the published results (in turn verifying our workflow), we will extend these findings by targeting novel high-pressure phases. The resulting high-pressure phase discovery, powered through nanoHUB's MCP connected to Claude, and simulation workflow will be published on nanoHUB as a tool to accelerate the discovery of high-pressure two-dimensional materials.

Mentor(s):
Alejandro H Strachan (Engineering); Aidan Damian Pantoya (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1639
Presentation Time: Session 4: 1:30-2:30pm

Bistable Auxetic Patterns and Their Use in Non-Cooperative Space Object Detumbling

STEM

Authors(s):
Vedansh Gupta† (Engineering); William James Rowe‡ (Polytechnic); Veeraj Vikrant Dalwale‡ (Polytechnic)

Abstract:
Spacecraft can go out of control for many reasons, such as misfiring thrusters or broken reaction wheels. Conventional methods of recovering non-cooperative space objects remain complex, expensive or have a high cost of energy consumption. Objects in space typically have an unknown mass and angular velocity and require detumbling that is both fast and minimizes damage to the capturing craft and the detumbled object. This project seeks to use auxetic patterns (patterns that expand in multiple directions when stretched) to conform to varying shapes of space objects. The goal is to develop a process that is low-cost, has a low energy budget, and minimizes damage to the object. Springs are attached to the auxetic pattern to help it expand, thereby reducing the energy budget. Springs have two stable states: stretched and unstretched. Therefore, the auxetic pattern becomes bistable. The auxetic pattern sheets are 3D printed via TPU and then springs are added in predetermined spots. The claw is formed by joining 3 equally spaced sheets and will be tested by capturing a simulated non-cooperative probe in a low friction environment on Earth. This low friction environment mimics the microgravity experienced by spacecraft in space. It is expected that the pattern will successfully capture the probe.

Mentor(s):
Ran Dai (Engineering); Yuto Tanaka (Engineering)

Other Acknowledgment(s):
CJ Holdeman* (Engineering)

Poster Presentation Abstract Number: 1640
Presentation Time: Session 4: 1:30-2:30pm

Prey Density as an Indicator of Roadkill Frequency on Indiana State Roads

STEM

Authors(s):
Hannah Guy† (Liberal Arts|JMHC); Samantha Marie Bachler† (Liberal Arts|Science|JMHC); Sam Hornung† (Liberal Arts|JMHC); Havish Goutham Prageeth† (Science|JMHC)

Abstract:
Indiana landscape was changed dramatically with the implementation of the federal highway program in the mid 20th century. These highways divided natural animal habitats, disrupting natural animal movement for food, water, and potential mates.

Wildlife fatalities on roads (roadkill) are one of the most evident effects of the ecosystem disruption caused by roadways. In addition to their impact on animal welfare, animal-vehicle crashes also have a steep economic cost, ranging from a few thousand to millions of dollars per crash depending on severity. Despite its prevalence, studying roadkill can be challenging due to the vast network of roadways and difficulty identifying roadkill species.

Sound ecology uses passive acoustic monitors to quantify species' presence and other acoustic wildlife data without researcher interference, which informs our understanding of natural, unobserved patterns. While research indicates that human constructed barriers, such as roads, may increase the number of animal mortalities, little is currently known about how best to identify specific pressure points. Here, we propose using soundscape data from ARUs (autonomous recording units) (n=6) near state roads to quantify prey density near roadkill sites (n=86,000; 2020-2024) and determine if there is a relationship between animal mortality on rural Indiana State roads and prey density.

We predict that prey density on rural state roads may impact the count of animal mortality on roads. This study may give an indication of preventative measures that could be taken to limit roadkill and the associated costs for humans and vehicles involved in these incidents.

Mentor(s):
Kristen Marie Bellisario (JMHC)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1641
Presentation Time: Session 4: 1:30-2:30pm

Machine Learning Solution for Efficient Cryogenic BSIM Parameter Extraction

STEM

Authors(s):
Olivia M Gzamouranis† (Engineering|Science)

Abstract:
CMOS transistors, which are fully functional at cryogenic temperatures, are critical for competitive circuits in extreme-environment applications such as quantum computing controllers and deep-space electronics due to their enhanced carrier mobility and reduced thermal noise. However, modeling these devices at cryogenic temperatures (4K - 77K) requires time intensive Berkeley Short-channel IGFET Model (BSIM) parameter extraction, creating a huge bottleneck in ASIC design. To accelerate this workflow, we have developed an open-source machine learning framework to fit BSIM parameters to a pre-measured IV curve, greatly reducing the time required to create a model that accurately predicts device behavior at cryogenic temperatures. For this first iteration, we created a cryogenic extraction Neural Network for Skywater 130nm Process Design Kit (PDK) devices. A Multi-Layer Perceptron (MLP) was trained on synthetic IV curves generated via Ngspice, utilizing a Latin Hypercube Monte Carlo simulation to explore the parameter space of low threshold voltage devices. Our Neural Network takes input IV curve data for a specific device and predicts the ideal low voltage threshold BSIM parameters to recreate the exact measurement. This method greatly reduces parameter extraction time from the traditional methodology and has the potential to improve parameter accuracy.

Mentor(s):
Alex Ruichao Ma (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1642
Presentation Time: Session 4: 1:30-2:30pm

An Analysis of Racing Principles for Autonomous Go-Karting

STEM

Authors(s):
Daniel Hancock† (Engineering); Anthony Michael Girard† (Engineering); Himank Chadha† (Engineering); Arjun Rakkappan Krishnan† (Engineering)

Abstract:
As autonomous racing continues to develop as a sport, the gap between autonomous and real drivers is still apparent. Taking lessons on racing strategy from human drivers can help bridge the gap between lap times for autonomous racing towards human performance. This will help as the overall goal for autonomous racing is to replicate and improve upon a physical person driving the car. To better understand how kart and car dynamics and physics affect racing, and how an autonomous vehicle operates in race conditions, a complete breakdown of the kart dynamics was completed. It focused namely on the drive train/vehicle power and vehicle steering/turning, as well as a basic analysis on the autonomous system of the go kart. Autonomous go-karts rely on input from various sensors such as combining LiDAR, GPS, and camera systems to determine position and the next steps for the go-kart to take, as opposed to a traditional human driver, who relies on experience and racing knowledge. The adaptability provided by a human driver currently gives it an edge over autonomous driving. After taking into consideration the breakdown and analysis of the go kart, suggestions for how to make improvements for better race performance are presented. These improvements could range from minute code changes all the way to changes to the physical representation of the car.

Mentor(s):
Richard Ajagu (Engineering); Andres Felipe Hoyos Moreno (Engineering); Reed Joseph Freer (Engineering); Samuel Labi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1643
Presentation Time: Session 4: 1:30-2:30pm

Combining Machine Learning and Language Models Through Uncertainty to Predict Sinus Treatment Outcomes

STEM

Authors(s):
Mohammad Abdullah Haris† (Science)

Abstract:
Deciding whether a treatment will help a patient is one of the most consequential judgements a physician makes. Machine learning (ML) models and large language models (LLMs) are increasingly being proposed as aids in this decision-making process. However, these tools give no reliable signal when they are guessing, and in a clinical setting a confident but incorrect prediction is not an inconvenience; it is a consequence. For AI to genuinely improve a physician's decision, it must not only predict an outcome but also indicate how far that prediction can be trusted. Building on prior work that measured LLM uncertainty through the Shannon entropy of repeated outputs, this ongoing project explores entropy as that trust signal, with the aim of helping doctors choose the right treatment for chronic rhinosinusitis (CRS). Using clinical information collected before treatment from 791 patients, each patient's outcome is judged by whether their symptoms improved meaningfully after six months, measured by a standard symptom questionnaire. Three ML models and two LLMs each predict whether a patient is likely to improve, and each also reports how certain it is, measured through entropy. For the LLMs, this certainty comes from asking the same question many times and checking how consistent the answers are. A final model then learns which of the five models to trust for each patient, based on their predictions and their certainty. A vital question is whether this ensemble arrangement can predict outcomes more reliably than any single model, laying a potential groundwork for a system where doctors and AI complement and keep a check on one another.

Mentor(s):
Snehasis Mukhopadhyay (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1644
Presentation Time: Session 4: 1:30-2:30pm

How has Private Equity Changed Youth Sports?

Business Case Study

Authors(s):
Noah Hill† (Education)

Abstract:
In recent years, youth sports has seen a significant rise in the popularity of travel sports. Travel sports require more financial and time commitments than rec-leagues. Parallel to the rise of travel teams has been private equity groups investing in youth sports. Private equity groups operate by taking in investments and using them to make a company or industry as profitable as possible. These investments come to fruition in the form of teams, tournaments, and facilities. These investments have altered the affordability of youth sports in the United States. Is it still possible for low-income families to have children participate in youth sports? If private equity is endangering accessibility to athletic programs to children, then what can be done to prevent it?

This paper will focus on how private equity has changed affordability, accessibility, and familial commitments regarding amateur sports in the United States. It will also look at the demographics that are now playing youth sports. Research will examine studies to analyze if private equity involvement made it so children from middle to lower class households are unable to participate in sports teams. It will also examine the fashion in which family lifestyles have had to adjust to the more demanding commitment requirements that these travel sports teams have created.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1645
Presentation Time: Session 4: 1:30-2:30pm

How Does Human Disturbance Impact Wolf (Canis lupus) Habitat Selection on a Boreal Island, National Park Setting?

STEM

Authors(s):
Jordan Ma'sandra Sue Hinkle† (Agriculture|JMHC); Lourdes Gabrielle Ferrer-Ortiz‡ (Agriculture|JMHC); Liam Ray King‡ (Agriculture|JMHC); Phol Jiraphasuksakul‡ (Engineering)

Abstract:
Wolves (Canis lupus) function as a vital part of ecosystem health as they regulate population densities of ungulates like deer (Odocoileus virginianus), elk (Cervis canadensis), and rodents such as beavers (Castor canadensis). National parks serve as protected habitat for many species while allowing the public to engage with nature. As a keystone species, their extirpation from previously inhabited areas, such as Yellowstone National Park, can impact vegetation, bird presence, and water flow. Voyageurs National Park, which has a known wolf population, will serve as a comparison site to Acadia National Park. Both parks have similar vegetative backgrounds of a Northern forest landscape. Which is comprised of a mix of coniferous and deciduous trees with its accompanying understory vegetation. Trees such as red pine (Pinus resinosa), jack Pine (Pinus banksiana), and red maple (Acer rubrum) dominate this landscape. Understory vegetation is marked by cinnamon fern (Osmundastrum cinnamomeum), purple aster (Symphyotrichum patens), and moss varieties (Lycopodium spp.). Even though both parks share a common landscape, a main difference is the presence of wolves. With a broad goal of wolf conservation and reintroduction in mind, our study aims to identify which key environmental factors play a role in wolf habitat selection.

We plan to set out camera traps with accompanying ARUs and Kestral devices to record images, weather, and acoustic data. We aim to use this data to compare Acadia and Voyageur sites to determine if there are key differences that play a role in wolf presence. We also plan to survey Acadia National Park to determine if anthropogenic presence plays a role in selection. We plan to conduct trail surveys by counting the number of people on a trail during pre-set time intervals to estimate trail use throughout a given day. Our findings may be used to help support the reintroduction of wolves back into Acadia National Park.

Mentor(s):
Kristen Marie Bellisario (JMHC)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1646
Presentation Time: Session 4: 1:30-2:30pm

Russian Short-of-War Actions in Europe and Its Effect on Coordination & Assurance Within the EU and NATO

Social Science

Authors(s):
Tomas Ho† (DSB|Liberal Arts); Alexander Tyler Ng† (Liberal Arts); Landon Oliver King† (Liberal Arts|Science)

Abstract:
Since 2022, Russian backed individuals and groups have committed acts of sabotage and disruption through most of Eastern Europe and part of Western Europe. These include attacks on energy, communication, and individuals. While individually insignificant, the sum of these events have created regional effects that assist Russian efforts in the region. Russia aims to use these attacks to discredit EU and NATO's resolve to respond and coordinate. This is in order to support and supplement their war in Ukraine and greater interests. Attacks that have discredited the EU and NATO's willingness to respond include the attack on Spain's power grid in 2025, French grocery stores in 2026, and an attempted assassination of Armin Papperger in 2025.

Mentor(s):
Chiara Cervini (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1647
Presentation Time: Session 4: 1:30-2:30pm

Effects of Proximity to Nuclear Reactors on Water Quality and Habitat

STEM

Authors(s):
Gwendolyn E Hofman† (Engineering|JMHC)

Abstract:
Nuclear power is becoming more popular in the United States. Although there are no currently functioning nuclear power plants in Indiana, eager new companies and a widespread desire for carbon-free energy will likely change that within the decade. Nuclear power is staggeringly efficient and requires much less carbon dioxide to be emitted than other nonrenewable energy plants. Using fission reactions to generate electricity is an appealing answer to climate change, since fossil fuels are not needed for the reactions themselves. In this way, even though it is not a renewable source, nuclear energy is often labeled as sustainable, but it is not totally free of contaminants. Nuclear waste and the pollution involved with maintenance of power plants in general could still be harmful if not managed properly. In the case of a plant accident, especially, there is unique potential for disaster. Unprotected and nearby biological organisms could be subject to prolonged exposure to radiation. This paper will explore the relationship between proximity to a nuclear reactor and ecosystem prosperity, examining the water quality and critical habitat of the areas surrounding nuclear power plants. The goal of this research is to weigh the benefits of nuclear energy against any negative impact its production has on the environment.

Mentor(s):
Kristen Marie Bellisario (JMHC)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1648
Presentation Time: Session 4: 1:30-2:30pm

Evaluating the Net Conservation Benefits of Land-Based Recreation

Social Science

Authors(s):
Jack Hoppesch† (Agriculture)

Abstract:
The purpose of this research project is to determine the ways in which nature-based recreation can produce a net positive ecological impact. Research will be gathered by reviewing literature that discusses the negative environmental impacts of recreation, the revenue that comes from recreation and how that funding is used, what effects place attachment has on environmental advocacy and how it is developed, and the effect of conservation culture among recreationists. Primary research will be conducted by interviewing Purdue University faculty in the Department of Forestry and Natural Resources, focusing on natural resource social science and conservation decision-making. The results will be used to determine how land managers can leverage these findings to allow public access and conservation to coexist.

Mentor(s):
Catherine Jean Shukle (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1649
Presentation Time: Session 4: 1:30-2:30pm

Increasing 3-Hydroxypropionic Acid Production in Issatchenkia orientalis

STEM

Authors(s):
Sayge Ellenrose Hopwood† (Agriculture)

Abstract:
Microbial production of 3-hydroxypropionic acid (3-HP), a chemical precursor to bioplastics, acrylic

acid, and more, offers a sustainable alternative to nonrenewable petrochemical-based processes.

Currently, 3-HP microbial synthesis has remained inefficient and unable to meet industrial demands due

to costly pH neutralizers and low 3-HP yield. The use of engineered acid-tolerant and nonconventional

yeasts such as Issatchenkia orientalis can provide an efficient platform for increasing 3-HP production.

The stress and acid tolerance of I. orientalis also make it a good candidate to produce 3-HP from

lignocellulosic biomass hydrolysate. In this study, I. orientalis was engineered to improve 3-HP

bioconversion from biomass sugars glucose and xylose via the β-alanine pathway. Previously, a

heterologous xylose consumption pathway from Scheffersomyces stipitis and a β-alanine 3-HP

biosynthesis pathway containing aspartate decarboxylase (TcPAND) from Tribolium castaneum, β-alaninepyruvate aminotransferase (BcBAPAT) from Bacillus cereus, and 3-hydroxypropanoate

dehydrogenase YDFG (EcydfG) from Escherichia coli, were introduced into I. orientalis SD108. To

enhance production, a second copy of the β-alanine pathway was integrated, leading to a 1.4- fold

increase in 3-HP titer. This study tested performance of the improved strain which produced 8.44 g/L of

3-HP from 40 g/L of xylose during batch fermentation. Additionally, introducing a heterologous redox

balancing gene (Gene A) and a second copy of xylitol dehydrogenase (XYL2) were identified as

strategies to reduce xylitol accumulation and increase 3-HP production in I. orientalis. However,

engineering attempts to transform these genes were unsuccessful. Future studies will focus on optimizing

CRISPR-Cas9 transformation in I. orientalis and identifying new gene targets to further improve 3-HP

titer. These results support the feasibility of 3-HP production from the biomass sugars glucose and xylose.

Mentor(s):
Sara Thomason (Agriculture); Eun Joong Oh (Agriculture)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1650
Presentation Time: Session 4: 1:30-2:30pm

Predicting Hard Drive Failure with Backblaze Drive Stats: A 30-Day Early Warning Approach to Proactive Replacement

Business Case Study

Authors(s):
Sage Hota† (DSB|JMHC); Sam Zichen Lai† (DSB); Kelly Thomas Rezek-Te Winkle† (DSB|JMHC); Alexander Chase Alfele† (DSB)

Abstract:
Unexpected drive failures risk data loss and trigger costly replacement in data centers. Our aim: To predict whether a hard drive will fail within the next 30 days using its daily SMART (Self-Monitoring, Analysis, Reporting Technology) metrics. We flag at-risk drives early enough for proactive replacement through the analysis of daily Backblaze Drive Stats records from Q1 2025 through Q1 2026: snapshot of about 145.8 million drive-days and 5,347 failures. Using DuckDB, we filter high-volume drive models, drop duplicate drive-days and post-failure rows, forward-fill short gaps, and cap implausible values. Additionally, we engineered features to capture error onset, error trends, age, thermal stress, and model context. We compare logistic regression and random forest in scikit-learn, testing class weights against 10:1 under sampling and SMOTE. Because only 0.1% of drive-days fall within 30 days of a failure, accuracy is misleading; precision-recall AUC on a held-out future period is our primary metric. Survival analysis (Kaplan-Meier curves and a Cox model) examines time to failure by drive model. Preliminary findings indicate that although individual predictors show near-zero linear correlations with failure, non-zero sector error counts serve as strong, non-linear indicators of imminent failure. Older drive models also exhibit higher cumulative failure rates. Ultimately, we expect to deliver a 30-day risk score per drive and a replacement cutoff that minimizes the total cost of false alarms and missed failures. Beyond hardware reliability, this cost-aware approach to rare-event prediction can help organizations shift from reactive to predictive maintenance, guiding accurate replacement and procurement decisions.

Mentor(s):
Adrian Hoffert Wolanski (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1651
Presentation Time: Session 4: 1:30-2:30pm

Improving RC Circuit Fabrication and Developing Integrated RLC Devices

STEM

Authors(s):
Bo-Wei Hsieh† (Engineering); Alexandre Chan Tome† (Engineering); Luke Joseph Hojnicki† (Engineering); Saloni Pothireddy† (Engineering); Isabel C Forand† (Engineering); Patrick Joseph Jordan† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Zhihong Chen (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1652
Presentation Time: Session 4: 1:30-2:30pm

Twig GPU Compiler Integration of Packetization Instruction Reordering

STEM

Authors(s):
Zay Linn Htet† (Engineering); Sean Lee* (Engineering); Tushar Singh* (Engineering|JMHC); Felix Liu* (Engineering)

Abstract:
Modern graphics processing units (GPUs) accelerate graphical workloads through massive thread concurrency. Cardinal, a custom general-purpose GPU was designed to render the workload of a 3D spinning cube. Then, to bridge the high-level rendering kernels with the Cardinal's microarchitecture, the custom Twig compiler was developed. Inspired by NVIDIA's Maxwell architecture, Twig offloads data hazard resolution to compile-time analysis through instruction packetization, which bundles data-independent instructions. Though it streamlines the issue stage, the rate of issue remains to be bottlenecked by execution unit availability, leading to stalls that lower throughput and wastes idle power. To resolve such inefficiency, this project aims to reorder instructions to be prepared to fit in available execution pipelines, specifically the usage of integer and floating point arithmetic units (ALUs and FPUs). The effectiveness of this approach will be evaluated by running the compiled rendering pipeline kernels through the Cardinal microarchitectural simulator, comparing instructions per cycle (IPC) and execution unit utilization (ALUs and FPUs) against a baseline in-order packetizer. In practice, however, Maxwell's dual-issue scheduling is limited by register file read-port bandwidth, which prevents concurrent dispatch to multiple execution units. Instead, Twig's reordered multi-instruction issues will be serialized across consecutive cycles. By maximizing hardware utilization, this technique mitigates idle stall cycles and maximizes throughput, cutting down stale power usage. Future work will extend this framework to memory operations, incorporating memory system hierarchies when determining load-store instruction rescheduling.

Mentor(s):
Zach Anthony Barna (Engineering); Charles Spencer Bowles (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1653
Presentation Time: Session 4: 1:30-2:30pm

The Hidden Superpower of Visual Design in Food Branding

STEM

Authors(s):
Dominic George Iannelli† (Agriculture)

Abstract:
Food and beverage marketing increasingly depends on visuals/logos to separate unique products from one another and create brand identities. This research examines how popular food corporations use visual design, iconography, packaging, and entrepreneurship to persuade consumers and create lasting associations with their products. Research on food packaging shows that consumers use visual cues to form expectations about products, including their taste, healthiness, and quality. For example, the Pepsi “Breathtaking” design strategy provides a case study of how a company deliberately combines geometry, color, and emotional associations to construct a memorable identity. Through visual and rhetorical analysis of marketing strategies and comparison with research on food packaging and consumer perception, this project explores how design can function as a form of persuasion rather than simply decoration. Ultimately, this research discusses how food marketing uses visual identity to shape consumer recognition and emotionally respond to products, as well as cement their legacies and iconography through short term means like pop culture methods.

Keywords: food marketing, visual design, branding, packaging, iconography, consumer perception, advertising

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1654
Presentation Time: Session 4: 1:30-2:30pm

Additively Manufactured Functional Materials with Memory and Sensing Capabilities

STEM

Authors(s):
Arman Islam† (Engineering)

Abstract:
Smart materials are increasingly being explored for embedded sensing, actuation, and memory-enabled applications, where they can enable responsive functionality within engineered structures. Additive manufacturing (AM) offers new opportunities to fabricate these materials into multifunctional, complex components; however, guidance on selecting and optimizing processes for specific applications remains limited. This review synthesizes current literature on functional materials across all major AM processes: Material Extrusion, Powder Bed Fusion, Vat Photopolymerization, Binder Jetting, Material Jetting, Sheet Lamination, and Directed Energy Deposition. The findings compare functional ceramics, polymers, and metals, identifying process specific strengths and disadvantages in material-based sensing, stimulus-responsive actuation, and memory behavior. While Material Extrusion and Powder Bed Fusion are well represented in the literature, emerging work in Directed Energy Deposition and Sheet Lamination demonstrates additional opportunities for functional materials. Across all these processes, material composition, process parameters, and post processing strongly influence performance of the manufactured sensor, yet standardized optimization procedures and combined memory enabled sensing demonstrations remain limited. At Herrick Laboratories, our ongoing research investigates thermal sensing through temperature-dependent resistance changes in conductive filaments utilizing material extrusion. This review highlights opportunities to improve process optimization, reliability, and multifunctional integration in AM smart materials.

Mentor(s):
Davide Ziviani (Engineering); Amanda Elizabeth Stone (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1655
Presentation Time: Session 4: 1:30-2:30pm

High-FPS Stereo Vision System for Resolving PnP Pose Ambiguity of High-Speed Objects

STEM

Authors(s):
Manya Shree Jain† (Science); Yuhan Xiong† (Engineering); Silas Lovett† (Engineering)

Abstract:
A major limitation of conventional Perspective-n-Point (PnP) algorithms is their susceptibility to pose ambiguity, which can compromise target localization accuracy in BoilerBots aiming systems. To overcome this limitation, this study proposes integrating high-frame-rate stereo vision into the PnP framework, using stereo-derived depth information to distinguish between competing pose solutions while maintaining real-time performance.

Stereo vision estimates the depth of the target armor plate by identifying corresponding image features across the stereo image pair, computing their disparity, and triangulating their 3D positions. The resulting depth measurements will be used to evaluate the geometric consistency of the candidate PnP solutions, enabling selection of the pose that best agrees with the stereo-derived depth information.

A pair of Basler ace 2 cameras will capture synchronized stereo video. PnP pose estimation and stereo matching will be implemented within the ROS 2 Humble framework to support modular, low-latency processing. The system will be optimized to minimize computational overhead and maintain real-time performance on the resource-constrained hardware used in BoilerBots applications. Ultimately, multiple algorithms and software architectures are evaluated based on pose estimation accuracy, ambiguity resolution reliability, and computational efficiency to identify an optimal configuration for real-time autonomous aiming.

Mentor(s):
Andrew Li Niu (Science); Yi Royce Cheng (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1656
Presentation Time: Session 4: 1:30-2:30pm

Development of an AI-Assisted Workflow for Automated Analysis of Untargeted Nano-DESI Mass Spectrometry Imaging Data

STEM

Authors(s):
Joseph Anthony Janicek† (Engineering)

Abstract:
Mass spectrometry imaging (MSI) generates large and complex datasets that require labor-intensive analysis, especially in untargeted experiments where each detected m/z value must be assigned to a molecular formula. This project aims to develop an automated, AI-assisted workflow to simplify and accelerate MSI data analysis. As a first step, Python-based pipelines have been developed to automate key stages of the analysis, including peak extraction and data filtering. Currently Python-based pipelines are being developed to automate the process of molecular formula assignment. These pipelines will be subsequently converted into modules for an agentic AI system that orchestrates the analysis of MSI data. The AI will be trained using these modules alongside a mass spectrometry database containing reference m/z values and corresponding molecular formulas. After training, the AI agent will be used to analyze new nano-DESI MSI datasets, assigning molecular formulas to detected peaks by referencing the database, thereby substantially reducing manual effort and accelerating data analysis.

Mentor(s):
Govindi Soba Rashmiraji Walimuni Dewage (Science); Qiaorong Xie (Science); Xindi Tang (Science); Julia Laskin (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1657
Presentation Time: Session 4: 1:30-2:30pm

Algorithm-driven Grid Refinement for Ultrasonic C-scan Mapping of Defects in CFRP Laminates

STEM

Authors(s):
Chanhoo Jeong† (Polytechnic); Paul Kyu-Hwan Park‡ (Polytechnic)

Abstract:
Non-destructive testing (NDT) can provide an important role in evaluating the structural integrity of carbon fiber reinforced polymer (CFRP) composites by detecting internal defects. This study researches the application of handheld ultrasonic testing (UT) to identify and map artificial defects in CFRP laminates through two-dimensional C-scan reconstruction. Four CFRP panels were manufactured: a 100 × 100 mm pristine control panel, a 100 × 100 mm panel with induced porosity, and two 200 × 200 mm panels containing foreign object inclusions and artificial defects of varying sizes and depths. Ultrasonic inspections were conducted using a handheld flaw detector at 10 mm grid intervals. An individual A-scan was performed at each grid point, recording both back-wall and defect echo amplitudes. These measurements were utilized for spatial coordinates to support two-dimensional C-scan reconstruction. An algorithm was utilized to further detect, analyze, and characterize defects by processing ultrasonic measurements and identifying variations in signal amplitudes. Variations in ultrasonic amplitudes were analyzed to identify potential defect regions and characterize their responses. This study evaluates the feasibility of manual ultrasonic mapping and establishes a foundation for future adaptive scanning and automated CFRP inspection systems.

Mentor(s):
Garam Kim (Polytechnic); Todd A Brewer (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1658
Presentation Time: Session 4: 1:30-2:30pm

Predicting Sephora Product Recommendations: A Data-Driven Approach to Customer and Product Insights

Business Case Study

Authors(s):
Jiya Jindal† (DSB|JMHC); Marley Marie Schrof† (DSB); Riley M Budreau† (DSB); Rebecca Grace Matthieu† (DSB|JMHC)

Abstract:
What product, brand, reviewer, and customer experience characteristics can be used to predict whether a customer will recommend a Sephora product?

The main goal of this project is to use the Sephora product and customer reviews to predict whether a customer will recommend a product and determine which factors are most useful in making that prediction. This is valuable to Sephora to understand the existing customer reviews which helps to evaluate the most popular/wanted brands/products, making more informed decisions about future product assortment, inventory, and shelf-space allocation.

The analysis uses Sephora product information and customer review data to determine if the customer will recommend a Sephora product. After cleaning the datasets by eliminating missing values, duplicates, and unnecessary variables, we used is_recommended as it will serve as the binary target variable. We will use logistic regression and decision trees to predict whether a customer recommends a product. Our primary model will focus on product, brand, and reviewer characteristics. Our secondary model will include customer star ratings and review sentiment to measure their additional predictive value. Our models will be evaluated using F1-score, accuracy, precision, recall, confusion matrices, and cross-validation.

Preliminary exploratory analysis shows a significant difference between recommended and non-recommended reviews, additionally a strong relationship between star ratings and recommendation rates. Product popularity, measured by loves count, doesn't suggest a relationship with recommendation rate. These findings indicate that an individual customer recommendation likely depends on a multitude of factors rather than product popularity alone. Ultimately, this project aims to translate the individual product recommendations into predictions on product and

brand-level insights supporting Sephora’s merchandising and product assortment decisions to increase revenue.

Mentor(s):
Adrian Hoffert Wolanski (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1659
Presentation Time: Session 4: 1:30-2:30pm

VIP 17911 IOT Laser Scanner Abstract

STEM

Authors(s):
Adam Jean Joly† (DSB)

Abstract:
Thus far in my time working as a part of the VIP 17911 IOT, I have worked to become familiar with the laser scanner. I learned that outside of the many cool personal projects that I first imagined when I heard I would have the opportunity to use this machine, that there are an incredible number of practical applications for this handy tool. One of the more prevalent examples is labeling that is smear-proof and practically able to mark nearly any material. This is particularly useful in the medical and industrial fields where stainless steel is a very common material on which labels would not be desired to be washed off. So far, my team and I have developed a Standard Operating Procedure for the laser scanner including basic maintenance processes and have successfully etched on a variety different mediums including plastic sheets and metal water bottles. Some of our most successful jobs were a homemade ruler, a nameplate and labeling an Owala water bottle with the name of its owner. This is all relevant to manufacturing and the Internet of things because the process that we used for these projects is the same as the ones used for labeling and part-making in industry. Also, for every project that we worked on, we considered, “what are the potential cost benefits of using the laser scanner over another tool?” and “how can we conserve resources?” – the same questions that professionals in all engineering fields are constantly considering.

Mentor(s):
Chun-Kang Huang (Engineering); Steven R Dunlop (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1660
Presentation Time: Session 4: 1:30-2:30pm

Coverage-Driven Functional Verification of an AHB-to-APB Bridge Using SystemVerilog UVM

STEM

Authors(s):
Derek Jones† (Engineering); Seung Won You† (Engineering); Sogo Bakare† (Engineering)

Abstract:
Reliable communication between components in a System-on-Chip (SoC) requires correct operation of bus interfaces, particularly when connecting high-performance components to lower-bandwidth peripherals. An Advanced High-Performance Bus (AHB) to Advanced Peripheral Bus (APB) bridge translates transactions between these interfaces while managing differences in transaction timing, control signaling, and peripheral wait states. Incorrect translation can corrupt data, stall transactions, or cause system-level failures. Although an AHB-to-APB bridge exists, a systematic verification environment is needed to evaluate its compliance with the supported AMBA protocol requirements before integrating it into larger SoC designs.

This project develops a reusable, coverage-driven Universal Verification Methodology (UVM) environment in SystemVerilog to verify the bridge's functional correctness. The environment uses AHB and APB agents to generate and monitor transactions, while a transaction-level reference model and scoreboard compare expected and observed behavior. Directed and constrained-random tests will exercise read and write operations, APB wait states, back-to-back transactions, reset behavior, and supported error conditions. SystemVerilog Assertions (SVA) will check protocol requirements, while functional coverage will identify untested scenarios and guide further test development.

Verification effectiveness will be evaluated using functional coverage, code coverage where available, scoreboard mismatches, assertion violations, and automated regression results. These metrics will provide measurable evidence of verification progress and help identify remaining verification gaps. Although simulation-based verification cannot guarantee the absence of all hardware defects, the resulting environment aims to improve confidence in the bridge's functional correctness and provide reusable verification components for future AHB/APB-based designs.

Mentor(s):
Srilekha Jagarlamudi (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1661
Presentation Time: Session 4: 1:30-2:30pm

Extending the Processing Capabilities of Threat Intelligence Platforms

STEM

Authors(s):
Joshua Joseph† (Science)

Abstract:
The goal of this research is to extend the capabilities of the OpenCTI threat intelligence platform by enabling the extraction, search, and retrieval of text embedded in social media images. To avoid the costs associated with commercial AI models, we focus on open-source OCR libraries and VLMs that can run locally. The solution must be deployable within OpenCTI's Dockerized environment and handle the challenges of extracting text from social media images with different layouts, fonts, and backgrounds. To evaluate potential solutions, we benchmarked six OCR tools using a dataset of approximately 5,000 Reddit memes, comparing their text extraction accuracy, inference speed, and performance across different image types. Our preliminary results show that EasyOCR performs best out of the box in terms of text extraction accuracy, while the other evaluated systems achieve varying levels of success. These findings suggest that traditional OCR approaches may offer advantages over larger VLMs for extracting text from social media images in resource-constrained applications.

Mentor(s):
Courtney Allen Falk (Centers & Institutes)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1662
Presentation Time: Session 4: 1:30-2:30pm

Measuring Effects of Blood Flow Using Fluid Mechanics

STEM

Authors(s):
Ryan Khoury† (Engineering)

Abstract:
Different fluids in a biological system react to pressure changes differently, affecting how doctors might understand and treat different conditions. This research project specifically analyzes how different types of fluids interact as they flow through a system, similar to blood flowing in the circulatory system from the heart to extremities. We will take pressure readings at strategic positions within the system, specifically at inlets and outlets. We will simulate blood being pumped through the body by creating a system of pipes and glass containers, with a pump to simulate the heart. As the glass containers fill up, the pressure in them increases. Once all containers are full, the pump stops. The sensors will read in-flow rates and pressures, resulting in graphical data for us to analyze. Different data from different fluids will show the ideal fluid for this system, where we will eventually use a fluid similar to blood to see how it behaves as compared to other fluids. The findings from this research will help doctors understand how and why different fluids behave the way they do as they move within the body due to pressure changes and flow rates.

Mentor(s):
Huidan Yu (PWL)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1663
Presentation Time: Session 4: 1:30-2:30pm

What Enables Regeneration?

STEM

Authors(s):
Wonshin H Kim† (Science)

Abstract:
Reparative regeneration, a biological process that repairs or replaces an injured or lost body part without scarring, is a fascinating topic in biology that has been researched for centuries. A pattern observed from research on this topic is that some cold-blooded animals can regenerate a significant part of their bodies after amputation while seemingly all warm-blooded animals are unable to regenerate more than a small fraction of their bodies. This research paper will attempt to reveal the reasons why warm-blooded animals, i.e., birds and mammals, have limited reparative regeneration capabilities compared to those of certain cold-blooded animals, more specifically some invertebrates, amphibians, and reptiles. To determine the causes of the limited regeneration seen in warm-blooded animals, this paper will draw information from peer-reviewed research articles and books, all related to reparative regeneration. For this research paper, the regeneration processes and mechanisms of a variety of cold-blooded animals will be laid out in detail and compared to the healing processes and mechanisms of warm-blooded animals, specifically mammals. The main significance of the research done on this paper is to help understand the limits of regeneration in warm-blooded animals, including humans, and to attempt to explain what enables reparative regeneration in animals.

keywords: regeneration, animal

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1664
Presentation Time: Session 4: 1:30-2:30pm

Predicting Online Purchase Intent: Using Shopper Session Behavior to Target Conversion Efforts

Business Case Study

Authors(s):
Marie Cathryn Kingery† (DSB|JMHC); Himaja Rangisetty† (DSB); Himani Ashok† (DSB); Nicole Yu† (DSB)

Abstract:
Can retailers identify which online shopping sessions will end in a purchase, so they can target discounts and ads more effectively? Only 15.5% of sessions convert, so offering discounts or ads to every visitor wastes margin. We predict whether a session ends in a purchase (Revenue) from behavior observed during the visit, so retailers can decide who receives ads and discount offers. Using Python and scikit-learn, we analyze 12,330 sessions with 17 features from the UCI Online Shoppers Purchasing Intention dataset. We remove duplicate sessions, one-hot encode categorical codes, and log-transform skewed features. A stratified 80/20 split creates a training set and a 2,441-session holdout test set. We compare a dummy baseline, logistic regression, a decision tree, and a random forest, tuned with stratified 5-fold cross-validation inside a leakage-safe pipeline. Logistic regression gives an interpretable model, while decision trees and random forests capture nonlinear relationships and interactions in browsing behavior. PR-AUC is our primary metric because it measures the tradeoff between identifying buyers and false positives that waste discounts and advertising spend. Sessions with a Page Value above zero convert at 56.3% versus 3.9%, conversion falls from 26.5% to 2.8% across Exit Rate quartiles, and new visitors convert more than returning visitors (24.9% vs. 13.9%). EDA suggests Page Value, Exit Rate, Bounce Rate, product page activity, Visitor Type, and Month as useful signals. We also compare models with and without Page Value, which may include information unavailable before a purchase. These are associations, not causes. Results could help retailers target ads and personalized offers while avoiding unnecessary discounts; because the data come from one retailer and lack January and April sessions, findings need validation on other sites.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1665
Presentation Time: Session 4: 1:30-2:30pm

Benchmarking AI-Assisted Workflows for System-on-Chip Design

STEM

Authors(s):
Jason Andrew Kluthoٹ (Engineering); Enio Hysaٹ (Engineering); Jaanav Bhavin Shahٹ (Engineering|JMHC); Eshan Mathurٹ (Engineering)

Abstract:
Designing a system-on-chip (SoC) requires months of manual engineering to develop hardware code and verify functional correctness. While artificial intelligence has become widely adopted in software development, its effectiveness in hardware design remains less understood, particularly in identifying where AI tools can improve efficiency without compromising design quality.

To investigate the practical applications of AI in hardware development, our project benchmarks NEX (by ChipNexus.ai), a specialized chip-design tool, against general-purpose language models during the development of a complete microcontroller. Rather than relying on AI to generate designs independently, team members develop structured specifications for a processor core, communication buses, and input-output peripherals, drawing inspiration from an existing design refined across eight generations over 14 years. These specifications guide the models in implementing hardware components, which are subsequently evaluated through standardized simulation tests for functional correctness and optimization.

We evaluate each tool using measurable metrics, including hands-on engineering time, model token costs, and automated test pass rates. While our study focuses on a single microcontroller architecture and relies on structured specifications, potentially limiting the generalizability of our findings to other hardware designs and development workflows, it provides a controlled framework for evaluating AI-assisted hardware development. By identifying where AI tools are most effective, we aim to reduce repetitive engineering bottlenecks within our 400-student organization.

Mentor(s):
Pranav Sangam (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1666
Presentation Time: Session 4: 1:30-2:30pm

Estimating the Effect of PAC Contributions on House Electoral Outcomes

Business Case Study

Authors(s):
Vipul Konnur† (DSB|Liberal Arts)

Abstract:
This study investigates the relationship between PAC contributions and electoral outcomes in the 2024 U.S. House elections, with particular focus on whether this relationship differs between incumbents and challengers. Drawing on Federal Election Commission bulk data, I construct a candidate-level dataset comprising 1,003 House candidates and 18,420 PAC and organizational contribution records totaling approximately $210 million. Total PAC receipts are aggregated at the candidate level and merged with general election results. A logistic regression model estimates the probability of winning as a function of total PAC contributions, incumbency status, and party affiliation. Results indicate that a one standard deviation increase in total PAC contributions ($779,223) is associated with a 24% increase in the odds of winning (OR = 1.24), though this effect is substantially smaller than that of incumbency status, which is associated with 5.46 times higher odds of winning after controlling for PAC money and party affiliation (OR = 5.46). Party affiliation shows no independent effect on electoral outcomes once incumbency and PAC money are accounted for (OR = 0.97). The model achieves an overall accuracy of 80.8%, with incumbency accounting for the majority of predictive power. These findings are consistent with the hypothesis that PAC contributions reflect strategic donor behavior favoring likely winners rather than constituting a direct determinant of electoral success, and contribute to longstanding debates in the campaign finance literature regarding the causal relationship between money and electoral outcomes.

Mentor(s):
Prateek Jaiswal (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1667
Presentation Time: Session 4: 1:30-2:30pm

AI Competency in Mathematical Research

STEM

Authors(s):
Aayush Kumar† (Science)

Abstract:
Artificial intelligence can already solve mathematical problems and assist with proofs. As AI tools become more common in research, they may change how we approach problems and conduct research. In this preliminary investigation, I examine how AI may change the skills mathematicians need for research. The review explores how AI can guide mathematical intuition, help develop conjectures, and assist with proofs, while also considering the importance of verifying AI-generated results and understanding the reasoning behind them. Initial research suggests that skills such as evaluating AI-generated results, understanding their reasoning, and connecting them to existing mathematical knowledge will become increasingly important. This will help explain how AI may change mathematical research and what skills mathematicians may need to develop as AI becomes more capable.

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1668
Presentation Time: Session 4: 1:30-2:30pm

Event-Based Vision and Feedback Control for Robotic Pencil Balancing

STEM

Authors(s):
Meghana Kumar† (Engineering|JMHC); Lucca Su Mo† (Engineering|Science|JMHC)

Abstract:
High-speed robotic systems require rapid sensing and control while minimizing computational demands and energy consumption. Event-based cameras offer a promising alternative to traditional cameras by detecting changes in a scene rather than continuously capturing full image frames. This research investigates the use of event-based vision and feedback control to balance a pencil on its tip, a highly unstable system that requires fast and accurate responses. A robotic platform was developed using event cameras to track the pencil's position and orientation in real time. The resulting measurements are processed using state estimation techniques, including low-pass and Kalman filtering, to estimate the pencil's motion. A pole-placement feedback controller then commands a two-degree-of-freedom platform driven by servo motors and a five-bar linkage mechanism to maintain balance. Experimental testing demonstrated successful stabilization of the pencil, with the longest continuous balancing trial lasting approximately nine minutes. This result demonstrates the ability of event-based sensing and feedback control to stabilize a rapidly changing physical system. Ongoing work focuses on integrating a spiking neural network for state estimation, with the goal of preserving the sparse nature of event-camera data and reducing computational requirements. Ultimately, this platform provides a foundation for investigating neuromorphic sensing and computation in high-speed robotic applications.

Mentor(s):
Takashi Tanaka (Engineering); Owen Lucas Bishop (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1669
Presentation Time: Session 4: 1:30-2:30pm

Expanding Non-Student Membership at the Purdue Cordova Recreational Center

Business Case Study

Authors(s):
Alexander Joseph Kurtz† (DSB); Frederick George Olthof† (DSB); Steven David Banks† (DSB); Kaijing Liang† (DSB); Wesley Jacob Mauzy† (DSB); Aditya Mittal† (Liberal Arts)

Abstract:
The Purdue CoRec faces a challenge in attracting and retaining eligible non-student members. Currently, approximately 95% of CoRec memberships are held by students, leaving faculty, staff, alumni, retirees, and their family members as an underdeveloped market segment. This presents an opportunity for the CoRec to diversify its membership base, increase participation, and boost revenue from the broader Purdue community. By conducting surveys and using secondary CoRec data, focusing on member pain points and developing an updated marketing outreach framework, focused on digital and targeted channel outreach and strategic brand positioning, this project aims to deliver strategic marketing recommendations to expand the CoRec's non-student membership base.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1670
Presentation Time: Session 4: 1:30-2:30pm

Finding and Competing for Arbitrage Cycles on Decentralized Exchanges

STEM

Authors(s):
Justin Lam† (Polytechnic)

Abstract:
A cyclic arbitrage on a decentralized exchange is a negative cycle in a graph whose vertices are tokens and whose edge weights are negative logarithms of exchange rates. Profiting from one requires finding it and winning it against other traders.

Part I studies finding it. An exact detector for cycles of length at most 5 combines the locality of new negative cycles, a restricted search from the changed edge, and a weighted hub decomposition that replaces search through a few high-degree tokens with maintained tables. It agrees with brute force on every checked query and takes about 90 times fewer steps than plain search on Uniswap V2 data. A lower bound computed from the graph alone chooses the best hub set, or one within 1% of its cost, in seven windows from 2021 to 2026. A cycle's maximum profit factors into an effective depth times a function of its weight, and a backtest on on-chain reserves reports 27 of 28 executed arbitrages before they occur.

Part II studies winning it. Arbitrage is ordered by sealed bids paid to block producers. In our model a searcher earns an opportunity's value times the probability that no competitor is present, and the median share paid is $\tanh(\Lambda/2)$, where Λ is the expected number of competitors. On all atomic WETH arbitrage in a 2021 and a 2026 window, the median arbitrage pays 68% and 64% of its value. With three adjustment factors (a distribution of Λ, fixed-share bids, and arbitrage won without an auction by builder-controlled searchers), the model predicts that winners keep 38% and 36% of the value, against the observed 38% and 35%. An arbitrage opens new opportunities only through its traded pools in reverse. On real reserves, backrunning earns 5 to 11 times as much as acting a block later, and bidding minimum in the replay earned about twice as much as the model's equilibrium bid. Profit is decided by acting within the block and choosing uncontested opportunities rather than solely by faster detection.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1671
Presentation Time: Session 4: 1:30-2:30pm

Fiber-Delay Design for Spherical Particle Scattering Measurements Using a Single Silicon Photomultiplier

STEM

Authors(s):
Woojun Lee† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
euiwon Bae (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1672
Presentation Time: Session 4: 1:30-2:30pm

The Future of Cell-Cultivated Meat: The Truth

STEM

Authors(s):
Surin Lee† (HHS)

Abstract:
As technology evolves in the 21st century, an up-and-coming technology has been introduced named "cell-cultivated meat." Cell-cultivated meat is an artificially synthesized creation that resembles the nutritional benefits of traditional meat while also being advertised as a less harmful, eco-friendly alternative. With the possibility of food becoming scarce after 2050, companies are striving to create cell-cultivated meat as a sustainable food source (Kirsch, 3). However, there are numerous challenges concerning this technology's environmental impacts, which must be considered before the industry flourishes. This exploratory research project aims to investigate the technological limitations of cell-cultivated meat. By doing so, it will also cover the environmental impact and the ethical dilemma of falsely advertising cell-cultured meat as a more environmentally friendly alternative to traditional meat. To examine this topic, I performed a preliminary literature review of the current development of the technology. For cell-cultivated meat to truly replace traditional meat in a meaningful way, the cell-scaffolding technology must be much more advanced than its current state. Furthermore, the production of cell-cultivated animal meat on this scale is significantly more harmful to the environment than the current production of traditional meat (Risner, 67). This research will contribute insights to future research and development on food technology and ethical debates comparing traditional meat and those that are synthesized in labs.

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1673
Presentation Time: Session 4: 1:30-2:30pm

A Benchmarking Suite for Evaluating Automated Software Verification Approaches

STEM

Authors(s):
Cheng-En Lee† (Science); Robert S Zhou† (Science); Hongcheng Li† (Engineering|Science); Andre Tsoi† (Science)

Abstract:
As AI-generated software becomes increasingly common, ensuring its correctness through automated verification is becoming more important. Large language models (LLMs) have shown promising capabilities in assisting with software verification, particularly in generating and repairing program specifications. Frontier models paired with coding agents showed strong performance in automatically generating proofs for individual functions, but their efficiency in verifying a system of functions remained a question. This setting introduces an additional challenge: reconciling the proof contracts of callee functions so that they are sufficiently strong to establish the callees' correctness while remaining compatible with the requirements of their callers. Our project aims to develop a benchmark suite in VeriFast to evaluate the efficiency of coding agents in verifying multi-function systems. We chose VeriFast because it is a C program verifier that supports separation logic for reasoning about program correctness and memory safety. We are adapting existing benchmark programs to VeriFast and exploring ways to evaluate coding agents in a standardized environment. Ultimately, this benchmark suite will help identify the challenges and bottlenecks that coding agents encounter when verifying multi-function systems, providing insights to guide the development of more effective LLM-based software verification techniques.

Mentor(s):
Wen Fan (Engineering); Jenna L Wise DiVincenzo (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1674
Presentation Time: Session 4: 1:30-2:30pm

Effects of Passive Back-Support Skeleton on Center of Pressure Throughout Repetitive Lifting

STEM

Authors(s):
Yuseok Lee† (Engineering)

Abstract:
Construction site application of passive back-support exoskeletons (PBSEs) is emerging, as it helps reduce lumbar compression demand during repetitive motions by storing and releasing elastic energy. However, PBSEs, as an additional device worn on top of the workers, add weight to the body and constrain trunk and hip motions, which require compensatory movements by wearers to maintain balance and the center of mass. For practical application of PSBEs, previous studies have examined their effects on postural control during repetitive lifting tasks; however, little is known about how these effects change as fatigue accumulates over intensive series of repetitive lifting by construction workers whose daily exposure to physical activity may result in a different fatigue progression pattern compared to the non-construction population. To fill the gap, this study examines the effect of usage of PSBEs on Center-of-Pressure (COP) characteristics during repetitive lifting. In a within-subject design, eight healthy construction workers were recruited and performed two sessions of four-minute intensive repetitive lifting of an 18lb concrete block with and without an exoskeleton. Plantar movement was recorded using 16 pressure incorporated insole sensors (Moticon OpenGo Inc), which anterior-posterior (AP) and medial-lateral (ML) COP displacement and mean velocity were calculated. A two-way repeated measures ANOVA was conducted with condition (with vs. without PBSEs) and phase (early vs. late) as factors. The authors expect that PBSE use will alter COP displacement and velocity, particularly in the AP direction because lifting primarily involves sagittal plane movement, and the displacements will be statistically significant in the late phase as fatigue accumulates. The findings will provide empirical evidence to guide the safe deployment of PBSE in construction tasks where fall injury is common.

Mentor(s):
Hyewon Seo (Engineering); Behzad Esmaeili (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1675
Presentation Time: Session 4: 1:30-2:30pm

How Do Individual Differences in Personal Space Preferences Affect Shared-Space Utilization in Virtual Crowd Simulations?

STEM

Authors(s):
Junyong Lee† (Science); Vishaal Iyer† (Science)

Abstract:
In real life, the capacity of public spaces is not solely determined by its physical square footage, but by human psychology and social proxemics. People maintain dynamic personal distances from strangers based on their social affinity and comfort levels. Many crowd simulations simplify spatial capacity by relying on static collision boundaries, assuming pedestrians will pack perfectly into available areas. For example, a simulation might show fifty people efficiently utilizing a shaded seating area, but in reality, some individuals may avoid or leave the space because they feel uncomfortable being too close to others, even when there is still physical space available. This behavior can also vary from person to person depending on their personal space preferences. To better understand these differences, we narrow our experiment to examining how individual personal space preferences affect the use of shared spaces in virtual environments.

We will compare how simulated pedestrians utilize the same shared space under three different conditions:

Baseline population: Pedestrians consider only physical collision avoidance without additional personal space preferences.

Uniform population: Every pedestrian has the same personal space radius.

Individualized population: Pedestrians have different personal space radii assigned to them.

We will generate comparative spatial heatmaps and measure how many pedestrians enter shared spaces, how long they remain there, and how often they choose to avoid or leave an area. Individual pedestrian data will be recorded and analyzed to compare occupancy patterns and movement behavior across the three conditions.

Through these comparisons, we aim to understand whether representing individual differences in personal space preferences produces different crowd behaviors than using a single preference for an entire population. The findings may help guide future improvements in virtual crowd simulations.

Mentor(s):
David Michael Barbarash (Education)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1676
Presentation Time: Session 4: 1:30-2:30pm

VGA Display Controller for a Fixed-Function GPU

STEM

Authors(s):
Sangjin Lee† (Engineering); Ahmad Saleem Timbo† (Engineering); Justin Meng An Chen† (Engineering)

Abstract:
The SoCET (System-on-Chip Extension Technologies) team at Purdue University is developing "Birdy," a fixed-function GPU designed to process geometric data and convert it into final frames composed of color pixels stored in memory. Rendered frames only become meaningful when displayed on a screen, and the process of delivering them to the display requires real-time performance; monitors must receive pixel data at precise intervals and cannot tolerate delays in data transmission. Simple VGA controllers often found in academic projects circumvent this issue by generating test patterns or reading from small on-chip memories that guarantee single-cycle response times. In contrast, Birdy's frame buffer resides in external DDR3 memory shared with the rendering pipeline; consequently, reading pixel data involves variable latency and competition for bandwidth with other memory requests. This project aims to develop a VGA display controller for Birdy that bridges this gap. The controller pre-fetches scanline data from DDR3 memory into a buffer and outputs the buffered data at a fixed pixel clock rate while simultaneously generating the horizontal and vertical synchronization signals required by the monitor. By decoupling the memory domain—characterized by irregular timing—from the display domain—which demands strict timing—the buffer ensures that visual glitches do not occur even if memory responses are delayed. However, this controller supports only a single, fixed display mode via a legacy VGA interface rather than modern digital interfaces like HDMI. Nevertheless, the display controller serves as a crucial stage for visualizing the GPU's output, marking the first point where the entire pipeline can be verified end-to-end.

Mentor(s):
Charles Spencer Bowles (Engineering); Zach Anthony Barna (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1677
Presentation Time: Session 4: 1:30-2:30pm

Validating Equipment Alarms with LLM Agents on a Plasma Etcher

STEM

Authors(s):
Sooji Lee† (Science)

Abstract:
Machine-learning anomaly detectors on semiconductor process equipment raise many false alarms, meaning alarms with no fault present. Many come from start-up transients and recipe step changes, and engineers still sort them from real faults by hand.

Large language models (LLMs) have been used to review detector alarms, but mostly on benchmarks or simulated faults, and LLM work in semiconductor manufacturing focuses on offline failure analysis rather than equipment alarms. It is unclear whether LLM agents can remove false alarms on real fab equipment without missing real faults, and what limits them.

We present a council of role-specialized LLM agents that reviews the alarms of an LSTM/conformal detector once per process run. The agents receive the physical context of the process, such as engineering units and settling time, and the Failure Manager agent judges only the samples after the signal settles. We test it on one week of logs from an inductively coupled plasma reactive-ion etching (ICP-RIE) tool at Purdue's Birck Nanotechnology Center, covering 67 process runs labeled from the tool's own fault logs, and ablate each component in turn.

The detector alone raised false alarms on 100% of normal test runs. The council lowered this to 5.6% while detecting 85.7% of faults, a median 21.5 s before the tool aborted, and raised run-level F1 from 0.438 to 0.857. Ablations showed that the gain came mainly from the samples and prompt given to the Failure Manager agent. The missed fault occurred after helium shutoff, outside the monitored region.

Grounding an LLM agent council in the physical context of the process lets it remove nearly all false alarms on real equipment while keeping early fault warnings, and what data each agent sees proved to be the key design choice. Next, we will extend the framework to faults spanning

multiple signals, where combining context across sensors and explaining each alarm should matter most.

Mentor(s):
Guang Lin (Engineering|Science); Jiyong Kwon (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1678
Presentation Time: Session 4: 1:30-2:30pm

Comparing AI-Assisted Workflows for Virtual Chemistry Laboratory Development in Unity and Unreal Engine

STEM

Authors(s):
Yukun Li† (Polytechnic); Taozhe Wang† (Polytechnic)

Abstract:
Virtual chemistry laboratories can provide interactive and repeatable learning experiences while reducing many of the cost, accessibility, and safety constraints of physical laboratories. However, developing these environments often requires substantial programming and game-engine expertise. Recent advances in AI-assisted development, together with the Model Context Protocol (MCP), may reduce these barriers by enabling AI agents to interact directly with development tools and support game-engine workflows.

This study compares AI-assisted development of an interactive virtual chemistry laboratory in Unity 6 and Unreal Engine 5. Two AI systems, ChatGPT Astra and Google Gemini, will be evaluated across both engines, resulting in four development configurations. Each configuration will implement the same chemistry experiment using a common set of functional, scientific, and interaction requirements. MCP-enabled tools will be used to support direct interaction between the AI agents and development environments.

The resulting applications and workflows will be evaluated based on functional completeness, chemical and procedural accuracy, development time, reliability, required human intervention, and user interactivity. The study aims to identify how AI-agent and game-engine selection influences both development efficiency and simulation quality, while highlighting the strengths and limitations of AI-assisted workflows for creating interactive science-learning environments.

Mentor(s):
Georgios Pappas (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1679
Presentation Time: Session 4: 1:30-2:30pm

Developing an Automated CI/CD Pipeline for a Custom Stack-Based ZPU Processor

STEM

Authors(s):
Bing-Rui Liao† (Engineering); Aakrit Gupta† (Engineering); William W Zhao† (Engineering|JMHC)

Abstract:
The Zylin Processing Unit (ZPU) is a stack-based, 32-bit processor architecture designed to reduce hardware resource usage. SoCET is developing a custom ZPU core for integration into its AFT system-on-chip (SoC). Existing open-source ZPU implementations rely on outdated code, lack modular SystemVerilog testbenches, and do not support SoCET's bus interfaces. These limitations motivate a modern design and verification workflow.

As multiple subteams develop the processor, integrating changes manually can be time-consuming and introduce functional errors. Our CI/CD subteam aims to build a reproducible pipeline that builds and tests contributions before they are merged. This will help developers detect regressions early and collaborate without configuring tools or running tests by hand.

Our current work focuses on the testing infrastructure. We are developing local test scripts and integrating a C++ processor simulator into the verification workflow. Docker will provide a consistent development environment, while GitHub Actions workflow files will eventually run the same checks automatically when runners become available. As the processor develops, we plan to expand these checks to include SystemVerilog simulation and regression tests. Our targets are a pull-request regression runtime below 10 minutes, passing required tests before merging, and a reproducible setup using one Docker configuration.

Limited computing resources and access to proprietary electronic design automation tools may prevent gate-level verification and post-synthesis timing simulation in the pipeline. Nevertheless, automated build and functional tests can reduce integration effort and identify errors earlier. Once validated on the ZPU, the workflow can be extended to other AFT components by adding their build scripts, test suites, and interface

checks. Ultimately, this shared CI/CD framework could verify changes across subteams before integration into the full AFT SoC.

Mentor(s):
Kameswari Mantha (Engineering); Cole Aaron Nelson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1680
Presentation Time: Session 4: 1:30-2:30pm

Mouse and Human Granzyme A Both Elicit a Proinflammatory Cytokine Response in Mouse Macrophages

STEM

Authors(s):
Samantha Sarah Lin† (Pharmacy|JMHC)

Abstract:
Granzyme A (GrA) is a serine protease stored in the granules of cytotoxic T cells and natural killer cells that can induce apoptosis upon release into target cells. In addition to its catalytic activity, recent studies show that extracellular GrA can play a role in inducing inflammation. Interestingly, GrA exists in both a monomeric and dimeric state, but the roles of these distinct states in cell killing or inflammation are unclear. Previous studies in our lab have shown that upon treating human macrophages with human dimeric GrA, a surge in the production of the proinflammatory cytokine tumor necrosis factor alpha (TNF-α) was observed. However, despite mouse and human GrA possessing structural similarities, they have been previously suggested to have unique substrates, making mechanistic studies in mice difficult to translate to human health and disease. To address this, the goal of my work was to determine if mouse and human dimeric GrA had conserved cross-species proinflammatory activity. Here, I hypothesize that mouse and human GrA can induce similar levels of proinflammatory cytokines upon stimulation in mouse cells. To investigate this, RAW 264.7 cells, a mouse macrophage-like cell line, were treated with increasing levels of mouse or human GrA dimer or lipopolysaccharide (LPS) as a positive control. After stimulation, we found that both mouse and human GrA significantly induced TNF-α production, but concentrations of TNF-α induced by human GrA stimulation were significantly less than mouse GrA. Overall, our findings suggest that human GrA is less effective than mouse GrA in inducing TNF-α in mouse cells but is still capable of eliciting a response. These data support the hypothesis that the proinflammatory nature of dimeric GrA is conserved between mouse and human and further investigation of overlap in functional conservation between mouse and human GrA will increase human health relevancy of our mouse models of GrA-mediated inflammatory diseases.

Mentor(s):
Matthew Olson (Science); Rheanna Elizabeth Walther (Science); Jenny Alejandra Rodriguez Osorio (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1681
Presentation Time: Session 4: 1:30-2:30pm

AI 4 Musicians: Evaluator Vision

Creative

Authors(s):
Alston Lin† (HHS|Science); Rose Lin† (Engineering); Anderson Yu† (Engineering); Anish Kumar Bandapelli† (Science); Yucheng Lin† (Polytechnic); Xinru Jiang† (Engineering|Liberal Arts)

Abstract:
The purpose of the AI in Music Evaluator project is to develop an app that improves musicians' overall playing posture with the use of artificial intelligence models. The system uses You Only Look Once (YOLO) with Oriented Bounding Boxes (OBB) on an expanding dataset of 600 images to detect violin bows and strings using machine learning models. It also employs Google MediaPipe for hand and body trajectory tracking. The project uses geometric calculations to identify bow placement and angle while also using deep neural networks to evaluate wrist and elbow posture. These methods are integrated into a React Native mobile application with Kotlin and Swift components to process camera frames and provide real-time posture feedback. Some of the bow and string models have shown a detection accuracy as high as 92.6% for 2,286 datapoints. Some of the trials for the posture models have shown accuracies as high as 100% for 175 datapoints. While these results are optimistic for the early development of the project, the system is projected to be able to identify common technique issues, such as incorrect bow position, bow angle, hand posture, and body posture, and provide clear corrective feedback to the user in real time. With continued development, the system is expected to become a practical tool for supporting independent music practice and helping students recognize and correct technical problems more efficiently. While real directors still remain important, this project may help prevent bad habits from forming by catching mistakes like poor bow angle or wrist tension in the absence of a director, such as during individual practice. The same detection approach used by this project can also be applied to other string instruments or to other physical skills where posture matters. The following are appended: (1) Demo videos that show how the system tracks posture and provides feedback; (2) Sample violin posture image; (3) Other project documentation.

Mentor(s):
Yung-Hsiang Lu (Engineering); Yeon Ji Yun (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1682
Presentation Time: Session 4: 1:30-2:30pm

ConCAVe: an Effective Connected and Automated Vehicle Capture The Flag Platform

STEM

Authors(s):
Xinyu Liu† (Engineering); Cyrus Munshan† (Polytechnic)

Abstract:
As connected and autonomous vehicles (CAVs) transition from research laboratories to real-world deployment, their expanding connectivity creates a growing need for security education in Vehicle-to-Everything (V2X) communication. Existing automotive security training primarily focuses on in-vehicle hardware, leaving broader networks, backend services, and connected applications underexplored. We present ConCAVe, an open-source, lightweight, containerized Capture-the-Flag (CTF) platform built on the CARLA simulator. ConCAVe organizes hands-on security challenges around five threat models relevant to emerging V2X-enabled CAV environments. V2X infrastructure, including over-the-air (OTA) update services and CAM messages, that players can interact with through hands-on challenges, is also included. These components are designed with reference to standards and regulations, including UN R156 and ISO 24089, to provide realistic exposure to the CAV system. By extending training beyond in-vehicle systems, the platform introduces participants to security risks across the connected vehicle ecosystem and provides a practical foundation for learning CAV security.

Mentor(s):
Aditya Vardhan Padala (Engineering); Aravind Machiry (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1683
Presentation Time: Session 4: 1:30-2:30pm

Activity-Aware Power Optimization of the Physical Design Flow for SoCET's AFTx08 System-on-Chip

STEM

Authors(s):
Andrew Yu-en Loh† (Engineering); Juneseok Kwon† (Engineering); Anirudh Vummadising† (Engineering); Christine Yixin Liu† (Engineering|JMHC)

Abstract:
Power optimization is a critical challenge in modern VLSI design because increasing design complexity leads to higher switching activity and dynamic power consumption. Traditional physical design flows may optimize circuits without considering the actual activity patterns of a target workload, missing opportunities for power reduction. This project investigates activity-aware physical design optimization for SoCET's AFTx08 chip using switching activity information generated from simulations. Our approach simulates representative testbenches to generate Switching Activity Interchange Formats (SAIFs) that are fed into a Placement and Routing (PnR) tool for the chip's optimization. Two complete physical design flows will be evaluated: a baseline flow without activity information and an activity- aware flow in which the signal toggle activity is provided to the PnR tool prior to placement and routing. After the design has been routed, both implementations will be evaluated by a power analysis tool under equivalent workload conditions. Success will be measured by the percentage of power reduction from the comparison of the standard and SAIF-guided flows while meeting timing requirements, functional correctness, and comparable area and performance. The limitations of this project come from only optimizing the dynamic power consumption and having to choose the testbenches that most closely represent the chip's overall activity. We focus on the dynamic power and not the static power and are limited to lowering the capacitance of the chip through switching activity optimization. Also, if the activity-aware optimization uses benchmarks that are not representative of the chip activity, it will not optimize the correct parts of the chip, so multiple combinations of testbenches will need to be tested to see which cover the chip activity to the fullest. The project establishes an automated and reusable SAIF generation flow that can be integrated into future SoCET designs.

Mentor(s):
Niels van Ritbergen (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1684
Presentation Time: Session 4: 1:30-2:30pm

Predicting Hotel Booking Cancellations to Support Revenue Management

Business Case Study

Authors(s):
Zachary Andrew Lovell† (DSB); Jiangjun Zhu† (DSB); Joseph Chen† (DSB); Kyle Arthur Kneller† (DSB)

Abstract:
When hotels can follow up on only a subset of reservations, how can they use booking data to identify cancellation risks and prioritize customer follow-up? Since booking cancellations create uncertainty in occupancy and revenue planning, the goal of this project is to estimate each reservation cancellation probability and compare risk-ranking strategies to help hotels allocate limited follow-up resources. This study uses the Kaggle Hotel Reservations dataset containing 36,275 reservation records, 32.76% of which were canceled. Using Python and scikit-learn, we check for invalid dates, duplicates, and unusual values. We create features like total nights booked and total guests, and verify if input information is available at prediction time. We compare logistic regression, decision trees, and random forests to a majority-class baseline. Preprocessing is fitted in each training fold using pipelines and five-fold cross-validation to prevent data leakage, keeping an independent test set for final evaluation. Preliminary exploration showed canceled reservations had a median lead time of 122 days, compared with 39 days for non-canceled ones. Cancellation rates also vary by the number of special requests and market segments. Further analysis uses Average Precision as the primary model-comparison metric and assesses probability calibration. Under a 20% follow-up capacity limit, we will compare three strategies: ranking by cancellation probability, ranking by cancellation probability multiplied by estimated booking value, and random selection. We will evaluate how many actual cancellations and how much associated booking value each strategy captures. This project aims to provide an interpretable and measurable approach to prioritizing follow-up. Estimated booking value serves only as a proxy for the value at risk. Since the dataset lacks intervention and room resale outcomes, identified risks cannot be directly interpreted as preventable cancellations or recoverable revenue.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1685
Presentation Time: Session 4: 1:30-2:30pm

Validating a CFD Workflow Using the Ahmed Body for Pikes Peak Hill Climb Aerodynamics

STEM

Authors(s):
Abraham Josue Luna† (Engineering)

Abstract:
The Pikes Peak International Hill Climb starts above 9,000 ft and finishes at over 14,000 ft, where air density is roughly a third lower than at sea level. Thinner air reduces the downforce and cooling a race car's aerodynamic package can provide, so designing for this event requires reliable simulation tools. Before analyzing a full vehicle, the VIP Aero Pikes Peak team is validating its computational fluid dynamics (CFD) process using the Ahmed body, a simplified car shape with well-documented experimental drag data. The Ahmed body was modeled in SolidWorks and prepared for simulation in STAR-CCM+. The team is developing meshing strategies and boundary conditions so that predicted drag and wake behavior can be compared against published wind-tunnel results. Matching these benchmarks will show that the team's simulation settings are trustworthy. Once validated, the same workflow will be applied to evaluate aerodynamic changes for a Pikes Peak vehicle, including how reduced air density at altitude affects drag and downforce.

Mentor(s):
Charles Holliday Jenckes (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1686
Presentation Time: Session 4: 1:30-2:30pm

Why Do Supercapacitors Store So Little Energy? A Literature Analysis of Energy Density Limitations and Improvements

STEM

Authors(s):
Jiles Mahony† (Engineering)

Abstract:
The purpose of this research is to determine the specific attributes of supercapacitors that limit their energy density with the ambition of discovering potential improvements to the design. Supercapacitors have a vastly lower energy storage ability per kg than batteries, but provide significant benefits that could reshape how the world stores energy. Research was conducted through a literature review of peer-reviewed studies that tested the effectiveness of alternate materials in supercapacitor design and scholarly articles that describe the contemporary design of supercapacitors. The basis for the analysis is that the electrostatic potential energy is proportional to the voltage squared times the capacitance. It was found that the more impactful component, voltage, is currently limited by higher-voltage safety risks; the input or output needs of the load or source; limits in the electrode and electrolyte composition; and the usability of the initial voltage. Capacitance is limited by the surface area of the electrodes; the electrolyte material; and the electrode pores. Improvements of these factors are viable through innovations in voltage step-up and step-down efficiency; implementation of higher surface area to mass electrodes such as activated carbon nanotubes for typical or curved graphene sheets for high-voltage applications; and alternative electrolyte materials. Compared to batteries, supercapacitors have increased stability and safety; specific power 200 times higher; reduced energy loss during use; and roughly 100 times or higher cycle lifespan. Hybrid electrochemical-electrostatic storage is another option, which provides an effective balance between power output, energy density, and cycle lifespan and mitigates the tradeoff between increasing capacitance and voltage. Implementing supercapacitors with increased energy density or hybrid storage mechanisms could have profound technological, social, and environmental impacts on energy storage in the future.

Mentor(s):
Jaeeun Kim (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1687
Presentation Time: Session 4: 1:30-2:30pm

Penicillin Allergy Stratification and De-Labeling Tool

STEM

Authors(s):
Jessica Anna Malecki† (Pharmacy)

Abstract:
Intro/Background

Penicillin allergies can be delabeled via allergy history interviews, skin testing, and oral drug challenges. Considering allergy histories can lead to the delabeling of approximately 20% of penicillin allergies, St. Bartholomew's Health (SBH) sought out a method to accomplish this.

Objective/Study Aims

The objective was to create a risk stratification for penicillin allergies and determine which penicillin allergies could be directly delabeled via ERH data at SBH.

Methods

A literature search was completed using key terms including "penicillin allergies," "penicillin intolerance," and "de-labeling." Various tools were consolidated into evaluation terms and stratified by risk. Stratification was transferred to a Microsoft Excel® data collection table, which was validated twice: using de-identified patient EHR data versus patient interview data and then using retrospective EHR data alone.

Results/Outcomes

Validation comparing EHR data to patient interview was completed for 11 cases. When reviewing EHR data, the results were not enough information (n=8), high risk (n=1), moderate risk (n=1), and unlikely to be immune mediate (n=1). For the same 11 cases, patient interview information led to the following: high risk (n=3), moderate risk (n=3) low risk (n=4), and unlikely to be immune mediated (n=1). The second validation was completed for 149 cases with retrospective EHR data alone. The results were high risk (n=8), moderate risk (n=15), low risk (n=0), unlikely to be immune mediate (n=19), and not enough information (n=107).

Conclusion/Discussion

EHR data alone was not sufficient to stratify all patients into penicillin allergy risk levels. Targeted patient interviews are necessary to provide the best information for delabeling.

Mentor(s):
Ellen M Schellhase (Pharmacy); Monica Miller (Pharmacy)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1688
Presentation Time: Session 4: 1:30-2:30pm

Prolonged Circulation vs Tumor Diffusion: The Biophysical Trade-off of PASylated Interleukin 27

STEM

Authors(s):
Reyna K Maroni† (Science)

Abstract:
Interleukin-27 (IL-27) is a cytokine reported to be immunotherapeutic against solid tumors by suppressing tumor growth. However, its therapeutic effectiveness is restricted by short circulation half-life, limiting tumor exposure. PASylation addresses this limitation by genetically fusing a Pro-Ala-Ser (PAS) sequence to proteins, increasing hydrodynamic size through flexible, hydrophilic, disordered side chains, prolonging circulation and bypassing kidney filtration. While increased size improves protein half-life, it also hinders diffusion into tumors, slowing delivery and reducing exposure. Therefore, we aim to build a two-compartment computational model to investigate the biophysical trade-off between prolonged circulation and tumor diffusion of native (mIL-27) and a novel protein we have developed, PASylated mouse IL-27 (PAS200-mIL-27). Excel and VCell were used to model the concentrations of native and PASylated IL-27 in circulation and across tumor depths over time by establishing parameters for diffusion coefficients, protein size, tumor tortuosity, plasma clearance, and tissue elimination. Preliminary results suggest that PAS200-mIL-27 may promote higher concentrations in circulation over time, in agreement with the literature on other cytokines. While PAS200-mIL-27 diffusion through tumors was estimated to be slower, total cytokine exposure over 24 hours at varied tumor depths was higher than its native. With the success of PASylation in literature and our preliminary results, we hypothesize that longer circulation time may be more crucial than diffusion efficiency in tumors. To verify, simulation models will be further refined with experimentally determined parameters to improve precision and reliability with the goal that these models can be applied to evaluations of different cytokines and tissues.

Mentor(s):
Marxa Figueiredo (Vet Med); Ying Cheng Chen (Vet Med)

Other Acknowledgment(s):
Amanda Pawlecki* (Vet Med); Aryaman Dewan* (Centers & Institutes); Omnia Mohammed Hamid Ibrahium* (Science); Raluca Ostafe* (Science)

Poster Presentation Abstract Number: 1689
Presentation Time: Session 4: 1:30-2:30pm

Flame Retardant Electrolyte Additives in Lithium-ion Batteries

STEM

Authors(s):
Anish Jaganath Maroor† (Engineering)

Abstract:
Standard carbonate electrolytes are highly flammable and can contribute to fire and thermal runaway in lithium-ion batteries, encouraging the use of flame-retardant additives. Flame-retardant electrolyte additives improve the thermal stability of lithium-ion batteries but reduce ionic conductivity and electrochemical performance. This study evaluates TTFP, an organic chemical compound known as tris(2,2,2-trifluoroethyl) phosphite, as an alternative additive, benchmarked against PFPN, ethoxy(pentafluoro)cyclotriphosphazene, at varying concentrations, using cell cycling, rate-capability testing, DSC, EIS, and SET tests on fabricated coin cells. Analysis of the results suggests that TTFP degraded cell performance comparably to PFPN while achieving similar thermal stability, indicating that the two additives are interchangeable rather than one being clearly preferable.

Mentor(s):
Likun Zhu (PWL); Mohammad Behzadnia (Engineering); Zarrin Tasnim Probha (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1690
Presentation Time: Session 4: 1:30-2:30pm

Determining Viability and Cellular Changes of Bacteria Treated by Chemical Disinfectants via Raman Spectroscopy

STEM

Authors(s):
Veda Maturi† (Pharmacy|JMHC); Avery Chan‡ (Engineering)

Abstract:
In pharmaceutical manufacturing, environmental monitoring ensures cleanrooms remain sterile to protect medication purity. Standard optical instruments detect airborne microbes by using lasers to excite biological molecules that naturally glow. However, sampled biomolecules remain intact whether a bacterium is alive or dead, making it difficult to determine whether a detected particle poses a contamination threat. To address this limitation, we utilized label-free Raman spectroscopy, a technique that measures molecular vibrations using laser light to produce a unique chemical fingerprint of a cell. Four bacterial species, Escherichia coli, Kocuria rhizophila, Staphylococcus epidermidis, and Bacillus spizizenii, were treated with chemical disinfectants to assess cellular changes. Raman spectra were collected and analyzed using computational models to identify distinct chemical signatures that separate surviving bacteria from neutralized cells across different treatments. Ultimately, this work provides a framework to improve rapid bioburden detection, helping sterile manufacturing facilities quickly distinguish viable microbial risks from harmless dead particles.

Mentor(s):
Arezoo Ardekani (Engineering); David Perez Herrera (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1691
Presentation Time: Session 4: 1:30-2:30pm

Exploring the Physical Plausibility of Time Travel

STEM

Authors(s):
Aidan McClelland† (Liberal Arts|Polytechnic)

Abstract:
Time travel is often thought of as something that only exists in science fiction, but modern physics suggests that some forms of time travel may be possible. This project will explore the question: To what extent does modern physics support the possibility of time travel? The research will examine both travel into the future and travel into the past, while separating ideas that have scientific evidence from those that are still theoretical.

One focus will be Einstein's theory of relativity and the idea of time dilation, where time can pass at different rates depending on how fast someone is moving or how strong the gravity is around them. This means that, in a limited sense, traveling into the future is already supported by physics. The project will also consider whether traveling faster than the speed of light could theoretically lead to time travel, and whether ideas from quantum mechanics or other areas of physics could change our understanding of these limits.

Traveling into the past presents much greater challenges. The project will examine ideas such as wormholes, which are theoretical connections between different points in spacetime, and closed timelike curves, which are possible paths through spacetime that could return an object to an earlier point in time. This raises difficult questions about causality and whether these ideas could actually exist in the real universe.

Overall, this project will compare established evidence, theoretical possibilities, and the physical limitations surrounding different forms of time travel to determine how strongly modern physics supports the idea.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1692
Presentation Time: Session 4: 1:30-2:30pm

Sex Differences in Tau and TDP-43 Pathology: Insights Into Alzheimer's Disease Vulnerability and Cognitive Resilience.

STEM

Authors(s):
Hannah Mendel† (HHS)

Abstract:
Introduction

Alzheimer's disease (AD) is characterized by amyloid-β plaques, neurofibrillary tau tangles, and frequently co-occurring TAR DNA-binding protein 43 (TDP-43) pathology. Although women have a greater lifetime risk of AD, sex-specific differences in neuropathological burden remain poorly understood. Interestingly, some individuals maintain normal cognition despite substantial AD pathology, referred to as asymptomatic AD (AsymAD). Whether differences in proteinopathy accumulation contribute to sex-specific vulnerability or cognitive resilience remains unclear. This study investigates sex-associated differences in amyloid, tau, and TDP-43 pathology across diagnostic groups.

Methods and Results

We analyzed postmortem neuropathological data from 100 donors (75 females and 25 males) enrolled in the Religious Orders Study and Rush Memory and Aging Project (ROSMAP), stratified by sex and diagnosis. Amyloid-β plaque burden, TDP-43 and neurofibrillary tangle density were assessed using histopathological measures summarized across eight brain regions. Pairwise Wilcoxon rank-sum tests were used to compare pathological burden between groups. Preliminary findings revealed greater TDP-43 accumulation in both male and female AD donors compared with AsymAD donors, despite comparable amyloid burden. Additionally, females exhibited greater neurofibrillary tangle accumulation than males, suggesting sex-associated differences in tau pathology.

Conclusion

Our findings highlight distinct patterns of neuropathological accumulation associated with sex and clinical diagnosis. Greater tau burden in females and reduced TDP-43 pathology in AsymAD suggest that differences in proteinopathy accumulation may contribute to AD vulnerability and cognitive resilience.

Mentor(s):
Purba Mandal (HHS); Priyanka Baloni (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1693
Presentation Time: Session 4: 1:30-2:30pm

Small-Gap Performance Estimation for Projection-Free Algorithm Design

STEM

Authors(s):
Lucca Su Mo† (Engineering|Science|JMHC)

Abstract:
Optimization plays a role in identifying the best possible solutions under a set of constraints. This is used heavily in engineering, machine learning, and decision-making applications. However, many optimization algorithms rely on computationally expensive operations. They become increasingly difficult to perform as the size of the problem grows. Projection-free algorithms are a solution to this issue. These algorithms replace expensive operations with simpler computations. This makes them attractive for large-scale problems and motivates research into understanding their performance and developing more efficient algorithms. This research focuses on analyzing and designing projection-free optimization algorithms to improve their theoretical performance. We use a mathematical framework called performance estimation problem (PEP) to study how these algorithms behave under the worst challenging conditions. Specifically, we develop an optimization model using semidefinite and second-order cone programming to investigate algorithm designs that outperform the standard Frank–Wolfe method. We then solve these models to study the resulting mathematical certificates, which provide a way to verify performance guarantees, and use their structure to develop analytical bounds. These bounds help establish how well an algorithm is guaranteed to perform. From the analytical bounds, our findings demonstrate that the designed projection-free algorithms can achieve better worst-case convergence guarantees than the standard Frank–Wolfe method.

Mentor(s):
Alex L Wang (DSB)

Other Acknowledgment(s):
Dongxuan He* (Engineering)

Poster Presentation Abstract Number: 1694
Presentation Time: Session 4: 1:30-2:30pm

Is Formal Language Overused?

Social Science

Authors(s):
Vanessa Huangzi Mui† (HHS); Zachary Paul Garcia† (HHS)

Abstract:
The purpose of this research project is to determine whether or not formal language is overused in society. Research will be gathered by completing a literature review of the situations in which formal language is used, the pros and cons of using formal language, and the use of formal language in different societies. Primary research will also be completed through a survey of Purdue students. The findings will be used to determine whether formal language is overused and, if so, where it should be used less.

Mentor(s):
Catherine Jean Shukle (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1695
Presentation Time: Session 4: 1:30-2:30pm

Design and Fabrication of Integrated RLC Circuits Using Metal-Insulator-Metal Capacitors

STEM

Authors(s):
Ananya Anand Nadkarni† (Engineering); Dipali Rebecca Abraham† (Engineering); Ayush Ashok Khondge† (Engineering); Princess Gloria Onyinyechi Okoli† (Engineering); Rachel Christine Quisil Ordiales† (Engineering); Lakshmi Vardhan Yepuri† (Engineering)

Abstract:
Building upon previous work involving the fabrication of metal-insulator-metal (MIM) capacitors and resistor-capacitor (RC) circuits, the VIP Statistical Process Control (SPC) team is investigating the design and fabrication of integrated resistor-inductor-capacitor (RLC) circuits. These circuits combine passive electronic components to produce frequency-dependent electrical behavior, with applications in filtering and resonant systems.

The proposed RLC devices consist of MIM capacitors featuring a 20 nm hafnium(IV) oxide (HfO_2) dielectric, planar square-spiral inductors, and integrated resistive elements. The team aims to achieve a resonant frequency below 50 MHz while maximizing the circuit quality factor (Q), which describes the relationship between stored and dissipated energy. The primary design objective is to achieve Q greater than 3, with an aspirational target of 5 or higher.

This semester, the team is developing three RLC circuit designs by varying component geometries and electrical parameters. Particular emphasis is placed on optimizing the inductors' trace width, spacing, number of turns, and overall dimensions to balance inductance and resistance. Series combinations of MIM capacitors are also being investigated to achieve the required capacitance. These designs must satisfy electrical performance targets while remaining compatible with cleanroom fabrication processes on a 100 mm silicon wafer. The team will also be collecting statistical process control (SPC) data for the atomic layer deposition (ALD) process for the HfO_2 dielectric layer.

The team aims to evaluate the circuits through their resistance, inductance, capacitance, resonant frequency, and quality factor. The main goal is to extend the team's established MIM fabrication capabilities to more complex integrated passive circuits while investigating the relationship between circuit design, manufacturing constraints, and electrical performance.

Mentor(s):
Zhihong Chen (Engineering); Joerg Appenzeller (Engineering); Doosan Back (Engineering)

Other Acknowledgment(s):
Ronald K Reger* (Centers & Institutes); Richard D Harlan* (Centers & Institutes); Joon Hyeong Park* (Centers & Institutes); Angshuman Deka* (Centers & Institutes); Ryan Prado Bailey* (Engineering)

Poster Presentation Abstract Number: 1696
Presentation Time: Session 4: 1:30-2:30pm

Development and Validation of an Integrated Fiber-Length Measurement System for Recycled Fiber-Reinforced Composite Materials

STEM

Authors(s):
Minh Hoang Giang Nguyen† (Engineering)

Abstract:
One of the most common recycling methods for carbon fiber-reinforced composites is mechanical recycling, where the composite scrap is shredded into small recyclates. In doing so, individual fiber lengths are significantly shortened, altering various properties of the materials, which makes it critical to have reliable measurement of fiber length and fiber length distribution if one wants to comprehend these properties. Nonetheless, accurate measurement is particularly challenging because the fiber populations typically contain short and long, straight and curved, intersecting, overlapping, and clustered fibers. A common method involves using microscopes to zoom in the fibers and a semi-automated image software to tabulate the fiber population. However, the microscope covers a limited area at a time, which, in many cases, is not sufficient to generalize the whole fiber population. This project aims to develop an automated pipeline that measures fiber length from scanned images. The approach involves a flatbed scanner capturing fibers over a large area at high resolution. An image-analysis program will process the image, segment individual fibers, flag debris and edge-truncated fibers, and resolve overlapping and crossing fibers, to then output a complete fiber length distribution report. Accuracy will be checked against reference images of known length and manual microscopic measurement. The strength and stiffness of recycled carbon-fiber composites depend directly on retained fiber length, so this measurement pipeline has the potential of qualifying recycled fiber for reuse in different industrial applications.

Mentor(s):
Garam Kim (Polytechnic); Eduardo Barocio Vaca (Engineering); Anand D Tiwari (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1697
Presentation Time: Session 4: 1:30-2:30pm

Introduction to 3D Printing with Ceramics

STEM

Authors(s):
Samuel James Osburn† (Engineering|JMHC); Angelina Zhixu Cheng† (Engineering); Itay Ben Porat† (Engineering)

Abstract:
As part of a Vertically Integrated Projects (VIP) team at Purdue, this project explores the basics of 3D printing with ceramics. We are learning how to use computer-aided design (CAD) software to create digital models and experimenting with ceramic printing processes. This hands-on work helps us understand the challenges of additive manufacturing, including how shapes are built layer by layer and how materials behave during printing. This project provides foundational experience in digital fabrication and material science for undergraduate students.

Mentor(s):
Jing Zhang (PWL)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1698
Presentation Time: Session 4: 1:30-2:30pm

Toward an Image-First, Agent-Assisted Framework for Characterizing Subcutaneous Injection Dynamics

STEM

Authors(s):
George Panagos† (Engineering); Samuel Paul Surdez† (DSB|Engineering); Monish Jonnadula† (Science|JMHC); Iris Elyse Beijar† (Engineering); Joseph Franklin McQueary† (Engineering)

Abstract:
Subcutaneous drug delivery by autoinjector depends on device settings, needle placement, and structure of tissue at the injection site. Device and needle studies have identified many relevant delivery variables, but it remains difficult to observe directly where injected fluid goes and whether it reaches the intended tissue. Imaging provides that direct view of the local delivery event. Early evidence suggests that individual tissue anatomy can redirect fluid and may affect depot distribution as much or more than small changes in device settings. This project takes an image-first, measurement-centered approach, quantifying injection dynamics in the subcutaneous layer from existing 2-D radiographs and 3-D geometry data. Candidate 2-D measures are layer boundaries; needle and depot position; projected depot area, width, and depth from the skin surface; and, where serial images exist, change across the sequence. Candidate 3-D measures are depot volume, maximum dimensions, and shape irregularity; placement depth within the target layer and proximity to fascia or muscle; and visible channeling or leakage. Each measure will be linked to recorded delivery conditions (needle length and gauge, mechanics, volume, viscosity, rate, and insertion depth and angle) and local tissue context. To make the analysis reproducible, we are packaging existing analysis code as an agentic AI skill with documented inputs, parameter checks, quality-control overlays, an evidence record, and a required researcher-review step. The workflow proceeds in four stages: inventory the existing data, define parameters and measurement rules, build the skill, and run a pilot analysis to test repeatability. The intended outcome is a documented, repeatable evidence base for how tissue structure and delivery conditions shape depot formation, to guide later autoinjector studies. Image measures alone are not treated as evidence of pain, safety, absorption, or clinical effectiveness without paired outcomes.

Mentor(s):
Brett A Meyers (Centers & Institutes)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1699
Presentation Time: Session 4: 1:30-2:30pm

Predicting Premier League Match Outcomes for Evidence Based Broadcast Previews

Business Case Study

Authors(s):
Joshua K Pang† (DSB|JMHC); Dillon Jake Wright† (DSB); Anthony Thomas Yoways† (DSB); Quoc Thai Dinh† (DSB)

Abstract:
How accurately can we use historical Premier League match statistics to predict home wins, away wins, and draws before kickoff to help broadcasters produce data-driven match previews without relying on betting odds? Broadcaster predictions usually rest on betting odds or individual judgment, and failing to show supporting evidence can hurt their credibility with the audience. We train models on 62 potential predictors from 20 seasons of English Premier League records from Football-Data.co.uk: 7,270 matches across 44 clubs. Home wins account for 45.12% of matches, away wins 30.37%, and draws 24.51%, so accuracy alone would reward always predicting a home win; we also use measures that weight each outcome equally. Outcome rates shift across seasons (home wins range from 41% to 51%), so learned patterns may drift. Because in-match statistics are unavailable before kickoff, we convert them into historical features such as previous-season team strength, recent average scores, and home and away records, to prevent data leakage. Models are compared with expanding-window cross-validation, training on earlier seasons and validating on the next, with the most recent matches kept as a locked test set. Logistic regression is our interpretable baseline; tree-based ensembles, CatBoost, and possibly neural networks can capture interactions it cannot, such as a home team in top form facing a low-scoring opponent. Our primary metric is multiclass log loss, because broadcasters need reliable probabilities for all three outcomes; accuracy and macro F1 are secondary. Early logistic regression reaches 53.8% cross-validated accuracy versus a 44.9% majority-class baseline. We aim to beat that baseline, not betting markets, and expect draws to remain hardest. The probabilities can help broadcasters decide what to emphasize in evidence-based previews and communicate uncertainty to viewers.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1700
Presentation Time: Session 4: 1:30-2:30pm

Hardware Implementation of a Streaming 2D FFT for SDR-Based Reconfigurable Range and Velocity FMCW Radar

STEM

Authors(s):
Alec Peng† (Engineering); Areesh Manohar Sobhani† (Engineering); Archit Maurya† (Engineering|JMHC); Sourish Manthati† (Engineering)

Abstract:
An increased demand for 2D signal processing in space-applications, among others, creates a desire for high performance computational methods that remain power-efficient. In previous work, NASA created an efficient hardware implementation of the 2D Fast Fourier Transform (FFT) for its Gas and Ice Spectrometer Radar (GAISR). This implementation uses a “corner-turn” algorithm to transpose samples on a single buffer via addressing, which halves memory compared to a traditional ping-pong buffer. However, it does not address the ability to dynamically reconfigure memory addressing and FFT sizes. This project expands that work in a new direction by creating a version of GAISR with the addition of variable addressing during runtime. This allows the user to change the max range and max velocity on the fly, while still only using a single buffer.

We use an AntSDR E200 software defined radio to implement our design and compare the resource and power consumption to our reimplementation of the GAISR instrument as a measurable outcome. A limitation is that the bandwidth is held constant as the frequency slope changes; thus, while the max range/velocity can change, the range/velocity resolution cannot. Further research could focus on adding dynamic resolution. Regardless, this design as it is could be applied whenever an FFT pipeline must support multiple instruments with different range and velocity requirements, similar to the GAISR instrument. Moreover, if a team is prototyping multiple radar systems, they do not have to swap between multiple physical boards; they can simply reconfigure this system on the fly to test the parameters they require.

Mentor(s):
Brady Philhower (Engineering); Jorge Luis Hernandez (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1701
Presentation Time: Session 4: 1:30-2:30pm

Self-aligning Optical & Line-of-sight Adaptive Radio IoT Station

STEM

Authors(s):
Brant Hao Peng† (Engineering); Leo Malachowski† (Engineering|JMHC); Jude Allen Siddiqui‡ (Engineering); John Everett Gewax‡ (Engineering); William Joseph Sweeney‡ (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Carla Zoltowski (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1702
Presentation Time: Session 4: 1:30-2:30pm

6D Force from Photoelastic Tactile Images: Calibration and Evaluation of the PhoTac Wedge

STEM

Authors(s):
Katherine Xiaoxing Pesetski† (Engineering|JMHC); Benjamin Alan Capelle* (Polytechnic)

Abstract:
Tactile sensing allows robots to interpret contact interactions that vision alone cannot capture. Photoelastic vision-based tactile sensors such as the PhoTac Wedge provide a marker-free approach, using stress-induced optical patterns in a photoelastic element to encode contact information. Turning these patterns into quantitative force estimates, however, requires calibration against a reference and testing across diverse contact geometries. In this work, we evaluate the PhoTac Wedge using 125 objects selected from the Thingi10K dataset and fabricated by resin 3D printing, providing a varied set of contact shapes. Each object was pressed against the sensor while camera frames and six-axis wrench measurements from an ATI force/torque sensor were recorded and time-aligned, with the ATI serving as the calibration reference. We trained a deep learning model, a pretrained ResNet50 with channel-attention modules and separate prediction heads for normal force, to estimate contact force from a single cropped photoelastic image. On all 41,288 frames of the 15 unseen test objects, the MAE averaged 0.242 N over the three force components and 0.0055 N·m over the torques. The normal force was estimated with an MAE of 0.414 N and R^2 = 0.963. These results show that photoelastic tactile images support accurate 6D estimation across varied object geometries.

Mentor(s):
Md Rakibul Islam Prince (Engineering); Yu She (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1703
Presentation Time: Session 4: 1:30-2:30pm

Social Media's Influence on Skincare Behaviors Among College Students

Social Science

Authors(s):
Tanisha Poddar† (HHS)

Abstract:
Social media platforms such as TikTok and Instagram have become major sources of skincare information for young adults, exposing them to product recommendations, skincare routines, trends, and advice from influencers, dermatologists and other users. However, the reliability of this information varies, making it important to understand how online content affects real-world skincare decisions. This research investigates how exposure to skincare content on social media influences skincare behaviors among college students, with the objective of determining whether social media affects the products students purchase, the routines they follow, and the sources of skincare advice they trust. I argue that social media has a significant influence on college students' skincare decisions, but that influence may vary depending on students' level of exposure to skincare content and their trust in different online sources. To investigate this relationship, I will distribute a Google Forms survey to college students asking about their social media usage, frequency of exposure to skincare content, skincare product purchases, changes to their routines, and trust in advice from influencers, dermatologists, brands, and other users. I will analyze the survey responses to identify patterns between students' exposure to skincare content and their reported behaviors and compare these findings with existing research on social media and skincare information. Since data collection is still upcoming, this research aims to provide greater insight into how online skincare information translates into real-world decisions and help college students become more critical consumers of the skincare advice they encounter online.

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1704
Presentation Time: Session 4: 1:30-2:30pm

The Effects of 50% Citric Acid on the Surface Roughness of Crosslinked Chitosan Film

STEM

Authors(s):
Sricharan Pusarla† (Engineering); Keaton T Hale† (Science); Sreshta Reddy Loka‡ (Engineering|JMHC); Nehemiah Namin Kim‡ (Pharmacy); Tuna Tamkan‡ (Engineering)

Abstract:
Authors(s): Keaton Hale ‡ (Science), Sreshta Reddy Loka † (Engineering), Sricharan Pusarla † (Engineering),

Nehemiah Kim ‡ (Pharmacy), Tuna Tamkan ‡ (Engineering)

Abstract:

Chitosan is a biodegradable polysaccharide derived from a material called chitin. Chitosan's unique properties include high biocompatibility (the ability for a drug carrier to perform the intended effects without causing harm to the host), low allergenicity, and biodegradability, enabling it to be used as a highly versatile drug carrier material.

In this study, we investigate how highly acidic environments affect the surface roughness of chitosan film by measuring the change in Root Mean Square Roughness (RMS roughness) between two chitosan films, one being exposed to a 50% citric acid bath, and the other being unaffected. To ensure that the Chitosan samples don't completely dissolve in the acid, when producing the films a genipin crosslinker will be added to strengthen the covalent bonds of the film, making it more chemically resistant. To measure the roughness of the samples, we will use an atomic force microscope (AFM), which scans the surface topography of materials using a fine tip and returns images of the surface at an extremely small scale.

In conclusion, conducting this study will provide important data on how acidic environments affect chitosan films. Since chitosan film is regularly used as a drug carrier, this is especially important, as it is regularly exposed to highly acidic stomach acids. By better understanding chitosan's material properties, we can better assess its effectiveness as a drug carrier. The results of this study may help future researchers better understand how chitosan-based drug delivery systems maintain

their structural integrity under acidic conditions. And additionally how acids affect the nanoscale morphology of crosslinked chitosan films.

Mentor(s):
Ryan B Wagner (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1705
Presentation Time: Session 4: 1:30-2:30pm

Wartime Sexual Violence in the Democratic Republic of the Congo

Social Science

Authors(s):
Krystani Quinn† (Liberal Arts); Melissa Scartezini† (Liberal Arts)

Abstract:
Sexual violence against women has remained a persistent feature of armed conflict in the Democratic Republic of the Congo (DRC), despite international efforts in peacebuilding through disarmament and security reform. The continued violence raises questions about the effectiveness of conventional peacebuilding strategies and their capacity to address the inequalities in gender structures while women bear the consequences of that failure. This project develops a case study examining why peacebuilding and disarmament policies have failed to eliminate wartime sexual violence and what that failure reveals about the exclusion of feminist analysis from conflict resolution. Drawing on feminist international relations theory, this research focuses on how gender inequality, militarized masculinity, and gendered power dynamics perpetuate sexual violence. It argues that peacebuilding efforts prioritize military stabilization and arms reduction without addressing these underlying gendered conditions. Disarmament, demobilization, and reintegration (DDR) programs, for example, have centered on male combatants while overlooking women's roles and needs. This exclusion reinforces the inequalities that enable abuse. The analysis also addresses a central debate over whether sexual violence is best understood as a weapon of war. The limitations of framing sexual violence solely as a military strategy are highlighted through analyzing feminist scholarship and research. Effective conflict resolution requires more than military and national stability. Integrating feminist perspectives into conflict transformation policies through gender-responsive DDR and attention to militarized masculinity is vital to addressing the structural inequalities that allow sexual violence to persist.

Mentor(s):
Chiara Cervini (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1706
Presentation Time: Session 4: 1:30-2:30pm

Large Language Models and their Ability to Generate Meaningful Measurements for Aphasia Recovery

STEM

Authors(s):
Monish Ramesh Jayakumar† (Science|JMHC)

Abstract:
Aphasia is a language disorder often caused by stroke. Traditional measures of identifying aphasia through analyzing discourse samples take time and manpower, conducted by clinicians and researchers. AI has been increasingly used for aphasia recovery, adapting models trained on typical speech to better characterize atypical speech patterns. The goal of this study is to determine whether these models and methods can identify aphasic speech, and generate clinically meaningful measures.

First, surprisal was used to identify aphasia. Surprisal is the negative log-probability of a token given previous context, measuring how unexpected said token is. Higher scores reflect lower predictability and more atypical language production. We predicted that PWA (persons with aphasia) produce less predictable language, captured by increased surprisal. Using five different LLMs, surprisal scores were extracted from laboratory data and existing AphasiaBank datasets, and used to train various machine learning (ML) models to identify PWA. Results showed that PWA have higher surprisal scores than control, along with a wider distribution of scores, a variability consistent with aphasic language.

Second, LLMs were used to parse PWA discourse on various grammatical measures:ratio of nouns to verbs, open to closed words, type-token ratio (TTR: the number of distinct words divided by the total words), and propositional idea density (PID: how many propositional are present in a given sentence). Predicted scores showed a statistical significance in labelling tasks against CLAN (Computerized Language ANalysis, the software used to analyze AphasiaBank transcripts) data, while struggling to conceptualize abstract concepts such as PID.

Overall, these findings suggest that it is feasible to use LLMs to generate clinically meaningful aphasia measures, with simpler tasks giving better results. ML models and LLMs can provide additional tools and resources for aphasia rehabilitation.

Mentor(s):
Yan Cong (Liberal Arts); Ji Yeon Lee (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1707
Presentation Time: Session 4: 1:30-2:30pm

Optimizing NFL Stadium Operations and Resource Allocation Through Attendance Forecasting

Business Case Study

Authors(s):
Anika Rao† (DSB|JMHC); Lorraine Eileen Reams† (DSB|JMHC); John Vincent Patrick† (DSB)

Abstract:
How can NFL teams and stadium managers use pre-game attendance forecasts to reduce the costs of over- or underestimating game-day demand? Poor forecasts can cause understaffing, parking shortages, excess labor, and wasted concession inventory. This project predicts weekly NFL attendance using only information available before each game to support operational decisions. The analysis uses the Kaggle NFL Stadium Attendance Dataset by Sujay Kapadnis, originally sourced from Pro Football Reference. It includes 5,102 unique games from 2000–2019, with each game as one observation. The three source files contain 42 raw variables. The target is weekly attendance; key predictors include teams, season, week, game day/time, and pre-game or lagged performance measures such as wins, losses, and strength of schedule. EDA shows average attendance of about 67,557 fans and meaningful variation across seasons and weeks. Missing attendance values and duplicate team-level records require cleaning. These patterns suggest temporal effects and team/game interactions, supporting models that capture linear and nonlinear relationships. Preparation will merge datasets, remove duplicates and missing targets, handle missing predictors, encode categorical variables, and use a leakage-safe pipeline. Multiple linear regression will be the baseline because it provides an interpretable benchmark. Decision trees and random forests will test nonlinear effects and interactions, while Ridge and Lasso can manage correlated and encoded predictors. Models will be compared with time-aware cross-validation that preserves chronological order, with a later holdout set for final testing. Mean Absolute Error (MAE) will be the primary metric because it reports error directly in fans, making results useful for staffing, inventory, security, parking, and transportation planning. The final model should identify useful pre-game predictors and improve resource allocation while reducing costs from inaccurate forecasts.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1708
Presentation Time: Session 4: 1:30-2:30pm

Effects of Nano-Electrospray Ionization Emitter Tip Size and Shape on Native Protein Mass Spectra

STEM

Authors(s):
Margot Eleni Rechin† (Science)

Abstract:
Native mass spectrometry (MS) enables the analysis of intact proteins and protein–ligand complexes in their folded state. Nano-electrospray ionization (nanoESI) is commonly used for native MS because it generates protein ions from aqueous solutions at ultra-low flow rates of nanoliters per minute. NanoESI uses emitters with diameters ranging from a few micrometers to submicron, to produce smaller initial droplets, which can improve ionization efficiency and reduce salt adduction. It has also been found that the emitter geometry can influence spray performance and the quality of the resulting mass spectra. This project investigates how the tip size and shape of pulled fused silica nanoESI emitters affect native protein mass spectra. We fabricated nanoESI emitters using fused-silica capillaries with different dimensions and optimized Sutter P-2000 laser puller programs to produce emitters with varied tip sizes and shapes. The resulting tips were examined using brightfield microscopy to characterize their dimensions and shapes. NanoESI-MS experiments were performed using carbonic anhydrase as a model protein on a Bruker timsTOF Pro mass spectrometer. We compare the resulting mass spectra to evaluate how emitter geometry affects protein signals, charge-state distributions, and salt adduction. This work aims to identify emitter characteristics that support reliable native MS measurements and reproducible emitter fabrication.

Mentor(s):
Xindi Tang (Science); Julia Laskin (Science)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1709
Presentation Time: Session 4: 1:30-2:30pm

Age Related Differences in Balance and Gait

STEM

Authors(s):
Harlie Elizabeth Robbins† (HHS); Olivia D Markowitz† (Engineering|JMHC); Noah D Thurber† (HHS); Alyssa Mae Remenius† (Science)

Abstract:
Subtle differences in motor function may be difficult to detect in healthy adults during routine walking and standing. Increasing task demands may reveal differences that are less apparent under simple conditions. This project examines whether young and middle-aged adults differ in their responses to progressively challenging balance and locomotor tasks. Participants complete standing balance trials on firm and foam surfaces with eyes open and closed, as well as Figure-8 walking under self-selected, target-speed, and accuracy-constrained conditions. Standing balance is quantified using center-of-pressure measures, including 95% sway-ellipse area. Wearable inertial sensors are used to derive basic gait and movement outcomes during the Figure-8 tasks, while task performance is characterized using measures such as speed-regulation error and foot-placement errors. Analyses will compare young and middle-aged adults across task conditions and determine whether group differences become more pronounced as sensory, speed, or accuracy demands increase. Continuous age will also be examined as a secondary measure to complement the group comparison. Data collection is ongoing, with a larger young-adult sample currently available than the middle-aged sample. The study will provide an initial test of whether progressively challenging motor tasks reveal age-related differences in otherwise healthy adults and will help identify the balance and gait measures most useful for future studies of early changes in mobility.

Mentor(s):
Jeffrey M Haddad (HHS); Satyajit S Ambike (HHS)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1710
Presentation Time: Session 4: 1:30-2:30pm

Case Study: Majé Sushi

Business Case Study

Authors(s):
Gage Hunter Rodriguez† (DSB); Bryan Tran† (DSB); Edward Ter-Hovhannisyan† (DSB); Jake Landon Diaz† (DSB); Carter Andrew Palmer† (DSB)

Abstract:
This research evaluates the potential marketing strategies for Majé Sushi, a local sushi restaurant directly outside of Purdue's campus. We will examine the lack of awareness of the location because it hinders the potential for more customers. We aim to determine the existing barriers that prevent Majé Sushi from attracting more customers. We plan to use observational data to analyze the proportion of Purdue students who have visited Majé Sushi to all Purdue students who are regular consumers of sushi, using a survey.

We will determine specific marketing variables to devise a new marketing strategy. Currently, we are in the process of developing our survey, which we will use to reach our target market and collect our data. The results of the research will help us develop evidence-based recommendations to provide a strong marketing strategy to increase brand awareness, improve competitive positioning, and to encourage more Purdue students to go to Majé Sushi.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1711
Presentation Time: Session 4: 1:30-2:30pm

VIP Ed Tech Dev Teaching Assistant Web App

STEM

Authors(s):
Devon Ross† (Polytechnic); Ty Joseph Sanders† (Polytechnic); Fayzan Omar Refaqat† (Polytechnic); Vishwadeep Singh† (DSB); Leonard Wencl† (DSB); Duztyjed Macapinlac† (Science); Mariela Manzanares Rios† (DSB|JMHC); Austin Hsu† (Science)

Abstract:
Students in Purdue courses often need help from TAs during labs, office hours, and help sessions, but it can be difficult to keep track of a lot of requests at once. Students may not know when they will get help or how many TAs are available, while TAs and instructors need a better way to organize requests and manage sessions.

The goal of this project is to improve a web app that students can use to submit questions and request help from TAs. The app is being developed with Django along with other web development tools such as HTMX, AlpineJS, and Tailwind CSS. Some of the features we are currently working on include letting course coordinators create recurring sessions and showing information about the teaching team, such as how many TAs are available and their schedules. We are also looking at ways to make the queue easier to manage for both students and TAs by adding an estimated wait time feature.

We plan to collect feedback from students after a TA helps with a question. This information can be used with data to understand how effective TAs are at helping with different types of questions and topics. This information can help the teaching team improve over time by identifying strengths and weaknesses and reading student feedback. We are aiming to create a tool that can make it easier for students to get help, and make it easier for teaching teams to manage questions. We also want the app to be flexible enough that it could be used by different Purdue courses in the future.

Mentor(s):
John H Cole (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1712
Presentation Time: Session 4: 1:30-2:30pm

AI Teaching Assistant for ECE Courses

STEM

Authors(s):
Sasha - Sam† (Engineering); Shivanya Chandra† (Science); Arwa Mostafa† (Engineering); Vishwesswaran Gopal‡ (Engineering); Pragun Sethi‡ (Science); Eann M Gatuna‡ (DSB); Ethar Mostafa‡ (Engineering); Sathvik Kalakonda‡ (Engineering); Prajith Kattamuri‡ (Sc

Abstract:
Laboratory assignments require students to connect theoretical concepts with practical procedures, equipment, and troubleshooting. Students may need guidance when teaching assistants are unavailable, and while general AI tools might be capable of solving their problems, they do so without helping them understand the underlying concepts. Our team aims to address these concerns- the co-TA team is developing an AI teaching assistant platform that supports learning through personalized guidance. The platform aims to identify each student's conceptual mistakes and misunderstandings, adapt its guidance to their needs, and address those gaps before helping them work toward an answer. Its goal is to help students understand concepts, procedures, equipment, and errors without completing assignments for them. Three sub-teams contribute to this effort: the Human Interface team manages student interaction and responses. The Intelligence team develops context and guidance for relevant assistance. The Inference team manages model deployment and computing resources. Our planned outcome is a working prototype evaluated for guidance quality, personalization, and responsiveness under simulated demand. Because this is an initial prototype, the platform relies on estimated characteristics of student requests. Actual usage may differ once a section begins using it. Future work will use classroom feedback and observed request patterns to refine the system and assess its value as a learning aid.

Mentor(s):
Vijay Gupta (Engineering); Milind Kulkarni (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1713
Presentation Time: Session 4: 1:30-2:30pm

Using Drones and Artificial Intelligence to Predict and Prevent Pothole Formation

STEM

Authors(s):
James Sarkissian† (Science)

Abstract:
This research explores the use of drones and artificial intelligence (AI) to detect early pavement deterioration and predict future pothole formation. Pothole formation poses significant risks to roadway safety and infrastructure, highlighting the need for earlier identification of pavement deterioration. Traditional pavement inspections often involve manual assessments or specialized equipment, which require significant city resources. This project aims to develop an efficient and automated approach to evaluating road conditions. The initial phase focuses on developing a convolutional neural network trained on road imagery to identify potholes, cracks, and other signs of pavement deterioration. The model will then be integrated with live drone footage, enabling real time identification and analysis of damaged pavement. This approach establishes a foundation for future pothole prediction with drones and AI. By November, the research aims to present a functional pothole detection model and assess its ability to accurately identify pavement damage in real world imagery. Future development will incorporate geospatial data, traffic patterns, weather conditions, and maintenance records to identify factors associated with pothole formation. During the second semester, the project will focus on integrating these factors along with LiDAR measurements to develop a predictive model that identifies road segments at risk of future pothole formation. This research will explore extrinsic calibration techniques to determine the spatial relationship between the camera and LiDAR sensor, enabling 3D measurements corresponding to 2D images. This research could help towns prioritize preventative maintenance, reducing repair costs and improving safety proactively.

Mentor(s):
Seemein Shayesteh (Polytechnic)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1714
Presentation Time: Session 4: 1:30-2:30pm

Effects of Nose Cone Tip Angle on Perceived Loudness of Sonic Boom at Ground

STEM

Authors(s):
Aditya Sarwaikar† (Engineering); Michael David Green† (Engineering); Kaden Michael Phillips† (Engineering); Georgios Giannakis‡ (Engineering); Cooper James Buchman‡ (Engineering); Scott Swenson‡ (Engineering)

Abstract:
The primary barrier preventing commercial supersonic travel from becoming commonplace is the sonic boom that is when aircraft exceed the speed of sound. This sonic boom is a shockwave formed by the convergence of smaller shockwaves generated primarily by the nose cone, wings, and tail. Last semester, our team's focus was on utilizing aerospike devices in order to mitigate the sonic boom pressure. However, we found that although the aerospikes were effective in reducing sound, the drag caused by the aerospike was too much to ignore. As such, our focus this semester has been on investigating the relationship between the angle of attack of a conical nose cone, (which has the least drag), and the far-field pressure. Using computational fluid dynamics (CFD), we tested a full sweep of angles ranging from 3 to 45 degrees in order to see which angle optimizes the sound. Based on our results, we plan to manufacture a scale model of our best design and test it in a wind tunnel to validate our CFD. By mitigating the shockwave generated by the nose cone and keeping the drag at an acceptable level, supersonic commercial flight could potentially become viable again.

Mentor(s):
Curtis Earl Marshall (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1715
Presentation Time: Session 4: 1:30-2:30pm

Independent Voters and Political Moderation: Do Independent Voters Actually Hold Moderate Beliefs?

Social Science

Authors(s):
Matthew Robert Scheer† (Liberal Arts)

Abstract:
In 2025, the United States saw 45% of U.S. adults self-identify as independent voters, its highest share since 1988. Among political scientists, there is a belief that this is in large part due to moderate voters having left the Republican and Democratic parties over the past few years, as partisan gridlock and extremism have continued to rise within the government. Yet, there has been a lack of concrete definition or research towards what independent voters actually view as moderate policy compared to what they might view as extreme policy. The goal of my research is to close this gap. Through conducting exit polling for the 2026 midterms, I'll both define what independent voters actually classify as moderate policy and determine what specific policy positions from both major parties these independent voters actually support. I believe that with my research, political experts from both sides of the aisle can gain a better understanding towards why independent voters have seen such a major increase within recent years, what policy positions these independent voters actually hold, and how much of this increase is actually based on viewed political extremism compared to other issues.

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1716
Presentation Time: Session 4: 1:30-2:30pm

PAR-Guided Solar Tracking for Optimized Crop Growth in Agrivoltaic Systems

STEM

Authors(s):
Kierston Jezzarell Schneider† (Engineering); Ryan J Boswell† (Engineering|JMHC); Kyle Tavernier† (Engineering)

Abstract:
Agrivoltaic systems combine solar energy generation and crop production on the same

land; however, photovoltaic panels reduce the photosynthetically active radiation (PAR)

available to crops. A meta analysis of shading studies found that crop yield generally

decreases nonlinearly with reduced solar radiation, while leafy vegetables tend to

tolerate moderate shading better than many other crops (Laub et al., 2022). Previous

research has shown that lettuce grown under photovoltaic panels can maintain yield

under 50–70% shading by increasing leaf area (Marrou et al., 2013). However, light

distribution beneath and surrounding photovoltaic panels is both spatially and

temporally variable, and relatively few studies quantify PAR at the crop canopy level.

This project proposes a single axis tracking agrivoltaic system that directly measures

canopy level PAR beneath and around the shaded region of a photovoltaic panel. Real

time PAR measurements will be used to adjust panel orientation to maximize solar

energy generation while maintaining crop light exposure within a defined shade tolerant

range. A multi-channel light sensor will be used to collect light data below the solar

panel, through which PAR (400-700nm) will be isolated and the solar panels will be

adjusted as needed. Additionally, diverging lens attachments of varying sizes and

geometries will be investigated as a cost-effective method of redirecting light from the

panel edges into areas experiencing the greatest reduction in irradiance due to the

panel footprint (Humphrey et al., 2026). The proposed system aims to improve the

balance between photovoltaic energy production and crop growth by optimizing both

solar collection and the PAR available to crops. If successful, it has potential to maximize

joint outputs to increase the viability of deploying this technology more widely.

Mentor(s):
Peter Bermel (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1717
Presentation Time: Session 4: 1:30-2:30pm

East End Grill and Ripple Company 2027 Marketing Plan

Business Case Study

Authors(s):
Henry Thomas Schwartz† (DSB); Sophia Elizabeth Rinehold† (DSB); Sydney Elise Wheeland† (DSB); Naisha Jain† (DSB); Abigail Allisa Stengel† (DSB); Stephanie Adwoa Dankwaa Asare† (DSB)

Abstract:
East End Grill and Ripple Company, local Lafayette, IN restaurants, are building their marketing plans for 2027. This project will review their current marketing activities, identify gaps, and develop recommendations. We plan to examine existing partnerships, community events, gift-card donations, and social media efforts, using information provided by the business and a review of competitors. By applying marketing concepts from our coursework, we will evaluate current activities and new ideas based on audience fit, brand positioning, cost, and ease of implementation. The planned deliverable is a set of prioritized recommendations and an annual marketing calendar, presented to the business with suggested measures of success. This project is expected to help the restaurants make informed marketing decisions and communicate more consistently with their customers and the broader community.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1718
Presentation Time: Session 4: 1:30-2:30pm

A structural and biophysical investigation of filament formation of C. tropicalis GCH1

STEM

Authors(s):
Lore Sebata† (Agriculture|Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Emmanuel Ayo Oluwarotimi (Agriculture)

Other Acknowledgment(s):
Andrew D Mesecar* (Centers & Institutes)

Poster Presentation Abstract Number: 1719
Presentation Time: Session 4: 1:30-2:30pm

Should athletes be required to complete objective physical-performance testing before returning to sports after an injury?

Social Science

Authors(s):
Austin Seto† (HHS)

Abstract:
The purpose of this research project is to determine whether or not college athletes should be required to complete objective physical-performance testing before returning to sports after an injury. An athlete may feel recovered and no longer be in pain, but their movement and body could still have lasting weaknesses and movement limitations that could heighten their chances of reinjury. Research will be gathered by completing a literature review of returning to sport guidelines, effectiveness of physical-performance testing, and the risks of returning to sports prior to being fully recovered. The research will also examine whether or not physical-performance tests are accurate in determining if an athlete is fit to return to their sport. Primary research will be completed through a survey of college athletes and interviews with physical therapists, athletic trainers, and kinesiology students. These sources will provide both professional perspectives and personal experiences on how returning to sport decisions are made and whether physical-performance testing should be required. The findings will be used to determine whether objective physical-performance testing should be required as a part of the return to sport process and how it can be utilized to help athletes return to competition safely.

Mentor(s):
Catherine Jean Shukle (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1720
Presentation Time: Session 4: 1:30-2:30pm

Datacenter Network Accelerator integration with Ethernet and BRAM on HAPS subsystem

STEM

Authors(s):
Kshitij Miraj Shah† (Engineering); Evan Runzhao Liu† (Engineering); Jaeyun Kim† (Engineering)

Abstract:
Modern data-center networks are congested, and a key bottleneck is data movement. To address this, the team has developed the design for a Remote Direct Memory Access [RDMA] network interface card [NIC] and tested it in simulation. The next step is to implement and verify it on the HAPS 100 4F FPGA platform by Synopsys. Additionally, we are building a transaction-based C++ networking test environment that sends transactions to the NIC, checks its responses and resulting data against expected RDMA behavior, and verifies how its Ethernet interface works with other blocks. This will be used to to test the base functionality, but won't be used for the full transactor implementation. Our ultimate deliverable is a working FPGA demonstration with a testing environment and documented setup steps for implementing the design on the FPGA and using our testing framework. This term, we are validating a 1 gigabit per second [Gb/s] link as a proof of concept; higher-speed data center NICs, however, operate at 10–100 Gb/s. Moving forward, the infrastructure will support future tests with real workloads and serve as an example for others wanting to use the HAPS platform. Next, we plan to document how to validate additional components, such as block random-access memory, and explore splitting the design across multiple FPGAs.

Here is the updated abstract. The only thing we lost points on was the title and flow

Mentor(s):
Brady Philhower (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1721
Presentation Time: Session 4: 1:30-2:30pm

Custom Small Language Model and Image Identifier for Cardinal Cx01 GPGPU

STEM

Authors(s):
Tushar Singh† (Engineering|JMHC); Sean Lee† (Engineering)

Abstract:
The Cardinal Cx01 is a student-designed general-purpose graphics processing unit (GPGPU) with a custom instruction set architecture (ISA), so standard software frameworks cannot run on it and all workloads must be custom-written. Nest, Cardinal's software library, provides workloads that demonstrate the hardware's capabilities. However, prior Nest work produced only Cardinal-specific graphics demonstrations, which have no equivalent on other architectures, so Cardinal cannot be benchmarked against a CPU or AI accelerator. To address this gap, we propose implementing standard machine learning kernels (GEMM, attention, softmax, convolution, etc.) and combining them to train and run two models, an image classifier and a small language model, entirely on Cardinal. Because these models are defined independently of any hardware, the same workloads can be implemented on any architecture, and they also expose bottlenecks that guide kernel and system-level improvements. Performance will be measured as end-to-end execution time for training and inference, computed from instruction count, cycles per instruction, and clock frequency, so architectures with different ISAs and clock speeds can be compared fairly. Model correctness will be verified by matching a PyTorch reference within a numerical tolerance, since differences in floating-point precision and operation ordering can cause small deviations. A key limitation is that the current Cardinal simulators are not cycle-accurate, so early timing results will be estimates; a cycle-accurate simulator is being developed in parallel. Future work will run the same models on SoCET's other custom architectures, the AFT CPU and the Atalla AI accelerator, for comparison.

Mentor(s):
Zach Anthony Barna (Engineering); Charles Spencer Bowles (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1722
Presentation Time: Session 4: 1:30-2:30pm

Treatise on Invertebrate Paleontology: A Digital Hub for Fossil Records

STEM

Authors(s):
Asvin Sivathanu† (Science); Cameron Alexander Bass† (Polytechnic); Rhea Virk† (Engineering)

Abstract:
The Treatise on Invertebrate Paleontology is an extensive collection of references created on fossil and living invertebrates. Spanning more than fifty volumes and written by over 300 paleontologists, it details nearly 100,000 genera across every known phylum, class, order, and family. Each entry describes taxonomy, morphology, and both stratigraphic and paleogeographic ranges, making the Treatise an essential resource for paleontological research. In partnership with the Paleontological Institute at the University of Kansas, our team is bringing this monumental work into a digital format that can be searched, explored, and connected in new ways. The online Treatise provides open access to fossil data through a series of interactive, cloud-based databases. Each major invertebrate group, such as Brachiopods, Echinoderms, Porifera (sponges), and Graptolites, has its own website (for example, brachiopod.treatise.geolex.org). Users can look up genera, examine when they first and last appeared in geologic time, and explore where they were discovered around the world. Entries include classification, age range, and distribution data, with images being added for thousands of genera. The site also includes tools to create diversity plots that visualize how groups evolved through time, which can be exported for use in TimeScale Creator and other research software. Moving forward, our team is incorporating vertebrate fossil records alongside the existing invertebrate data. By moving the Treatise online, we are preserving a vital scientific legacy while making it easier for researchers, educators, and fossil enthusiasts to explore Earth's ancient biodiversity.

Mentor(s):
James G Ogg (Science); Aaron C Ault (Engineering)

Other Acknowledgment(s):
Ekaterina Tszyao* (Science)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1723
Presentation Time: Session 4: 1:30-2:30pm

Phantom Dependencies: Evaluating Software Supply Chain Risks from Large Language Model Package Hallucinations

STEM

Authors(s):
Sreekar Sreeram† (Polytechnic)

Abstract:
Large language model (LLM) coding assistants have rapidly become standard tools in modern software development. However, these models introduce critical security vulnerabilities by frequently hallucinating non-existent third-party software packages. Threat actors exploit this behavior through "slopsquatting," preemptively registering these fake package names on public repositories like the Python Package Index (PyPI) with malicious code attached. When developers or autonomous agents install these suggested libraries, malware executes automatically during installation. This study addresses the question: To what extent do hallucinated dependencies create an exploitable supply chain attack surface, and where do automated detection tools fail to protect developers? Using an empirical testing framework, I analyze LLM-generated code across standardized programming tasks, parsing suggested imports and verifying them against live PyPI registry metadata. I measure the frequency of these hallucinations and evaluate key detection failure modes, specifically false positives and the challenge of distinguishing legitimate new libraries from newly registered attacks. By identifying these critical blind spots and proposing automated client-side guardrails, this research helps developers and enterprise pipelines prevent silent supply chain compromise before arbitrary code is executed.

Mentor(s):
Karrie Kaiser Lee (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1724
Presentation Time: Session 4: 1:30-2:30pm

China and the Future of Unmanned Aerial Systems in Warfare

Social Science

Authors(s):
Ashlyn Grace Stallings† (Liberal Arts); Gabriella Barnjak† (Liberal Arts)

Abstract:
This case study examines how the People's Republic of China has changed their military tactics in response to the increasing use of unmanned aerial systems or drones in recent conflicts, particularly the use of it in the Russia-Ukraine War. The use of drones in this conflict has shown how it can have an effect on military or battlefield tactics. This topic connects to the ideas of unconventional, grey zone, and hybrid warfare. Unmanned weapons systems and drones have revolutionized military innovation and weapons and defense. These weapons are conventional currently because they are newer technology, but that may change depending on how the weapons continue to develop and its use. These weapons can also be considered grey zone or hybrid depending on their use. Since it can be used without engaging in direct conflict, such as surveillance, that can make it more on the grey zone side of the scale. But, since it can also be used in direct conflict and in military tactics, it could make it more hybrid warfare. By examining the PRC's development of Unmanned Aerial Systems Swarms, manned-unmanned teaming, and counter-drone capabilities, we can see how this has affected their future military planning and its future on the battlefield.

Mentor(s):
Chiara Cervini (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1725
Presentation Time: Session 4: 1:30-2:30pm

Development of a Gas-Fed Thermionic Cathode for Hall-effect Thrusters

STEM

Authors(s):
Christopher Robert Stemporzewski† (Engineering|JMHC); Aayush Ranjan Kumar† (Engineering); Samir Mehra† (Engineering); Derek Joseph Larson‡ (Engineering); Aran Thevar‡ (Engineering|JMHC); Bailey Marie Jones‡ (Engineering|Liberal Arts); Robert Maxwell Neitz

Abstract:
Hall-effect thrusters (HETs) are electric propulsion devices that accelerate a beam of positive ions to propel a spacecraft. They require a “neutralizer” to produce the electrons needed to ionize propellant and neutralize their beam. Traditionally, HETs use a “hollow cathode” neutralizer, which requires expensive and easily contaminated emitting materials to operate, complicating their use with small HETs intended for research purposes where the cathode needs to be frequently exposed to atmospheric pressure. This project investigates the use of a shielded hot-wire filament with the addition of a small flow of argon gas to allow for plasma generation and HET neutralization. The experimental setup consisted of a tungsten filament enclosed in a stainless-steel body, a propellant inlet, and an orifice plate. Different filament diameters and materials were tested, including pure and thoriated tungsten. Different orifice plates were used to vary the pressure within the setup. Operating conditions, including filament current, argon mass flow rate, and discharge voltage were varied to determine their effects on emission current. Emission current was measured with a biased collector plate in front of the cathode setup. The cathode was also tested in tandem with a custom-built HET to determine if it can produce the necessary emission current to allow for HET ignition and beam neutralization.

Mentor(s):
Alexey Shashurin (Engineering); Nicholas Vytautas Babusis (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1726
Presentation Time: Session 4: 1:30-2:30pm

Grey-Zone Conflict and the Security Dilemma: Russia's 2022 Cyberattack on Viasat's KA-SAT Network

Social Science

Authors(s):
Hazel Christine Stephens† (HHS|Liberal Arts)

Abstract:
This research examines Russia's cyberattack on February 24, 2022, against Viasat's KA-SAT satellite communications network. Using Marsh's framework of grey-zone conflict and a realist perspective, I investigate how Russia's use of non-kinetic cyber operations and methods operating below the threshold of conventional warfare demonstrate the characteristics of grey-zone conflict. The central research question asks: To what extent did Russia's 2022 cyberattack against Viasat's KA-SAT network demonstrate a type of grey-zone conflict and does this type of conflict trigger a security dilemma? This poster explores how the attack reflected strategic efforts to advance Russian security interests while potentially intensifying insecurity among Ukraine and Western states. Ultimately, this case study seeks to evaluate the relationship between grey-zone conflict, cyber operations, and the escalation of the security dilemma.

Mentor(s):
Chiara Cervini (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1727
Presentation Time: Session 4: 1:30-2:30pm

The Effects of Chronic Childhood Trauma on HPA-Axis Dysregulation, Inflammation, and Type 2 Diabetes Risk in Adolescents

Social Science

Authors(s):
Hunter Nicole Stiles† (Science)

Abstract:
Chronic childhood trauma has been associated with long-term changes in the body's stress response and an increased risk of developing metabolic disorders later in life. Repeated exposure to adverse childhood experiences (ACEs), including abuse, neglect, and household instability, can disrupt the hypothalamic-pituitary-adrenal (HPA) axis, which regulates the body's response to stress through the release of hormones such as cortisol. Prolonged changes in cortisol regulation may also contribute to chronic inflammation and impaired insulin signaling, potentially increasing the risk of insulin resistance and type 2 diabetes during adolescence. This research examines how childhood trauma affects HPA-axis functioning and inflammatory pathways, with a particular focus on the biological mechanisms connecting early-life stress to metabolic dysfunction. A review of peer-reviewed scientific literature will be conducted to evaluate relationships between adverse childhood experiences, cortisol regulation, inflammatory responses, and insulin resistance in pediatric and adolescent populations. Existing research suggests that childhood adversity is associated with alterations in stress physiology and increased cardiometabolic risk, although the biological pathways involved are complex and not fully understood. By examining these relationships, this research aims to better explain how psychological trauma during childhood may contribute to the development of physical disease during adolescence. Understanding these mechanisms could help identify adolescents at greater risk for metabolic complications and emphasize the importance of recognizing childhood trauma as a potential factor in the prevention and early detection of type 2 diabetes.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1728
Presentation Time: Session 4: 1:30-2:30pm

Comparative Evaluation of CogniPilot and Betaflight for Autonomous Drone Racing

STEM

Authors(s):
Anirudh Sura† (Engineering); Alvin Zhang† (Engineering); Lohen Chen† (Engineering); Mariam Habib† (Engineering); Pierson Alexander S Darling† (Engineering); Zhi Lin Shao Lu† (Engineering)

Abstract:
Autonomous drone racing requires flight control systems capable of maintaining stability and accurately tracking trajectories during high-speed maneuvers. This research investigates the performance of two open-source flight control systems, CogniPilot and Betaflight, to evaluate their onboard attitude estimation and control capabilities under identical operating conditions. A software-in-the-loop (SIL) simulation framework integrates Modelica-based quadrotor dynamics, Rumoca-generated simulation components, and a shared position controller to provide a consistent testing environment. Both flight controllers receive identical trajectory commands and feed-forward inputs, allowing differences in performance to be attributed primarily to their onboard attitude estimation, attitude control, and angular rate control algorithms. The experimental methodology involves autonomous hover, position-step, square, and figure-eight flight tests, followed by progressively increasing trajectory speeds to evaluate tracking accuracy and control limitations. Performance will be assessed using position tracking error, attitude response, motor saturation, and maximum achievable flight speed under predefined tracking constraints. Repeated simulations under varying sensor noise conditions will evaluate the reliability and robustness of each controller. Following simulation validation, the framework will be extended to physical quadrotors using motion-capture-based position feedback to compare real-world flight performance. This research aims to establish a reproducible benchmarking methodology for autonomous flight controllers while identifying opportunities to improve CogniPilot's control performance and competitiveness in autonomous drone racing.

Mentor(s):
James Michael Goppert (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1729
Presentation Time: Session 4: 1:30-2:30pm

IoT 3D Printing Research

STEM

Authors(s):
Zachary John Thain† (Engineering); Reece Anthony Kupinski† (DSB); Jayde Gweon† (Engineering); Mitchell Wiley Scott† (DSB)

Abstract:
[Abstract Redacted]

Mentor(s):
Chun-Kang Huang (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1730
Presentation Time: Session 4: 1:30-2:30pm

Histological Image Analysis Methods

STEM

Authors(s):
Thrayi Thimmancherla† (Engineering); Sriya Siddula† (Engineering); Sohum Kashyap† (Science); Cuong Bui† (Science)

Abstract:
Histological assessment relies largely on manual, semi-quantitative scoring, even though quantitative image analysis methods are regularly published. These methods seldom reach laboratories that could use them because the paper describes the pipeline in prose, and the released code is a set of files with no record of how they connect. Applying a method to new tissue images requires interpreting the methodology, identifying the relevant code, resolving dependencies, and linking the computational steps, which demands programming expertise many histology groups lack.

We propose a multi-agent workflow that builds a working histological image analysis pipeline from a paper and its public code. An orchestrator will identify the computational steps, determine their dependencies, inputs, and outputs, and coordinate sub-agents that integrate these steps into a workflow verified against the published methodology.

As a case study, we used Codex to audit the MATLAB archive released with a published histological analysis method. The audit mapped the archive onto four pipeline stages: preprocessing, histogram and feature extraction, k-means clustering, and tissue layer identification. It also showed why the archive cannot yet run automatically: scripts stop for interactive input, files and numerical values are inconsistent, and preprocessing differs. The stages and the conditions the orchestrator must resolve before running each one form a candidate workflow.

Next, we will develop an orchestrator that creates and integrates sub-agents, tests their execution, and evaluates whether the resulting workflow performs the published analysis. This approach aims to turn published methods into working tools that laboratories can apply to their own images.

Mentor(s):
Brett A Meyers (Centers & Institutes)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1731
Presentation Time: Session 4: 1:30-2:30pm

Predicting Late Hotel Cancellations: Identifying Reservations Too Late to Resell

Business Case Study

Authors(s):
Phuong Linh Tran† (DSB); Nhu Nguyen† (DSB); Derin Thomas Whitaker† (DSB); Jayden Tsai† (DSB); Harshini Madhusudhanan* (DSB)

Abstract:
Can a hotel identify, at the time of booking, which reservations will be cancelled too late to resell the room? A room cancelled months ahead can usually be resold, but a late cancellation or no-show often leaves it empty. We predict which reservations will end this way so managers can decide which bookings to reconfirm, require a deposit for, or offset through overbooking.

We use the public Hotel Booking Demand dataset of reservations at a city and a resort hotel in Portugal. Our sample covers 78,703 reservations arriving July 2015 through December 2016, with 32 variables; 2017 arrivals are held out. The target is a no-show or a cancellation within seven days of arrival. Limitations include no booking ID (29% of rows are exact duplicates) and some fields recorded at check-in.

Late cancellations are rare (6.0%) and reverse a familiar pattern: bookings made 91+ days ahead cancel most often (52%) but rarely cancel late (3%). Non-refundable deposits mark 43% of early cancellations but only 6% of late ones. Lead time, deposit type, and booking agent emerge as the main predictors.

We remove outcome fields and fields recorded after booking, such as country and parking requests, leaving 22 booking-time predictors. We keep duplicates, which behave like group bookings, and split 60/20/20 by duplicate group so copies never cross sets. L2-regularized logistic regression is our baseline. A decision tree and a random forest can capture interactions, such as lead time with deposit type, that a linear model misses. We compare all models through 5-fold cross-validation on PR-AUC, which suits a rare target and rewards ranking true late cancellations first, since a hotel can follow up on only a short list.

The baseline already reaches a test PR-AUC of 0.16, more than twice the 0.07 expected by chance. Our contribution is a leakage-tested ranking that lets hotels focus reconfirmation and deposit policies on the riskiest reservations rather than every guest.

Mentor(s):
Davi Cordeiro Moreira (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1732
Presentation Time: Session 4: 1:30-2:30pm

Curriculum building and sports writing

Social Science

Authors(s):
Kenyon Owen Utterback† (Education)

Abstract:
In this exploratory research project, I examine/investigate what makes an interesting curriculum and what is effective and how to incorporate it into sports writing whether it be fiction or non fiction. I will survey Purdue students on what they liked most during their writing classes and how their teachers made what they did in class enjoyable. This research highlights the importance of a knowledgeable and caring teacher.

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1733
Presentation Time: Session 4: 1:30-2:30pm

A Harmonically Peaked Transformer Tank for Third-Harmonic Enhancement in a Wideband Injection-Locked Frequency Tripler

STEM

Authors(s):
Shashank Varamballi† (Engineering); Oliver Que† (Engineering)

Abstract:
This project presents a wideband injection-locked frequency tripler for mm-wave local signal generation. This work presents a high frequency ILFT architecture utilizing a transformer to passively maximize third-harmonic output without increasing power consumption. By transitioning from a standard tightly coupled load to a loosely coupled transformer with tuning capacitors, the tank's impedance exhibits a sharp peak precisely at the 72 GHz target frequency. ~24 GHz center frequency RLC bandpass filters act as notch filters, presenting an almost zero impedance path to ground for the fundamental injection frequency to maintain voltage headroom across the oscillator core. Theoretical insights on the effectiveness of the proposed technique are provided. A 65-nm prototype achieves 57–74 GHz operation without the need of tuning or calibration.

Mentor(s):
Seyedehmarzieh Rouhani (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1734
Presentation Time: Session 4: 1:30-2:30pm

Designing a Custom 32-Bit Stack-Based Microprocessor Core for the SoCET ZPU SoC

STEM

Authors(s):
Melody Wang† (Engineering); Leo Lesmes† (Engineering); Giorgos Constantine Adam† (Engineering); Karan Soni† (Engineering); Shriya Guduri† (Engineering)

Abstract:
Many embedded applications do not need the area and memory overhead of a RISC-V core. The Zylin Processing Unit (ZPU) is a stack-based microprocessor that is designed to be one of the smallest 32-bit CPUs with a GCC toolchain, trading speed for a reduced footprint and lower memory demands.

Our sub-team is designing the processor core of a ZPU-derived system on a chip (SoC) for an upcoming tapeout. Since previous ZPU implementations aimed to minimize FPGA resource usage, we are building the core from scratch to optimize it for a fabricated chip instead. Our work focuses on defining a ZPU-compatible microarchitecture, implementing the required instruction set in synthesizable RTL, and determining which additional instructions should be implemented in hardware to balance performance and area.

Because the core is non-pipelined and most of the stack remains in memory, it will run slower than more complex processors. However, the top two stack elements will be kept in registers, trading a modest increase in area for fewer memory accesses. Conversely, some instructions will be emulated in software to save area, making them slower than hardware implementations.

The core will be verified through simulation and instruction-level testing, with success measured by passing all instruction and benchmark tests. The finished core will be able to run C programs and form the foundation of a complete ZPU-based SoC. Future work will explore adding custom instructions in the ZPU's unused opcode space and extending GCC to use them, speeding up common operations in target workloads.

Mentor(s):
Kameswari Mantha (Engineering); Cole Aaron Nelson (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1735
Presentation Time: Session 4: 1:30-2:30pm

Manufacturing of Heat Shielding Tile Analogs for Stress Testing

STEM

Authors(s):
Benjamin Jay Weile† (Engineering|JMHC); Tanish Ghai‡ (Engineering)

Abstract:
As space travel grows as an industry, heat shielding has become a more pressing matter to protect vessels and crew from extreme temperatures. This is just one example of how tile patterns can be used in practical applications. However, it is important to consider the forces that these tile lattices experience and how factors such as variable bond strength, tile distortion/shape, and missing tiles affect their stress responses. The purpose of this study is to manufacture a viable physical analog of hexagonal tiles to undergo tensile testing to visibly analyze the changes in response that result from the variation of the previously mentioned variables. Laser cutting processes in conjunction with precise gluing procedure are utilized to create samples that minimize additional variables while maintaining low cost, high repeatability, and high accuracy. The tensile responses of physical samples are compared to that of finite element analysis using identical tile profiles within a MATLAB simulation. The overall goal of the project is to ensure the reliability of the FEA results when compared to their real world counterpart.

Mentor(s):
Thomas H Siegmund (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1736
Presentation Time: Session 4: 1:30-2:30pm

Find your Flavor

Business Case Study

Authors(s):
Johanna Shuang Wen† (DSB); Le An Phuong Phung† (DSB); Ella Rose Fennerty† (DSB); Emily Grace Bolen† (DSB|HHS); Cindy Ying Niu† (DSB)

Abstract:
Customers of Silver Dipper, a local ice cream shop in West Lafayette, are experiencing choice-paralysis with the establishment's new ice cream sampling alternative, "Mini Scoops". As a result of this problem, the customers of Silver Dipper are left confused, leading to issues with customer satisfaction. This study will investigate the marketing opportunities that can be taken to address the effectiveness of "Mini Scoops" and remedy choice-paralysis through audience analysis, surveys, and simulation of operations.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1737

Presentation Time: Session 4: 1:30-2:30pm

Evaluation of Impacts of unsustainable e-waste disposal practices

STEM

Authors(s):
Samuel Adison Widjanarko† (Engineering); Mallory M Kuntz† (Engineering|JMHC)

Abstract:
Lackluster regulatory infrastructure for both e-waste disposal and recycling has prompted the USA to direct ~11 million pounds of e-waste to landfills. 25 States, including D.C regulate e-waste recycling and 23 states including D.C prohibit landfill e-waste disposal. The leaching of hazardous elements contaminate groundwater systems, posing major health risks to humans and deteriorating the ecosystem. This study strives to quantify the concentration of leached elements using a simulated leaching procedure. In said procedure, Scientific Calculators, Computer Mice, and Earbuds were submerged in water at room temperature in 10- and 20-week increments, while USBs were leached for 31 weeks. USBs were submerged under three different conditions: Intact, Disassembled, and Powdered to identify how varying levels of exposure impact leaching. After leaching, electronics were removed, and the remaining leachate was evaporated to form dissolved solids and minerals. Said material was dissolved in concentrated acid and microwave digested to produce a particle-free, clear, homogenous liquid solution to be analyzed with ICP-OES for its composition. Nickel, Lead, Zinc, Erbium, and Lanthanum were found in computer mouse leachate. Lead, Nickel, and Zinc were found in leachate from both intact and disassembled USBs. However, concentrations were much higher in disassembled USBs, indicating the significance of altering leaching kinetics to mitigate contamination. Quantifying element leaching in landfills and understanding its behavioral kinetics are crucial in illustrating the impacts of unsustainable e-waste disposal. Existing literature highlights the negative impacts of releasing hazardous elements into the ecosystem. This paper intends to advocate for significant regulatory reform across the USA to improve e-waste disposal and recycling practices by providing evidence for the leaching of hazardous elements into groundwater in typical landfill disposal practices.

Mentor(s):
Nadezhda N Zyaykina (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1738
Presentation Time: Session 4: 1:30-2:30pm

Smelly Signals: How Frog-Biting Mosquitoes Use Multimodal Cues to Detect Anuran Hosts

STEM

Authors(s):
Nellie Nicole Wojdalski† (Science)

Abstract:
[Abstract Redacted]

Mentor(s):
Ximena Bernal (Science); Richa Singh (PWL)

Other Acknowledgment(s):
Anna Judy Lozen* (Science|JMHC)

Poster Presentation Abstract Number: 1739
Presentation Time: Session 4: 1:30-2:30pm

The Capabilities and Limitations of AI in Infrastructure Projects

STEM

Authors(s):
Jan Wojtaszek† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1740
Presentation Time: Session 4: 1:30-2:30pm

Bootstrapping Existing Codebases for Model-Based Agentic Engineering

STEM

Authors(s):
Ricky Wong† (Science); Salil Belgal† (Science); Alexander Lu† (Science); Velan Arunmozhi† (Science); Andrew John Billings† (Engineering); Aditya Gandhi† (Science)

Abstract:
Large codebases can exceed an agent's context window, making it difficult to understand relationships across files, identify relevant components, and anticipate the effects of code changes. To address these challenges, we investigate a bootstrapping approach for Model-Based Agentic Engineering (MAGE) that converts existing codebases into structured models of their architecture, components, and dependencies. We decompose the problem into repository analysis, model generation, validation, and context retrieval. Our approach represents codebase structure using modelling languages such as SysML and UML, preserving relationships among files, classes, functions, and modules. We develop tooling to connect these representations to source code and prototyping workflows that allow agents to retrieve relevant context when navigating repositories and making changes. Our research first aims to determine the codebase size and complexity at which MAGE becomes beneficial. We also investigate whether these models can be generated efficiently and whether the resulting environment improves agent performance on software engineering tasks. Then, we aim to generalize the bootstrapping process across different repository structures and sizes and programming languages, and automate model updates as codebases evolve.

Mentor(s):
James C Davis (Engineering)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1741
Presentation Time: Session 4: 1:30-2:30pm

Creating a Five-Star Experience: Pawradise Pet Hotel Marketing Analysis

Business Case Study

Authors(s):
Alejandro Xotlanihua† (DSB); Saurav Nandanan† (DSB); Hayden Krueger† (DSB); Tej Vikas Patel† (DSB); Soham Ankur Shah† (DSB); Akash P Mahalingam† (DSB)

Abstract:
Pawradise Hotel, a recently opened dog boarding business in the Lafayette area, faces two primary marketing challenges: building brand awareness and communicating the value of its premium overnight dog care compared to cheaper alternatives, such as traditional dog sitters. This project aims to develop a marketing plan that demonstrates Pawradise as a premium boarding experience for middle to upper income dog owners who view their pets as family and prioritize exceptional care. To find the target segments we will survey dog owners in Lafayette and research competitor markets. With the data, we can incorporate digital marketing strategies and integrate it into the customer base. The final deliverables will include an actionable implementation plan, strategic recommendations, and a supporting financial model. Ultimately, the project seeks to provide Pawradise Hotel recommendations to strengthen brand awareness, communicate its competitive advantages, and support sustainable business growth.

Mentor(s):
Stephen R Leitch (DSB)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1742
Presentation Time: Session 4: 1:30-2:30pm

Physical Design Implementation For SoCET's AFTx08+ SoC

STEM

Authors(s):
Simon Hongyi Xu† (Engineering); Koushik Narayan Chaliki† (Engineering); Morgan G Edwards† (Engineering); Joseph Wang† (Engineering)

Abstract:
Semiconductor chips are the backbone of our everyday world. These tiny silicon dies power our cutting-edge technology with connections to almost every industry. In this project, we are designing an integrated chip for an upcoming tapeout with TSMC.

First, we will work on tackling macro placement, such as SRAM for on-chip memory, and the core placement. We will experiment with different locations and use timing scripts to see which placement gives us the best performance without causing power or routing issues. Next, we will design the power network, which consists of pairs of power and ground pads, the power ring, power mesh, and standard cell rails. Our goal is to navigate manufacturing restrictions and efficiently lay out the power network to minimize electromigration and IR drops. Finally, the placement of IO pins and pads will connect our internal signals to relevant outside peripherals. This process involves careful placement to account for signal integrity and efficient routing.

All these steps come with decisions about tradeoffs. For example, increasing the performance of the chip might lead to higher power usage, increasing the floorplan of the chip will increase the cost of manufacturing, and decreasing the supply voltage will lead to worse performance. So, we must take all these parameters into consideration when executing physical design.

Ultimately, the physical design of semiconductor chips is multifaceted and crucial for optimizing performance. In this project, we apply industry-standard methods to design and validate our self-made chip, preparing for its fabrication in May 2027.

Mentor(s):
Niels van Ritbergen (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Poster Presentation Abstract Number: 1743
Presentation Time: Session 4: 1:30-2:30pm

Exploring Student Belonging and Campus Experience at Purdue University Indianapolis: A Qualitative Study

Humanities

Authors(s):
Ty Richard Yaguchi† (Engineering); Daniel Patrick Bueno† (Engineering)

Abstract:
Purdue University Indianapolis is a newly developing urban campus where students are forming new academic routines, industry connections, and contributing to the development of institutional identity. This qualitative study examines students' perspective of their experiences at the new campus, with particular attention to identity, faculty relationships, communication, and campus resources. Five student interviews were transcribed and analyzed. Initial codes were created from repeated keywords and ideas within the responses and then organized into a coding framework; used in cross-comparison and to identify recurring themes and underlying successes, opportunities, and challenges students face at the new campus. Simple word-frequency was also utilized to support the interpretations of repeated ideas within the interview responses.

The analysis revealed that students described positive experiences involving faculty accessibility, academic support, and personal interaction with instructors. However, reoccurring concerns included inconsistent teaching-assistant support, limited awareness of campus resources/events, and uncertainty towards Purdue University regarding the Indianapolis identity. Overall, the findings suggest that students more strongly connect through academic and interpersonal relationships than a developed campus community. Drawing on these findings, we recommend continued growth at the campus by strengthening the infrastructural development of Purdue Indianapolis, resource visibility, and opportunities for connection may enhance students' sense of belonging as the campus continues to grow.

Mentor(s):
Tracey Birdwell (PWL); Kal Holder (Science); Daniel A Guberman (PWL)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1744
Presentation Time: Session 4: 1:30-2:30pm

Lab-Grown Meat

STEM

Authors(s):
Abigail R Zurek† (Education|HHS)

Abstract:
What if I told you there's a way that we as a society could have food security global, reduce the effect we have on climate change, increase the public's health and animals through one solution? That solution would be making the switch from using traditional living stock as a mass source for food and instead using cultivated meat. This new emerging technology within the agriculture industry transitions the change from the slaughtering of living animals into the "meat developed from animal cell culture rather than through raising and slaughtering living animals" (BioInnovation Group, 2026). In this exploratory research project, my goal is to further evaluate the benefits and limitations on the topic of lab-grown meat. To investigate this issue, I conducted a preliminary literature review on multiple different sources including peer-viewed journals, academic articles, and popular new sources. This research will contribute insights to the ongoing development and research on the reasoning behind lab-grown meat, benefits of switching, limitations and perceptions on the topic, and what the future of lab-grown meat holds.

Mentor(s):
Carla B Rosell (Liberal Arts)

Other Acknowledgment(s):

Poster Presentation Abstract Number: 1745
Presentation Time: Session 4: 1:30-2:30pm

VIP ARES: Autonomous Quadcopter Abstract

STEM

Authors(s):
Luke M Zuzovsky† (Engineering); Brian Borui Xu† (Engineering); Jitong Tang† (Science); Carolina Sun† (Engineering)

Abstract:
Autonomous drone flight is a complex subject to implement, due to factors such as localization, path planning/obstacle avoidance, and hardware integration. This project aims to develop autonomous aerial waypoint navigation capabilities on a PX4-based quadcopter through staged testing. First, the simulation will create the testing grounds for the drone algorithms and avoid unnecessary damage while allowing for faster development. Then, the simulation will be used to control the hardware to confirm the behavior prior to flight. Initial testing has verified the capabilities of the motors and sensors on the physical quadcopter using QGroundControl. NVIDIA's Issac Sim was used to create a digital simulation of the drone, including programmed behaviors for waypoint navigation, takeoff and landing, and obstacle avoidance. Sensor localization will be analyzed to assess potential tracking errors and overall drone performance. Estimated positions will also be compared with simulator ground truth to evaluate localization accuracy. After successful simulations, integration of hardware-in-the-loop (HITL) will focus on connecting the physical flight controller to Isaac Sim through a variety of communication protocols. The simulator will provide sensor data to the flight board and use feedback comparing the localization algorithm to update the simulated vehicle dynamics. Similar missions will be used to compare results between software-in-the-loop (SITL) and HITL. The expected outcomes are successful waypoint missions in simulation and baseline performance data to guide future path-planning development, ROS 2 sensor integration, and outdoor flight testing. Future work could support autonomous exploration and data collection in areas that may be unsafe for human access.

Mentor(s):
Samuel Labi (Engineering); Andres Felipe Hoyos Moreno (Engineering); Richard Ajagu (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

RESEARCH TALK PRESENTATIONS

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7000
Presentation Time: STEW 214A at 9:00 AM-9:20 AM

Evaluating Precision–Efficiency Trade-offs in Systolic Array Architectures for Edge AI Inference

STEM

Authors(s):
Aiyan Alam† (Engineering)

Abstract:
The growing deployment of artificial intelligence on resource-constrained edge devices has increased the need for efficient neural network acceleration. Systolic arrays offer a promising architecture for accelerating matrix multiplication, a fundamental operation in machine learning inference. However, their efficiency depends on arithmetic precision, array dimensions, and workload characteristics.

This research investigates how numerical precision and systolic array configuration influence computational efficiency and inference accuracy. A Python-based architectural modeling framework will be developed to evaluate 2×2, 4×4, and 8×8 systolic arrays across representative matrix multiplication workloads. The study will compare processing-element utilization, estimated execution cycles, and theoretical computational throughput. In parallel, quantization experiments will evaluate the effects of floating-point, INT8, and INT4 representations on neural network accuracy and storage requirements.

By combining architectural performance modeling with quantization analysis, the project aims to identify trade-offs between numerical accuracy, computational efficiency, and resource requirements. Expected deliverables include a reproducible simulation framework, comparative performance measurements, and visualizations highlighting promising configurations for resource-constrained AI inference.

Mentor(s):
Vijay Raghunathan (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7001
Presentation Time: STEW 214A at 9:20 AM-9:40 AM

Microwave Theory and Technology Society Synthetic Aperture Radar Project

STEM

Authors(s):
Jaswant Singh† (Engineering); Vikram Madhusudan Chakrabhavi† (Engineering); Elena Gutierrez† (Engineering); Azamat Eshmuratov† (Engineering); Vikram Ganesh Kumar‡ (Engineering); Griffin Rhoads‡ (Engineering); Ryan Leviste‡ (Engineering)

Abstract:
Synthetic Aperture Radar (SAR) is a radar imaging technology that utilizes radar pulses gathered from multiple positions to imitate the application of a large antennae, and relies on computation to reconstruct an image of an observed area. Combining multiple signals is computationally expensive, and the signal processing needs to be accurate. The goal of our project is to construct and implement a range-doppler digital signal processing SAR algorithm to successfully transform raw data into an accurate SAR image. Our algorithm separates the necessary tasks into 8 different python functions meant to make the whole process more modular. This made it easier to collaborate on the whole program, because we could each work on our functions at once without waiting for one another to finish. Our first few functions load the data and define the global variables. Our next few functions include the FFTs in the range and azimuth direction and the range cell migration correction. Finally, we undo the FFTs and create an image with the data. The image created is a black and white image where the darkness of each pixel indicates the strength of the received signal. Stronger signals indicate that the radar reflected over more reflective surfaces like metal objects or buildings. Our results show that our algorithm implementation was largely successful as it combined multiple signals accurately to form an image of the observed area. Areas that more strongly reflected the signals were properly indicated on the image as being lighter compared to less reflective areas. These results validate our implementation of the algorithm on an FPGA to improve algorithm speed and efficiency.

Mentor(s):
Priya Adiga (Engineering|JMHC); Andrew Owen Fewell (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7002
Presentation Time: STEW 214A at 9:40 AM-10:00 AM

EPICS Junior Achievement Shelves

STEM

Authors(s):
Robert Charles Feeney† (Engineering); Olivia Grace Hart† (Engineering); Brendan Charles Willour‡ (Engineering); Benjamin Isaac Miller‡ (Education|Polytechnic)

Abstract:
Community-engaged engineering projects ask students to make technical decisions while responding to the needs of users. This poster examines the design and development of a modular storage system for Junior Achievement of Northern Indiana and the learning that emerged through the project. The team addressed inefficient storage for hundreds of educational kits by translating partner needs into design requirements related to capacity, space efficiency, accessibility, structural stability, safety, and cost. Students generated multiple concepts through sketches and CAD models and compared alternatives using a decision matrix that considered portability, accessibility, space efficiency, weight, and storage capacity. These decisions led to a three-module shelving system with different dimensions and functions, reinforced connections, standardized assembly features, and mobility where needed. The poster draws on two sources of evidence: the team's design document and end-of-semester reflections from four students. The design document was reviewed to trace key design decisions and iterations, while the reflections were analyzed for recurring themes in students' academic, professional, and social learning. Findings show that moving from conceptual design to fabrication required continued iteration as physical constraints challenged ideas that had appeared workable on paper. Students described learning to prioritize safety over aesthetics, adapt solutions to partner needs, develop hands-on fabrication skills, and use communication and shared decision-making during construction. Delivering and installing the shelves also helped students connect technical work to the partner's educational mission. Overall, the findings show how community-engaged design can link engineering decision-making with teamwork, professional growth, and a stronger understanding of community impact.

Mentor(s):
Aparajita Jaiswal (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7003
Presentation Time: STEW 214B at 9:00 AM-9:20 AM

ATTEST: Auditable AI Guidance for Manufacturing

STEM

Authors(s):
Amogh Bysani† (Science|JMHC)

Abstract:
AI-generated manufacturing instructions can omit safeguards or lack supporting evidence. Overall accuracy treats errors uniformly, although a missing interlock check can have different consequences from a wording error. ATTEST is an evaluation framework and abstention policy under development at Build @ Scale. It examines whether withholding insufficiently supported instructions and escalating to a human expert can reduce consequence-weighted errors while retaining useful guidance. ATTEST links instructions to evidence and checks whether they should be issued. An exploratory offline pilot used two language models to generate 32 responses across 16 synthetic scenarios based on one procedure grounded in public lockout/tagout requirements. Reviewers classified 26 responses as instruction-bearing, and the gate withheld eight. Two AI reviewers from the same model families as the generators judged five withholdings unnecessary; three remained unresolved. Citation normalization, omitted source locators, and extraction mismatches contributed to withholding guidance the reviewers considered acceptable. No instruction was judged defective by both reviewers, so the pilot does not establish error-detection effectiveness. Planned evaluation will benchmark omitted steps, missing safety checks, incorrect parameters, unsafe substitutions, and fabricated steps across multiple manufacturing procedures. Two domain experts will independently review a subset. Model evaluation will compare uniform and consequence-weighted scoring and measure error among issued instructions as coverage changes. Procedure-level confidence intervals will be estimated when enough independent procedures are available. A session audit record will document instructions, supporting evidence, abstentions, and operator overrides. The pilot shows that faults in evidence handling can restrict useful guidance. Expert-reviewed evaluation across multiple manufacturing procedures remains planned.

Mentor(s):
Wenzhuo Wu (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7004
Presentation Time: STEW 214B at 9:20 AM-9:40 AM

Evaluating the Cardiotoxicity of Doxorubicin via 4D Echocardiography in a Murine Model

STEM

Authors(s):
Alekh Shah† (Engineering); Bea Olivia Cabot* (HHS|Science); Helen Yee* (Engineering)

Abstract:
Doxorubicin (DOX) is a popular chemotherapeutic agent known to cause cardiotoxicity, which can lead to heart failure if not detected early. Conventional methods can fail to identify subtle functional cardiac defects before damage starts to occur. Imaging modalities such as 4D echocardiography can provide better sensitivity for detecting early myocardial dysfunction over 2D methods due to added spatial information. This study evaluates the acute cardiac effects of DOX treatments in a murine model with the use of 4D ultrasound technologies.

Male mice between the ages of 8-12 weeks were assigned to a DOX-treated group (25 mg/kg dose, n = 9) or a saline control group (n = 9). Cardiac function was assessed using the Vevo3100 ultrasound system before DOX or saline administration and at 2 and 7 days after (FUJIFILM VisualSonics, Inc.). Dobutamine (DB) stress tests (4.5 µg/g body weight) were administered to evaluate myocardial stress response. 4D echocardiography images were acquired to quantify metrics such as ejection fraction (EF), left ventricular mass, and circumferential strain.

While 2D ultrasound and baseline 4D ultrasound showed no significant differences in EF between DOX-treated and control groups, 4D ultrasound with dobutamine stress testing showed a near-significant impairment in EF increase due to DB in DOX-exposed mice compared to controls ($p = 0.07$). Also, DB stress testing showed significant declines in 4D global circumferential strain and left ventricular mass in the DOX group by Day 7.

From this study, we can conclude that ultrasound is not sufficient enough to detect any subtle changes in doxorubicin-induced cardiotoxicity within this model. Dobutamine stress testing combined with 4D ultrasound shows some myocardial dysfunction and a decline in other heart metrics that remain hidden in earlier evaluations. Thus, noninvasive imaging

reveals reduced cardiac response to stress that may be a signal of early damage before cardiac function decreases.

Mentor(s):
Craig Goergen (Engineering); Benjamin Zeidler (Engineering)

Other Acknowledgment(s):
Cortland Hannah Johns* (Engineering)

Talk Presentation Abstract Number: 7005
Presentation Time: STEW 214B at 9:40 AM-10:00 AM

A Survival Analysis Framework for Predicting Flexible Pavement Deterioration in Wet-Freeze Climates

STEM

Authors(s):
Mark Vincent Waldron† (Science)

Abstract:
Traditional machine learning approaches to pavement management often frame structural deterioration as a binary classification problem, which fails to capture the fundamental reality that all infrastructure eventually degrades to a hazardous state. This research introduces a time-to-event prediction framework utilizing survival analysis to forecast pavement deterioration. Instead of outputting fixed-year classifications, the model generates probabilistic survival curves that estimate the time remaining until a road segment crosses a critical hazard threshold.

Using longitudinal data from the Long-Term Pavement Performance (LTPP) database, the study focuses on a tightly controlled subset of 272 flexible asphalt sections (GPS-1 and GPS-2) located in the Wet-Freeze climate zone. By integrating early-stage condition scores (e.g., IRI, cracking) with cumulative environmental stressors (freeze-thaw cycles, precipitation) and traffic loading (AADT, ESALs), the model captures how specific physical pavements react to varying stress environments over a 15-year horizon. The architecture is evaluated using the Concordance Index (C-index) on temporally held-out test sets to validate predictive ranking. This framework establishes a robust, statistically sound baseline pipeline that can be seamlessly adapted to ingest proprietary, high-frequency sensor or RGB-D imagery data in future deployments, enabling more proactive and precise infrastructure triage.

Mentor(s):
Mohammad Reza Jahanshahi (Engineering); Nikkhil Vijaya Sankar (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7006
Presentation Time: STEW 214C at 9:00 AM-9:20 AM

Deep Learning-Based Automated Detection of Cardiac Cycle Events in Echocardiography

STEM

Authors(s):
Jeremy Zhang† (Engineering); Hillary Chen‡ (Engineering|Science)

Abstract:
The heart relies on valves to regulate blood flow direction. The mitral valve controls flow from the left atrium into the left ventricle, and the aortic valve controls flow from the left ventricle into the aorta, the body's main artery. Echocardiography, an ultrasound modality producing real-time heart videos, is among the most accessible cardiac imaging modalities. Clinicians use valve opening and closing to time measurements of heart and aortic function in patients with aortic aneurysm, a bulging of a weakened aortic wall that can rupture. Because aneurysms often enlarge silently, repeated measurements are the main way to track growth and decide when to intervene. However, manual annotation of these events is time-consuming and varies between clinicians.

Deep learning, a type of artificial intelligence that learns patterns from labeled examples, can automate this process. Prior models detect cardiac phases with errors of about 1–3 frames, but most identify only end-diastole and end-systole. The few that time individual valve events used apical views; none detect all valve events in the parasternal long-axis (PLAX) view. We aim to develop a deep learning model that detects five valve events in pediatric PLAX echocardiography videos: aortic valve opening and closing, mitral valve opening and closing, and the mitral valve plateau. Using a custom annotation interface, we labeled 90 videos from 45 healthy subjects and 45 age-matched subjects with aortic aneurysms. We will train and test multiple architectures, including a convolutional network that extracts per-frame features paired with a temporal convolutional network that models motion across frames, evaluated by frame error between predicted and annotated events.

We anticipate that this automation will reduce analysis time and clinician workload and remove observer-dependent variability in event timing. We also plan to evaluate the model on larger datasets spanning more diseases, image qualities, and ages.

Mentor(s):
Shubh Parag Mehta (Engineering); Craig Goergen (Engineering); Benjamin Landis (Indiana University)

Other Acknowledgment(s):
India Ree Walker* (Engineering); CJ Holdeman* (Engineering)

Talk Presentation Abstract Number: 7007
Presentation Time: STEW 214C at 9:20 AM-9:40 AM

CVGM: Contact-Guided Flow Matching for Articulated Piano Hand Animation

STEM

Authors(s):
Rishi Bagri† (Liberal Arts|Science); Nimisha R Rangarajan† (Science); Luca Chen† (Engineering); Callum Roderick Sizer† (Science)

Abstract:
Piano hand animation has to get two things right at once: fingertips landing precisely on keys, and the motion between notes looking like a person played it. This project builds explicit contact guidance into conditional flow matching. Tipiano and PianoFlow inform the design, but the question we care about is narrower: can a generative model keep the flexibility of learned motion while still obeying where and when the hand must touch the keyboard?

The contribution is a contact-aware formulation that handles fingertip placement, note timing, and vertical finger articulation together rather than separately. MIDI events, fingering annotations, and keyboard geometry define the contact targets that condition generation. Training objectives push the model toward accurate presses and releases while keeping the finger lift that happens between contacts. Articulation becomes something the model is trained on directly, not a side effect we hope survives. That matters because smoothness constraints tend to flatten exactly the gestures that make a performance read as a performance.

Next is working out how these constraints interact inside the flow matching framework, with ablations isolating what each one contributes. We plan to measure fingertip alignment, contact timing, vertical movement, and temporal smoothness, and to check the results visually in Blender. The outcome we want is a clear answer on whether contact constraints plus articulation-aware generation improve the tradeoff between playing accuracy and natural motion, and a base to build more controllable piano hand animation on.

Mentor(s):
Yung-Hsiang Lu (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7008
Presentation Time: STEW 214C at 9:40 AM-10:00 AM

Semiconductor-Based Electrochemical Sweat Sensors for a Physiological Digital Twin

STEM

Authors(s):
Iniya Venkat† (Engineering)

Abstract:
Digital twins of human physiology require continuous, real-time biochemical data to make accurate predictions about an individual's metabolic and neurochemical state. Blood draws and lab tests are invasive and too infrequent to capture rapid changes. Sweat offers a non-invasive alternative, but its biomarkers are dilute ([11] nM to [8.64] μM; Zhang, 2023) and mixed with interferents. This project designs and characterizes electrochemical sensors for dopamine, norepinephrine (stress), and glucose (energy metabolism) in sweat. The sensors use tellurene and zinc oxide, as the sensing layers. We first reproduced sensor fabrication and performance from prior thesis work as a validated baseline (sensitivity [0.083] μM, LOD [2] nM; Zhang, 2023). The sensors are then characterized across sweat-relevant concentrations of each analyte and compared against known standards. Validated sensors will then be integrated into a wearable sweat patch whose data, with an existing dataset from more than 45 individuals, will train a digital twin that forecasts metabolic and neurochemical changes, such as post-meal glucose, in real time.

Mentor(s):
Robert Jose Ccorahua santo (Engineering); Wenzhuo Wu (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7009
Presentation Time: STEW 214D at 9:00 AM-9:20 AM

A Cycle-Level Simulation Framework for Early Design-Space Exploration of the Atalla AI Accelerator

STEM

Authors(s):
Rafael Monteiro Martins Pinheiro† (Engineering)

Abstract:
Semiconductor development proceeds from architecture to physical implementation, and Register-Transfer Level (RTL) design and simulation is a critical but resource-intensive stage where errors sharply increase cost and risk. Moreover, the verdict on an architectural decision often arrives late, once real programs run on the design, when a flawed decision may invalidate the work spent on that iteration. Simulators such as gem5 deliver that verdict earlier for CPUs and memory hierarchies, and its accelerator extensions model fixed-function datapaths rather than a programmable instruction set. Modeling a custom VLIW instruction set, a software-managed scratchpad, and a systolic array in gem5 thus requires new C++ components inside a large framework, making each architectural iteration expensive.

Atalla is a domain-specific AI accelerator for tensor workloads, focused on efficient General Matrix Multiplication (GEMM) and data movement. We develop Atalla-Sim, a Python-based, cycle-level simulator for early system and software validation. It models the full tensor datapath and its instruction scheduler at cycle granularity, so kernels run on a parameterized model of the machine that checks their functional correctness and quantifies the performance impact of design trade-offs before hardware implementation.

We validate component timing cycle by cycle against RTL simulation traces where available and hand-derived RTL timing elsewhere, validate the Instruction Set Architecture (ISA) model against a functional-simulator golden reference, and execute kernels from the system-software team end to end. Two limitations remain: Python orchestration limits throughput on large workloads relative to C++-based frameworks, and timing fidelity is bounded by each component's RTL reference, with hand-derived timing the weakest. Even so, Atalla-Sim establishes a foundation for broader workloads, faster validation, and better-informed design decisions.

Mentor(s):
Hassan Al-alawi (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7010
Presentation Time: STEW 214D at 9:20 AM-9:40 AM

Sequential Extraction Process to Recover Rare Earth Elements and Other Metals From E-Waste

STEM

Authors(s):
Grayson D Givens† (Science|JMHC); Rajan Joshi† (Engineering)

Abstract:
As the demand for compact electronics continues to rise, recycling high-value materials such as Rare Earth Elements (REEs) has become essential due to the use of REEs in components within consumer electronic devices. Electronic waste (e-waste) represents a valuable secondary resource of REEs. However, conventional e-waste recovery methods pull out an excess of elements with little selectivity, leading to contamination of target metals. The need for a more sustainable extraction method is becoming paramount to isolate specific elements from e-waste. A composite feedstock for extractions was created by mixing fine powders of e-waste devices (produced within a previous research project (1)), including mobile phones, a DVD player, hard disk drives (HDD), electronic ash, and an answering machine. To determine the highest yield of elemental extraction, a sample of the blend was digested in five replicas with hydrogen peroxide and concentrated nitric and hydrochloric acids at 230°C using microwave-assisted acid digestion (MWAD). From the same feedstock, 3 g samples underwent stepwise leaching in triplicate in oxidizing environments with increasing strength. After each step, the leachates were analyzed with Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES) to determine the concentration of REEs and other extracted elements. The resulting data were used to identify the optimal leaching conditions for stepwise extraction of specific elements while reducing hazardous waste generation. It was hypothesized that increasing the strength of the oxidative leaching solution would increase REE yield, but that an intermediate acid strength would achieve optimal target element recovery while consuming less concentrated acid and generating less hazardous waste than nearly complete one step extraction by digestion.

Key words: electronic waste, rare earth elements, sequential extraction, elemental recovery.

(1) Buechler et al. (2020)

Mentor(s):
Nadezhda N Zyaykina (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7011
Presentation Time: STEW 214D at 9:40 AM-10:00 AM

Physical Design Flow Architecture for SoCET AFTx08+

STEM

Authors(s):
Vladimir D Bondar† (Engineering); Alexander Repikov* (Engineering|JMHC)

Abstract:
Modern chip design relies heavily on Electronic Design Automation (EDA) tools to complete the process from compiling high-level SystemVerilog code to placing, routing, and verifying physical cell layouts. Synopsys EDA tools, used for Physical Design in SoCET's Design Flow subteam, are complex, and flow runtimes can take a long time to finish. To help students better understand and use the Synopsys EDA tools, various improvements to the flow architecture, or custom tooling surrounding the EDA tools, will be implemented. These changes will also aim to improve the general developer experience. Improvements to the Makefile will allow for more control over which parts of the flow run, reducing unnecessary computation and runtime while keeping a log of what changes have been tested. GitHub Actions will be implemented to track build statuses and verify build correctness for pull requests and merges into the main branch. Additionally, build tracking will be implemented to reduce the number of redundant builds by retaining expensive-to-generate EDA outputs for reuse. However, a completed build will still be required if no reusable build outputs are available, meaning these improvements will not eliminate the initial computational cost of running the EDA flow.

Mentor(s):
Niels van Ritbergen (Engineering); Timothy Francis Hein (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7012
Presentation Time: STEW 218A at 9:00 AM-9:20 AM

Comparing Experimental Protocols for Measuring Magic on a Single Quantum Computer

STEM

Authors(s):
Medhansh Garg† (Science)

Abstract:
Not every quantum circuit and computation gains quantum advantage. Some states called Stabilizer States are easily simulable on classical computers, no matter how many qubits are involved. What separates non-stabilizer states, the ones that have quantum advantage, is a property called “magic.” Magic measures how far a quantum state is from the stabilizer state family. Because magic underpins true quantum advantage, measuring it on real hardware is crucial for benchmarking today’s noisy quantum computers. Researchers have proposed many experimental methods of doing this. This work focuses on two: Rényi entropy and Bell Magic. The Rényi entropy protocol applies random rotations to individual qubits and measures them jointly. The Bell magic protocol prepares two copies of the same quantum state and measures them jointly. Each method has been demonstrated separately, on different machines and different test states. Hence, there is no clear answer to which protocol an experimenter should use for a given problem. This work answers this question by directly comparing the methods on the same quantum computer and quantum state. We compare each method’s accuracy, how quickly it improves with more measurements, how often noise fools it into reporting magic that isn’t there, and how much of the quantum computer’s resources it uses. We also test how well each method’s noise correction deals with real hardware. The results will provide practical guidance on which of these two methods to choose, depending on the size and quality of the quantum computer in question.

Mentor(s):
Andy Jung (Science); Noah Charles Singer (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7013
Presentation Time: STEW 218A at 9:20 AM-9:40 AM

A 3D DIPG-Microglia Spheroid Co-Culture Model for Developing NK Cell Immunotherapies

STEM

Authors(s):
Rohan Joseph Eapen† (Engineering|Science)

Abstract:
Diffuse intrinsic pontine glioma (DIPG) is a pediatric brain tumor with a median survival of 8 to 11 months. Because of its diffuse infiltration of the brainstem, neurosurgical resection is not feasible, and palliative radiation is the primary therapeutic option. More recently, targeted therapies and immunotherapies have emerged, but most have shown limited benefit so far. A major challenge in developing immunotherapies for DIPG is the lack of reliable preclinical models that recapitulate the aggressive and heterogeneous tumor microenvironment. In this study, our goal was to develop a translational DIPG model to evaluate immune-neuronal interactions in the tumor. The model is based on patient-derived co-cultures to generate 3D spheroids, allowing us to test how microglia influence natural killer (NK) cell cytotoxicity against DIPG. SF8628 (DIPG) and HMC3 (microglia) cells were co-cultured in 48-well flat-bottom plates (in 2D) and ultra-low attachment (ULA) U-bottom 96-well plates (in 3D), then exposed to human NK cells. NK infiltration is then visualized via confocal microscopy, and cytotoxicity is measured by lactate dehydrogenase release (2D) and Incucyte imaging (3D). DIPG-microglia spheroids formed uniformly in ULA plates, and confocal microscopy shows significant NK infiltration at both 2:1 and 5:1 effector-target (E:T) ratios. In 2D, NK cells induced ~16% specific lysis of DIPG at a 2:1 E:T and ~62% at 5:1 E:T, with a trend toward reduced killing as HMC3 fraction increased (n=2), demonstrating the negative regulation of NK cell immune activity contributed by tumor-associated microglia. Overall, this 3D spheroid model provides a robust and translationally-relevant platform for studying NK cell immunotherapy and tumor-neuronal-immune interactions in DIPG. Future work will use these optimized conditions and test chimeric antigen receptor (CAR)-NK cells to evaluate their potential as immunotherapies against DIPG.

Mentor(s):
Sandro Matosevic (Pharmacy); Soumyajit Das (Pharmacy); Valentina

Andrade Perez (Pharmacy); Shuyi Zhou (Pharmacy); Tyler Parker Fritsch (Pharmacy)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7014
Presentation Time: STEW 218A at 9:40 AM-10:00 AM

Device Engineering for STM Studies of Correlated Electron Behavior in 2D Semiconductors

STEM

Authors(s):
Priya Mishra† (Science)

Abstract:
Two-dimensional (2D) materials beyond graphene host a large range of correlated electronic phases; however, imaging these phases with scanning tunneling microscopy (STM) remains a big challenge. An example is a Wigner crystal, where electrons freeze into an ordered lattice when their Coulomb repulsion becomes stronger than their kinetic energy. This overwhelming force drives a phase transition from an electron liquid to an electron solid. Monolayer molybdenum diselenide (MoSe2) is a promising host for this state, but semiconducting layers are difficult to contact at the low densities and temperatures which are required for this crystal to form. In this work, we fabricate gate-tunable STM devices via exfoliation and dry transfer, with the $MoSe_2$ layer placed underneath a trenched graphene gate. A top hBN layer protects the sample during storage and slides off before measurement, exposing a clean area for STM. When assembled in inert conditions, such as in a glove-box, the same device architecture can extend to more air-sensitive chalcogenides which exhibit behaviors such as superconductivity and other correlated phenomena. This platform provides a general route towards real-space imaging of correlated phases in 2D materials, with Wigner crystallization in MoSe2 as a primary target.

Mentor(s):
Tiancong Zhu (Science); Kyung Jun Lee (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7015
Presentation Time: STEW 218B at 9:00 AM-9:20 AM

Simulating Stable Isotope Partitioning in Atmospheric Chemistry Using Modified CMAQ Modules

STEM

Authors(s):
Samin Sanjana† (Engineering)

Abstract:
Atmospheric nitrogen and oxygen isotopes serve as powerful tracers for understanding air pollution sources and chemical transformation pathways. However, seasonal variations in isotopic composition shown by field measurements are not fully explained by current atmospheric models. This project aims to incorporate stable isotope chemistry into a zero-dimensional box-model framework using AtChem2 to better constrain gas- and aqueous-phase reaction mechanisms. Reaction mechanism files were modified to explicitly include isotopologue reactions alongside conventional nitrogen oxide (NOx) and radical (ROx) chemistry. Isotope-substituted reactions were parameterized assuming identical base kinetics unless experimentally derived fractionation factors were available from peer-reviewed literature or kinetic databases. Additional reactions were implemented to represent key oxidation pathways, including OH-, O3-, and N2O5-driven chemistry. Updated mechanisms were compiled and executed on Purdue's high-performance computing cluster to simulate isotope partitioning under varying initial conditions, including oxidant concentrations and precursor abundances. Simulations quantify how shifts in dominant oxidation pathways influence isotopic enrichment in nitrate and related nitrogen species. Preliminary results are expected to quantify how chemical pathways influence isotopic enrichment in nitrate and related species, improving the interpretation of field measurements. By isolating chemical controls on isotope signatures, this work improves the interpretation of field observations and provides mechanistic insight into seasonal isotope trends. This work contributes toward integrating isotope-enabled chemistry into larger chemical transport models such as CMAQ and enhances predictive understanding of atmospheric nitrogen cycling and air pollution dynamics.

Mentor(s):
Greg M Michalski (Science)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7016
Presentation Time: STEW 218B at 9:20 AM-9:40 AM

Longitudinal Count Data with Varying Treatment Trajectories in Clinical Trials: A Simulation Study

STEM

Authors(s):
Danica Althea Diva† (Science|JMHC)

Abstract:
Longitudinal count data assessing recurring events over time are frequently collected in clinical trials. Selecting the optimal analytical approach remains challenging, particularly when response trajectories include acute changes, delayed effects, or U-shaped profiles or rebounds. This simulation study evaluates and compares the performance of commonly used parametric models and non-parametric methods in estimating and statistical testing of treatment effects.

Using a simulation framework, we model a randomized clinical trial (RCT) under the reasonable response scenarios: no change, constant improvement, delayed response, initial acute response followed by stabilization, and initial acute response followed by rebound. In each scenario, four visits are simulated (baseline and follow-ups T1, T2, T3). Change in event rate from baseline to T3 and from T2 to T3 are evaluated.

The performance of each method is evaluated on bias, statistical efficiency (power), and Type I (alpha) error control. Current literature suggests that Negative Binomial mixed models are preferred in terms of efficiency while non-parametric methods based on median and the Wilcoxon test require less restrictive assumptions.

Mentor(s):
Ulysses Diva, Jr (U. Diva Statistical Consulting, LLC)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7017
Presentation Time: STEW 218B at 9:40 AM-10:00 AM

Automating Paired Colony Picking and High-Throughput Ambient Mass Spectrometry for Directed Evolution

STEM

Authors(s):
Juan Pablo Goyes Bucheli†

Abstract:
Drug discovery benefits from efficient methods for synthesizing complex molecules. Enzymatic reactions are a prominent alternative to accomplish these synthetic endeavors with high selectivity and under mild conditions. This biocatalytic approach has been enabled by the directed evolution of enzymes to expand their natural substrate scope or acquire new-to-nature activities. This process relies on screening large sets of enzyme variants, generated via random mutagenesis and bacterial expression. However, manual colony picking and preparation for downstream analysis limit the number of variants evaluated and slow successive rounds of enzyme improvement.

To address this, we are developing an automated picking-analysis workflow for directed evolution within a high-throughput (HT; <1 s per sample) ambient mass spectrometry (MS) platform. This system uses a Hamilton VANTAGE liquid handler and two mass spectrometers (Waters Xevo G2-XS QTof and Waters Absolute TQ), each equipped with an automated desorption electrospray ionization (DESI) source. A home-built Python controller enables colony picking from up to eight agar plates per run using eight independent pipetting channels and standard disposable tips. A 3D-printed camera-based imaging set-up is being integrated to identify colonies and provide sampling coordinates.

Several modes are under validation: (i) single picking transfers of colonies into broth for culturing and phenotypic assessment, and (ii) double picking of the same colony to generate both variant sequencing plates and HT-DESI-MS-ready plates for direct sub-second analysis, without incubation or purification, using substrate-doped agar plates. Linking each analytical sample to its corresponding culture allows promising variants to be retained for further evolution without adding time to phenotypic results. Consolidating these activities within one automated platform should accelerate biocatalyst development towards new or existing drug candidates.

Mentor(s):
Nicolas Mauricio Morato Gutierrez (Centers & Institutes); Alexis Toney Owen (Science)

Other Acknowledgment(s):
Robert Graham Cooks* (Science)

Talk Presentation Abstract Number: 7018
Presentation Time: STEW 218C at 9:00 AM-9:20 AM

Improving Robustness and Safety of Autonomous Vehicle Using Multi-Sensor Fusion Methods

STEM

Authors(s):
Natalie Bozinovski† (Engineering); Yi-Lien Chen† (Engineering); Max Lu† (Engineering); Skyler R Wenger† (Engineering); Greyson Andrew Altaffer† (Engineering)

Abstract:
In the advent of autonomous vehicles, sensor fusion technologies have become increasingly relevant towards maintaining passenger safety in adverse, high-noise conditions. The synchronization of sensors is crucial for vehicle perception where individual sensors are impaired.

Cameras and LiDAR, two of the most widely used perception sensors, have complementary strengths: cameras provide rich contextual information, while LiDAR delivers precise depth data. However, both degrade in adverse driving conditions. Controlled testing shows fog can reduce camera image entropy by up to 57%, while heavy rain degrades LiDAR point-cloud inliers by over 40%. In busy urban areas, tall buildings or garages can cause confusing geometric shadowing on cameras and interrupt visibility to satellites. Because no single sensor captures a driving environment in all conditions, multi-sensor fusion is a requirement for robust and safe autonomous driving systems.

The team will fuse data from a RealSense D435i camera and a Livox Mid 360 LiDAR using Extended Kalman Filter (EKF) nodes. Objects will be detected in camera frames with a YOLOv8 detector, and LiDAR point clouds will be clustered using Euclidean clustering with the Point Cloud Library (PCL). The resulting detections will be tracked using a Kalman Filter. Ultrasonic sensor data, which is used for close-range scenarios such as parking and heavy traffic, will be read as well to act for a final near-field safety layer capable of overriding the primary controller.

The performance of the fused system will be tested against real-world vision-only sensor configurations, such as those used for the Tesla Cybercab. Additionally, we will conduct targeted trials involving glare, camouflage, blind spots, and weather to demonstrate the necessity of a multi-sensor fusion approach. The end goal is a functional sensor fusion stack deployed on a 1/10th scale Redcat Racing Blackout RC vehicle.

Mentor(s):
Andres Felipe Hoyos Moreno (Engineering); Reed Joseph Freer (Engineering); Samuel Labi (Engineering); Richard Ajagu (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7019
Presentation Time: STEW 218C at 9:20 AM-9:40 AM

Identifying Longitudinal Immune Cell Predictors of Treatment Response Using XGBoost, SHAP, and Elastic Net

STEM

Authors(s):
Ramya Prasanna† (Science|JMHC)

Abstract:
Identifying immune-cell populations associated with treatment response may improve the development of predictive biomarkers. This study aims to identify and interpret immune-cell proportions associated with treatment response using XGBoost, SHapley Additive exPlanations (SHAP), and Elastic Net regression. Immune-cell proportion data will be analyzed at baseline (week 0), week 26, week 52, and week 104 to investigate predictive features at baseline, during early response, and during later follow-up. XGBoost will capture nonlinear relationships and interactions among immune-cell populations, while SHAP will quantify individual feature contributions and their directional associations with predicted response. Elastic Net regression will provide a regularized baseline for comparison and identify informative features while accounting for correlated immune-cell measurements. Predictive performance will be evaluated using receiver operating characteristic area under the curve (ROC-AUC), with subject-level data partitioning to prevent information leakage. Model performance and feature importance will be compared across timepoints to assess the predictive value of baseline immune composition and longitudinal immune profiles. This analysis aims to identify candidate immune-cell populations associated with treatment response, characterize how their predictive contributions vary over time, and determine whether XGBoost offers advantages over Elastic Net. SHAP visualizations and comparisons between modeling approaches will help prioritize candidate biomarkers for further investigation. This interpretable machine learning framework may support the development of biologically informed predictive models and guide future validation of immune biomarkers.

Mentor(s):
Nan Kong (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7020
Presentation Time: STEW 218C at 9:40 AM-10:00 AM

Genetic Domination of the Host in Eukaryogenesis

STEM

Authors(s):
Alexander Whitaker Raber† (Liberal Arts|Science)

Abstract:
The purpose of this study is to examine the genetic contribution of the host and endosymbiont to eukaryogenesis, the process by which complex cells on Earth evolved. To place this study in context, we argued that “mitocentrism,” the idea that mitochondria are responsible for the most important aspects of eukaryotic evolution, is pervasive throughout the literature in its iconography, wording, and assumptions, even by authors who do not explicitly endorse the view. In this study, we classified genes in the Last Eukaryote Common Ancestor into those of host and endosymbiont origin using two methods. First, we inspected the connection between phylogenetic and functional affiliations of gene families. Second, we compared the degree and source of genome chimerism in modern descendants of host and endosymbiont. Using these methods, we find that most of the endosymbiont’s gene contributions, ~7-11% of the LECA genome, are of proteobacterial origin. This disagrees with a pervasive assumption of nearly 50-50 contribution from each partner. Next, we explored how this new distinction affects the relative importance of the genetic roles of each partner using two methods. First, we extended a previously described pattern of endosymbiont gene expendability to mitochondria using our host-endosymbiont gene distinction to inform previous findings. Second, we identified important evolutionary patterns, which we call evolutionary rights, that include the propensity of genes to explore new functions, duplicate, and persist. We argue that endosymbiont genes hold fewer evolutionary rights compared to those of host origin. We conclude that the majority mitocentric view of eukaryotic origin is mistaken in regard to the relative genetic importance of each symbiotic partner. This study informs a large-scale altered view of the evolution of complex, including human, life, removing the central role of the mitochondria and placing due importance on other aspects of eukaryotic biology.

Mentor(s):
Sergio Munoz-Gomez (Science)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7021
Presentation Time: STEW 218D at 9:00 AM-9:20 AM

Improving the Solubility and Selectivity of a Targeted Cancer Immunotherapy

STEM

Authors(s):
Peter Gyusung Yoon† (Liberal Arts|Science)

Abstract:
Targeted cancer immunotherapy aims to activate immune cells within tumors while limiting unwanted inflammation elsewhere in the body. Folate receptor beta (FRβ), a protein on certain tumor associated immune cells, provides a target for drug delivery. Our laboratory previously developed an FRβ-targeted Toll-like receptor 7 (TLR7) agonist, which activates an immune sensor to stimulate antitumor activity. However, the original compound did not dissolve well in water-based mixtures used to prepare doses and also bound to folate receptor alpha (FRα), a related protein expressed in kidney cells and other tissues. These issues raised concerns about reliable dosing and drug uptake outside the tumor. We hypothesized that modifying the drug's structure and optimizing its formulation could address these limitations and ultimately support better antitumor activity.

We introduced a solubility enhancing modification and screened formulations to improve recovery during dose preparation. In parallel, we changed the targeting ligand and compared binding to FRα and FRβ. The selected lead combined these structural changes and showed more than a 95% recovery after filtration in multiple tested formulations. Binding competition IC50 values were 6.1 nM for FRβ and 19.8 nM for FRα, suggesting an apparent preference for FRβ. Tumor growth was compared among the vehicle, original construct, and lead construct groups in a 4T1 mouse breast cancer model. Preliminary results showed better tumor control with the lead than with the original compound at the end of observation. These findings support further evaluation of how these modifications affect drug delivery, antitumor activity, and unwanted effects.

Mentor(s):
Cameron Joseph Smith (Science)

Other Acknowledgment(s):
Makaela Marie Bennett* (Agriculture); Neel Tushar Parekh* (Science); Mary L Niedrauer* (Science); Stewart Andrew Low* (Science); Madduri Srinivasarao* (Centers & Institutes); Philip S Low* (Science)

Talk Presentation Abstract Number: 7022
Presentation Time: STEW 218D at 9:20 AM-9:40 AM

STEM Stop: Integrated STEM Lesson on Bus Stop Design for Middle School Students

Creative

Authors(s):
Yunsoo Cha† (Education|Science)

Abstract:
Integrated STEM has been widely accepted as an important interdisciplinary approach for enhancing students' learning of STEM subjects. However, successfully incorporating authentic contexts into classroom instruction remains a significant challenge in curriculum design. This project presents a 3-5 lesson middle school unit centered on a community bus shelter design project, which draws directly from students' lived experiences and daily interactions with local public transit.

The unit sets learning objectives aligned with targeted 6th-7th grade standards in science, mathematics, and technology and engineering literacy (TEL). Throughout the project, students evaluate construction materials, analyze data, and collaboratively develop architectural designs for their local community which comes to life with the help of AI technology. The unit aims to foster critical thinking, problem-solving, and teamwork while increasing student engagement.

After implementation, student data were analyzed using multiple regression analysis to see how problem-scoping strategies, scientific reasoning, and mathematical reasoning contribute to the engineering design products of the students. Problem-scoping and scientific reasoning significantly predicted engineering design performance, while mathematical reasoning was positive yet not significant. Ultimately, the study demonstrates that STEM integration into local contexts can strengthen students' ability to connect STEM concepts to meaningful, real-world applications.

Mentor(s):
Nathan Mentzer (Education|Polytechnic)

Other Acknowledgment(s):
Amiah Bailey Clevenger* (Education|Polytechnic); Dayat Hidayat* (Education)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7023
Presentation Time: STEW 218D at 9:40 AM-10:00 AM

Behavioral and Neuroinflammatory Effects of Chlorpyrifos Exposure in Pon1(-/-) and Wild-Type Rats.

STEM

Authors(s):
Karis Ge Fu† (HHS|JMHC)

Abstract:
Abstract:

Chlorpyrifos (CPF) is an organophosphate in many pesticides. It disrupts the nervous system by inhibiting acetylcholinesterase. Literature has linked CPF to Parkinson's disease (PD). However, it's unclear how genetic variation impacts Parkinson's-related genes, specifically dopaminergic toxicity. Paraoxonase 1 (Pon1) is a gene that plays a key role in detoxifying neurons that produces CPF. Knocking out the Pon1 gene may also increase the likelihood of PD from CPF exposure. We tested the hypothesis that Pon1 Knockout with CPF exposure would represent a PD- relevant gene- environment interaction.

Methods:

We tested this hypothesis on male and female rats with Pon1-knockout (KO) and wild-type (WT) genotypes, aged three months. They were then divided into treatment groups. CPF was administered at 2 mg/kg or a control treatment (corn oil) for 8 weeks, after which they were euthanized. During the 8 weeks, their body weight alterations and behaviors– cylinder testing, posture, stability, and VEBT. We then collected, sliced, washed, blocked and stained their brains to analyze the striatum and substantia nigra. We examined microglia, neurons, dopamine, dopamine transport, and oxidative stress within the brain using IBA1, MAP2, TH, VMAT2, and nitrotyrosine, respectively.

Analysis:

We used FIJI, a computer imaging program, to analyze the fluorescence. We measured fluorescence in the dorsal striatum, ventral striatum, and total striatum. We also used a confocal microscope to analyze oxidative stress and neurons in the 60x microscopy.

Results:

Behavioral results showed that Pon1 KO rats had a decrease in neurobehavioral assessments. Analysis of inflammatory markers showed increased inflammation in the substantia nigra than in the striatum. We plan to look for more neurons, oxidative stress, and microglia.

Mentor(s):
Reeya Tanwar (HHS); Jason R Cannon (HHS)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7024
Presentation Time: STEW 214A at 10:00 AM-10:20 AM

Influence of Electrochemiluminescence Co-Reactants on Cell Viability for Improved In Vitro Bioanalysis

STEM

Authors(s):
Hadley June Rumbach† (Science); Netra Ashish Shah‡ (Science); Advaith Bony Nair‡ (Science)

Abstract:
Electrochemiluminescence (ECL) couples electrochemical reactions with light emission, providing sensitive, low-background, and spatially controlled detection for applications ranging from chemical imaging to bioanalysis. In most ECL platforms, luminophore emission relies on coreactants that undergo redox reactions to generate highly reactive intermediates required for excited-state formation. Although coreactant chemistry is well-studied, the biological effects of these compounds remain poorly characterized, limiting the applicability of ECL to minimally invasive live-cell measurements. Here, we investigate the effects of three commonly employed coreactants—tri-n-propylamine (TPrA), 2-(dibutylamino)ethanol (DBAE), and oxalate—on cytotoxicity and reactive oxygen species (ROS) generation in mammalian cells. Using fluorescence microscopy, we quantify concentration- and time-dependent effects in HEK293, HPNE, MCF-7, and PANC-1 cells and further evaluate coreactant exposure in three-dimensional spheroid models. The three coreactants exhibit distinct effects on cell viability and ROS generation, revealing concentration and exposure regimes in which ECL-compatible conditions can be achieved while maintaining cellular viability. The effects of time and concentration were variable across each cell line but followed a general trend. Oxalate produced the greatest cytotoxic effects overall, followed by DBAE and TPrA. Oxidative stress did not change after one hour of coreactant exposure. These results establish experimentally derived benchmarks for coreactant concentrations and exposure times in biological ECL experiments and provide insight into the trade-offs between electrochemical conditions required for efficient ECL generation and preservation of cellular function. This work provides a framework for designing ECL measurements involving living biological systems and expands the utility of ECL as an analytical tool for dynamic measurements of biological processes.

Mentor(s):
Samuel Patrick Nortz (Science); Jeffrey Edward Dick (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7025
Presentation Time: STEW 214A at 10:20 AM-10:40 AM

Developing Graduate Student Personas for Graphical Abstract Construction

Social Science

Authors(s):
Matthew Dunlap† (Science)

Abstract:
In tertiary education, there is a lack of explicit scientific communication training, creating a need for new ways of integrating scientific communication instruction into undergraduate and graduate education. However, new instructional approaches warrant investigation to understand how students engage with them. This research explores how students communicate scientifically and reason through the completion of a primary literature assignment requiring the construction of graphical abstracts. Graphical abstracts are visual summaries of primary literature. Within this study, we examined how three graduate students construct graphical abstracts through the use of think-aloud and semi-structured interviews at two different time points in the spring of 2026. Through deductive and inductive qualitative coding of interview transcripts and content analysis of the students' graphical abstracts at each time point, personas were created for each student. These personas are based on understanding the behaviors around the students' graphical abstract construction. Personas will allow us to also better understand the behaviors of the students related to their scientific communication and make groupings of individuals based on such. Therefore, through persona development, science communication and education researchers, as well as instructors, can better understand how assignments such as this one can be utilized to aid in improving scientific communication skills and fruitful instructional design approaches. This study serves as one portion of a wider study of ten participants, where further persona refinement and integration of both the undergraduate and graduate students' data will occur.

Mentor(s):
Stephanie M Gardner (Science); Traven Levar Cargill (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7026
Presentation Time: STEW 214A at 10:40 AM-11:00 AM

Security Vulnerabilities of AI-Driven Software Development

STEM

Authors(s):
Boris Konstantine Smaguine† (Science)

Abstract:
In the last four years, the number of AI software development tools has skyrocketed. Among these are development environment AI assistants, data exposure practices such as context engineering, and autonomous AI agents. Adoption remains mixed, with some organizations promoting AI use and others bypassing it. However, new challenges related to the process and output of AI code generation have emerged. In my exploratory research, I will investigate the risks associated with the use of AI and the deployment of AI-generated code in production, with examples from industry. My study will concentrate on security vulnerabilities stemming from businesses using proprietary development-related information in AI models, increasing automation and autonomy of AI systems, and under-reviewing code created by Large Language Models (LLMs).

To that end, I will conduct a literature review of the theory and practice of AI-driven development security. My research will incorporate sources from throughout the last four years, with a focus on recent findings. Some of my sources will feature speculation on what future AI-backed development security guardrails may or ought to be, due to the recency of these shifts. This research stresses the need for a more rigorous examination of vulnerabilities in evolving AI-based software engineering techniques for economic and compliance reasons. My findings may improve the quality of software partially written by LLMs, prevent internal failures related to AI integration in IT workflows, and indirectly incentivize AI adoption.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7027
Presentation Time: STEW 214B at 10:00 AM-10:20 AM

Cervical Cancer Screening Perspectives Among People Experiencing Homelessness: A Thematic Analysis

Social Science

Authors(s):
Lauren M Hopkins† (Science)

Abstract:
Homelessness is a growing concern in the US where the homeless experience as a woman is marked by gender inequality, stigma, and sexual violence. People experiencing homelessness (PEH) encounter unique healthcare barriers contributing to poor health outcomes. Cervical cancer screening can prevent and detect cancer early, yet PEH have lower screening rates than the national average and up to four times higher incidence and mortality of cervical cancer than housed individuals. Despite this, PEH remain underrepresented in cancer prevention research. Of the scant literature, screening barriers like past negative screening experiences and history of sexual trauma have been reported, but most studies are quantitative and represent PEH in large cities; none focus on Indiana despite the state identifying homelessness as a priority issue. Our team sought to understand cervical cancer screening perspectives among PEH in Lafayette and Indianapolis. Moving beyond itemizing screening barriers and facilitators, we aimed to capture a more holistic view of how participants' values, identities, and experiences of homelessness shape these perspectives. Thirty interviews with women experiencing homelessness were conducted at two Indiana shelters. Following the six phases of reflexive thematic analysis, four final themes were identified: 1) screening is overwhelmingly viewed as important because at the end of the day, cervical cancer can happen to anyone and be serious; 2) screening importance and motivation are shaped by broader life values, such as self-love, filtered through lived womanhood; 3) the toll of instability hinders the ability of PEH to live up to their life values; 4) meeting PEH where they are is the ultimate facilitator to preventive care. The implications of these findings extend beyond cervical cancer and can inform strategies to improve screening access and, more broadly, preventive healthcare for PEH in these settings.

Mentor(s):
Lara Nicole Balian (HHS); Natalia Maria Rodriguez (HHS); Rebecca A Ziolkowski (HHS)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7028
Presentation Time: STEW 214B at 10:20 AM-10:40 AM

Development of a Human Induced Pluripotent Stem Cell Derived Placental Barrier

STEM

Authors(s):
Benjamin Thomas Barnaby† (HHS)

Abstract:
During pregnancy, mothers are inadvertently exposed to environmental toxicants at the workplace, or via consumer products, food, water, and outdoors. The placental barrier provides protection for some chemicals while others may cross, thus playing a key role in defining which maternal exposures reach the fetus. The Developmental Origins of Health and Disease (DOHAD) hypothesis states that exposure during development can increase the risk of disease later in life. We hypothesize that chemicals that cross the placental barrier can act on the nervous system and increase the risk for neurological disease. To test this, we developed in vitro placental barrier models consisting of trophoblasts and syncytiotrophoblasts. We are leveraging the BeWo model, a widely used placental cell line, in our lab and comparing it with a newly developed human induced pluripotent stem cell (hiPSC)-derived placental model. Our hiPSC models consisted of hiPSC-derived trophoblasts and syncytiotrophoblasts differentiated from trophoblasts. Our cell line models consisted of the BeWo cell line and BeWo cells treated with forskolin (to induce syncytialization/ fusion of trophoblasts). To confirm the development of these models, we used immunocytochemistry with various markers (e.g.KRT7 and GATA-3). To confirm syncytialization, we used markers such as HCG and WGA. We also included stem cell markers such as OCT3/4 and NANOG to confirm differentiation of hiPSCs. After confirmation of development, we performed a fluorescent dye assay to assess barrier integrity. We looked to see the amount of dye that passed through each model. We found that all 4 models formed a barrier with different tightness. Next steps are to investigate the kinetics of toxicant transport over these barriers, followed by co-culturing with hiPSCs developing into cortical cultures.

Mentor(s):
Aaron B Bowman (HHS); Anke Marije Tukker (HHS)

Other Acknowledgment(s):
Maxel Ludwig Sal Simmel* (HHS)

Talk Presentation Abstract Number: 7029
Presentation Time: STEW 214B at 10:40 AM-11:00 AM

Investigating Excitation-Inhibition Balance in Autistic Children Using Aperiodic EEG

Social Science

Authors(s):
Yao Yao† (HHS)

Abstract:
Autism and attention-deficit/hyperactivity disorder (ADHD) frequently co-occur and may share underlying neural mechanisms, including imbalance of neural excitation–inhibition (E/I). Aperiodic electroencephalography (EEG) activity, representing the non-oscillatory background component of neural signals, has been proposed as a potential index of E/I balance. However, findings regarding aperiodic EEG exponent in autism and ADHD remain mixed, and its relationship with categorical group differences and dimensional neurodevelopmental traits remains unclear. The objectives were (1) regional differences in aperiodic exponent between autistic and neurotypical (NT) children and (2) associations between exponent values and continuous autism and ADHD symptom measures.

Eyes-open resting-state EEG from 60 school-age children (30 autistic, 30 NT) was preprocessed using the Harvard Automated Processing Pipeline for Electroencephalography (HAPPE), and aperiodic exponent was estimated using spectral parameterization. Frontal, central, and posterior regions of interest (ROIs) were examined. Autism and ADHD traits were assessed using caregiver-reported Social Responsiveness Scale, Second Edition (SRS-2) and Conners, Third Edition (Conners-3), respectively.

A significant main effect of ROI was observed ($p<.001$), alongside a marginally significant main effect of group ($p=.060$) and a nonsignificant group x ROI interaction ($p=.115$). Follow-up comparisons revealed lower central aperiodic exponent in autistic children ($p=.006$), but no significant frontal or posterior differences (all $p>.05$). Neither SRS-2 or Conners-3 were associated with aperiodic exponent values for either autism or NT groups.

These preliminary findings suggest that group differences in aperiodic EEG exponent may vary across brain regions, while associations with

autism-related traits across the full sample may be partly driven by diagnostic group differences.

Mentor(s):
Brandon Keehn (HHS)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7030
Presentation Time: STEW 214C at 10:00 AM-10:20 AM

Digital Twins of Physio-Cognitive Stress Responses Using Mixed Reality and Wireless Wearables

STEM

Authors(s):
Kanishka Seiharia† (Science); Prisha Marpu† (Science)

Abstract:
Stress affects how individuals think and perform. According to the American Psychological Association (2022), 76% of U.S. adults reported at least one stress-related health symptom, such as headache or fatigue, in the past month. Yet it is

difficult to induce and measure stress in a controlled and repeatable way, and self-reports alone miss the physiological response. We present a system that combines immersive mixed-reality simulations with wireless embedded sensors to monitor physiological responses to stress in real time. Simulations run on Apple Vision Pro and replicate stress environments at varying levels of difficulty. During each simulation, participants wear sensors (ECG patch, EDA, and PPG) that wirelessly stream ECG and pulse waveforms. From these signals, we compute heart rate (HR) and heart rate variability (HRV). Each of the 5 participants completes seven seated conditions: a resting baseline plus physical (one-hand 10 kg lift), vocal (singing), cognitive (visual tracking, timed arithmetic), and emotional or social (personal and interview questions) tasks. After each condition, participants complete the NASA Task Load Index (NASA-TLX), rating six subscales from 1 to 6. We will compare HR and HRV in each condition against the resting baseline and test whether physiological changes track the NASA-TLX ratings across stress types. The combined biometric data and workload ratings are used to build a digital twin of each participant's stress response. By pairing objective physiological measurements with subjective workload assessments, this system offers a data-driven approach to understanding how individuals respond to physical, cognitive, and emotional stress.

Keywords: digital twin, mixed reality, wearable sensing, stress, NASA-TLX

Mentor(s):
Robert Jose Ccorahua santo (Engineering); Wenzhuo Wu (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7031
Presentation Time: STEW 214C at 10:20 AM-10:40 AM

Computational Insights into the Active Assembly of Physiologically Relevant Actin Bundles

STEM

Authors(s):
Hamsikasree Vedavinayagam† (Engineering)

Abstract:
Actin networks are essential for maintaining cellular architecture and generating the mechanical forces that drive processes such as cell growth, division, and intracellular transport. Within these networks, actin filaments are frequently organized into discrete bundles of varying connectivity by specialized crosslinking proteins. In plant cells, such as Arabidopsis, these bundles can grow to be extraordinarily long and dynamic. While crosslinker-mediated bundle formation has been well characterized through in vitro and in silico studies, the active role of myosin motors during this assembly process remains poorly understood. Because myosin motors walk along and exert pulling forces on filaments before bundles are fully mature, their presence fundamentally alters network mechanics. In this study, we employ an agent-based computational model to investigate the formation and structural organization of actin bundles under the combined influence of crosslinkers and myosin motors. By comparing active motor simulations against passive crosslinker-only controls, we systematically quantify changes in bundle number, length, thickness, and network connectivity. Furthermore, we explore how bundle dynamics are dictated by varying the timing of motor activation, motor walking speed, and motor density. Our findings provide crucial biomechanical insights into the physiologically relevant processes governing active, motor-mediated actin bundle formation.

Mentor(s):
Tae Yoon Kim (Engineering); Jeffery Robert Coulter (Engineering)

Other Acknowledgment(s):
Weiwei Zhang* (Centers & Institutes); Anjali Iyer-Pascuzzi* (Agriculture); Christopher J Staiger* (Agriculture|Science)

Talk Presentation Abstract Number: 7032
Presentation Time: STEW 214D at 10:00 AM-10:20 AM

From Research to Peer Support: A Purdue-High School Mentoring Pilot in Rural Indiana

Social Science

Authors(s):
Paola Scolletta Tagashira† (HHS)

Abstract:
Rural communities face gaps in youth mental-health services, making schools an important setting for prevention and connection to support. A 2026 workforce analysis reported 29.1 counselors per 100,000 residents in rural Indiana, compared with 90.9 across rural U.S. counties. This gap motivates examining school-based prevention and supervised peer support alongside professional services. This proposed pilot will assess a near-peer mentoring model in rural Indiana that positions high-school juniors as both research mentees and peer mentors.

Purdue undergraduate and graduate students would guide juniors in developing research questions, evaluating sources, analyzing data, and communicating findings. Alongside this mentoring, all students at participating high schools would receive training in coping skills, bullying prevention, safe bystander responses, and seeking adult help. Juniors would assist teachers during advisory, a scheduled period for student support within the school day, by helping freshmen practice these skills. Regular check-ins with Purdue mentors and supervising staff would address challenges and review mentoring quality.

Evaluation would use authorized, de-identified school records, structured staff observations, and faculty-scored research products. Common rubrics would assess juniors' research and facilitation skills at baseline and program completion. Analyses would compare pre- and post-program attendance, documented bullying incidents, and support referrals. Staff documentation would be coded for implementation barriers and observed peer-support practices. Interpretation of incident and referral records would account for changes in reporting practices. Findings would guide program refinement and identify priorities for a larger evaluation.

Mentor(s):
August Twopearls Masonheimer (Education)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7033
Presentation Time: STEW 214D at 10:20 AM-10:40 AM

Bringing Our Boilermakers Home: Research, Collaboration, and Commitment Towards Purdue's Vietnam War MIA Servicemen

Humanities

Authors(s):
Elijah James Patton† (Liberal Arts); Tran Le Ngoc Vo* (Science); William J Singer* (Liberal Arts); Kat Mccormick* (Liberal Arts)

Abstract:
Five Purdue alumni who served in the Vietnam War remain under the status of MIA in 2026. The MIA Accounting and Recovery Coalition (MARC) is an interdisciplinary research partnership between Purdue and the Defense POW/MIA Accounting Agency (DPAA) committed to locating, identifying, and recovering the remains of these Purdue alumni. Our research spans archives including Purdue, the Vietnam Center at Texas Tech, and NARA; databases such as the Library of Congress; and previous research and recovery efforts of the DPAA. Our findings help paint a larger picture of the individuals at hand, their experiences in Vietnam, and the evidence uncovered about their potential resting places. In the process, the MARC forged relationships with other Purdue disciplines, such as data science, anthropology, and aviation technology, greatly assisting our efforts in identification. Moving forward, the MARC plans to continue developing our partnership with the DPAA and to bring in more collaborators and contributors to this replicable framework, which can be applied to recovery missions worldwide.

Mentor(s):
Andrew Harold Bellisari (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7034
Presentation Time: STEW 214D at 10:40 AM-11:00 AM

Low-Cost Triboelectric Smart Glove for Contact Detection and Pressure Sensing During Manual Lifting

STEM

Authors(s):
Rohan S Thakur† (Engineering|JMHC); Anthony David Schmok† (Engineering); An Quoc Kieu† (Engineering|Science|JMHC); Ben Darin Xu† (Engineering|JMHC)

Abstract:
Musculoskeletal disorders and injuries due to manual lifting have become increasingly common, with the data needed to assess lifting risks lagging behind due to the difficulty of data collection in an industrial setting. Standard assessment relies on load weight and lifting frequency which are difficult to record during routine work. Commercial gloves can estimate load weight, but are inaccessible due to their cost and need for external power sources. This project tests BEWARE, a bioinspired triboelectric glove that provides electrical signal through contact and separation as a lower cost alternative. The glove uses conductive fabric that is coated with a silicone layer to serve as sensors. Sensors are placed at the fingertips and wrists to estimate when a worker grips and releases a load, and the goal is to determine if sensor signals can be used to estimate differences in grip force for different load weights. Since triboelectric sensors respond to changes in contact rather than constant pressure, wrist-mounted sensors will also be tested to see whether tendon movement can be detected while holding a load. Controlled lifting experiments with different weights will be used to measure sensor sensitivity and the relationship between voltage output and applied load. Voltage signals recorded during lifting, holding, and release will be compared to determine how the sensors detect these events and whether or not heavier loads produce measurable differences in their response. The experiments will also help identify where the sensors perform well and where further improvements are needed. The goal is to determine whether this type of glove could offer a practical and affordable way to collect lifting data and assess injury risks in the workplace.

Mentor(s):
Hettiarachchige D Perera (Engineering); Wenzhuo Wu (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7035
Presentation Time: STEW 218A at 10:00 AM-10:20 AM

Analysis of Fast Tuning Methods for Coupled Resonator Cavity Filters

STEM

Authors(s):
Peter Robertson Skrdla† (Engineering); Joseph Timothy Kritenbrink* (Engineering)

Abstract:
Microwave cavity filters are critical components in wireless communication systems. Cascading multiple resonant

cavities are essential to achieve the desired selectivity, insertion loss, and attenuation. Functionally, each cavity's physical dimensions must be precisely tuned to align with a center frequency and bandwidth. In practice, manufacturing tolerances, material variations, and external coupling effects often degrade the ideal resonator characteristics. While mechanical tuning elements, such as actuator-controlled tuning disks, can compensate for these deviations, the filter becomes highly non-linear when more than two resonators are coupled. Traditional manual or iterative actuator tuning for higher-order filters is time-consuming and computationally expensive. This work evaluates automated tuning approaches along with gradient descent to expedite fine tuning in real-time while alleviating computational expense. The setup utilizes a MATLAB controller that interfaces directly with a PNA-L Network Analyzer to instantly capture S-parameters. In tandem, a Raspberry Pi Pico 2 microcontroller is dynamically adjusting the actuator positions of the device under test (DUT). This work evaluates the methodology in order to assess viability and performance. The results from this study can be used to advance the implementations of systems relying on higher order resonant cavities.

Mentor(s):
Alex Santiago-Vargas (Engineering)

Other Acknowledgment(s):
Dimitrios Peroulis* (PWL)

Talk Presentation Abstract Number: 7036
Presentation Time: STEW 218A at 10:20 AM-10:40 AM

Variable-Stiffness Wearable Device Using Core-Shell Electroadhesive Fibers

STEM

Authors(s):
Anandi Durgam† (Engineering)

Abstract:
The purpose of this research is to develop a variable-stiffness wearable device using electroadhesive technology for potential biomedical applications, such as joint support. Previous laboratory testing of soft electroadhesives demonstrated that adhesion strength (kPa) increased with applied voltage (V). The current research focuses on fabricating core-shell fibers using direct ink writing (DIW) to deposit thin electrode layers around conductive thread and integrate elastic material with the fibers. Experimental testing will investigate the stiffness response of the core-shell fibers under applied voltage. The anticipated findings will characterize the behavior of multiple core-shell fibers working together and assess their potential for integration into a wearable device. This research may inform the design of wearable biomedical devices that provide joint support when increased stiffness is needed while retaining flexibility when stiffness is reduced.

Mentor(s):
Alex Chortos (Engineering); Mohammed Jamal Al-Rifaie (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7037
Presentation Time: STEW 218A at 10:40 AM-11:00 AM

Development of a Deformable Benchtop Model for Hemodynamic Analysis of Norwood Shunt

STEM

Authors(s):
Aishwarya Kunigal† (Engineering); Calvin Adriaan VanderSchee† (Engineering); Nicholas George Doherty† (Engineering|JMHC); Lincoln Ariel Alicea† (Engineering|JMHC); Kara Rochelle McCrindle‡ (Engineering)

Abstract:
Hypoplastic left heart syndrome (HLHS), a severe congenital heart defect with poor blood circulation due to an underdeveloped left ventricle and aorta, is fatal without surgical intervention. The Norwood procedure reconstructs the aorta and adds a shunt that connects to the pulmonary artery to supply the lungs with blood. Yet, 12% of infants discharged after Norwood die before the second-stage surgery. Shunt stenosis and thrombosis remain significant complications, possibly influenced by geometry and hemodynamics. Computational fluid dynamics (CFD) studies largely assumed rigid walls and lack validation against physical flow experiments across varied geometries.

This project addresses these limitations by developing a deformable physical model of the Norwood shunt and surrounding vasculature to investigate how shunt geometry affects blood flow. Polydimethylsiloxane (PDMS) will be cast around a 3D-printed acrylonitrile butadiene styrene (ABS) sacrificial core, then dissolved in acetone to create internal flow channels. The model will be connected to a pulsatile loop with pressure and flow sensors. Using design-of-experiments (DOE) principles, the model will vary shunt diameter, length, and anastomosis angle to evaluate their effects on hemodynamics.

Two complementary imaging techniques will characterize flow behavior. Four-dimensional flow magnetic resonance imaging (4D flow MRI) will capture three-dimensional flow patterns over time, while particle image velocimetry (PIV) will provide high-resolution optical measurements. The project will establish an experimental platform to evaluate shunt geometry and validate computational predictions, with the long-term goal of improved shunt designs that may reduce complications in infants with HLHS.

Keywords: Hypoplastic left heart syndrome, Norwood procedure, mBTT shunt, computational fluid dynamics, vascular phantom, hemodynamics

Mentor(s):
Brett A Meyers (Centers & Institutes); Hyeondong Yang (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7038
Presentation Time: STEW 218B at 10:00 AM-10:20 AM

Demand Specification Matters: Calibrated Choice Modeling for Dynamic EV Fast-Charging Pricing on the I-210 Corridor

STEM

Authors(s):
Nakul Sreekanth† (Engineering); John Lance Clark† (DSB|JMHC); Avi Gupta† (Engineering); Riya Chamala† (Engineering)

Abstract:
Dynamic pricing of public fast chargers can shift when and where electric vehicles charge, but it depends on the demand model underneath. Along highway corridors, charging demand is often approximated directly from traffic volumes, an assumption that is rarely tested. We develop a simulation environment that sets hourly prices at 51 fast-charging stations along California's I-210 corridor. Arrivals are derived from Caltrans PeMS off-ramp volumes, scaled by EV share, public-charging need, and trip length. Drivers choose among stations or an outside option through a multinomial logit model over price, detour, expected wait, charging time, and amenities. Stations operate as multi-server queues in which drivers may balk or abandon. Session energy and duration are calibrated to observed charging records, and operator margins reflect CAISO wholesale prices. The environment uses a Gymnasium interface for training reinforcement learning pricing agents.

At the corridor's highest-demand station, we run one-at-a-time and Latin hypercube sensitivity analyses across 13 uncertain parameters. The assumptions that convert traffic into charging demand explain 64–74% of profit variation. Price sensitivity and the outside option determine the profit-maximizing price, which ranges from $0.20 to $0.35/kWh across plausible values. Replacing the calibrated arrival model with a raw traffic proxy inflates demand 5.4-fold and forfeits 82% of attainable profit when used to set prices. Simulated utilization remains below industry benchmarks, so station-level arrival and choice data are the priority for further calibration. These results show that how demand is specified, more than the pricing algorithm, determines the quality of corridor charging prices.

Mentor(s):
Sivaranjani Seetharaman (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7039
Presentation Time: STEW 218B at 10:20 AM-10:40 AM

EmbedEval – Benchmarking LLMs for Embedded Systems

STEM

Authors(s):
Devesh Maheshwari† (Engineering|Science); Alex Chuan Yang Zhang† (Science); Richard Z Zhang† (Engineering); Aadi Gupta† (Science)

Abstract:
Large language models (LLMs) have demonstrated strong performance in code generation and software engineering tasks. However, their capabilities in real-world embedded software development remain poorly understood. Embedded systems require reasoning about hardware-specific constraints, resource limitations, and platform-level behavior that existing benchmarks do not adequately capture. Given the potential physical consequences of embedded software failures and the high cost of hardware-in-the-loop debugging, evaluating LLM performance in this domain is particularly important.

We introduce EmbedEval, a benchmark of real-world embedded software engineering tasks derived from merged pull requests across widely used real-time operating systems. Each task pairs a repository at its pre-fix state with tests introduced by the original fix, executed in simulated hardware environments for reproducible evaluation without physical devices. Tasks are verified to fail before the fix and pass afterward, ensuring that success is measured through executable tests. An initial evaluation of frontier LLMs on a small problem set reveals lower success rates than those reported on general software engineering benchmarks, highlighting the challenges of embedded software development.

We expand the benchmark through an automated pipeline combining deterministic filtering, LLM-based pull request assessment, and task validation, and evaluate frontier LLMs on this larger problem set to better characterize their capabilities and limitations.

Mentor(s):
James C Davis (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7040
Presentation Time: STEW 218C at 10:00 AM-10:20 AM

Creating a Consistent Workflow for Amorphous Oxide Structure Generation in OxRAM Research

STEM

Authors(s):
Pablo De Leon Devia† (Engineering)

Abstract:
Oxide-based resistive random-access memory (OxRAM) is a promising technology for nonvolatile memory.The device's behavior is closely related to changes in the atomic structure of oxide materials. Understanding these materials at the atomic scale requires structural models that represent their disordered, amorphous configurations. This project aims to establish a consistent computational workflow for generating amorphous hafnium oxide (HfO_2) and to support future studies of OxRAM devices. The workflow is being developed using Reverse Monte Carlo (RMC) modeling through RMCProfile, with experimental structural data and radial distribution functions (RDFs) or pair distribution functions (PDFs) serving as sources of structural information and comparison. Molecular dynamics or melt-quench simulations are planned to provide initial atomic configurations, while appropriate structural constraints will be incorporated as the methodology is refined. To date, the RMCProfile workflow has been established through initial testing, providing a foundation for its application to the selected oxide systems. However, the oxide structures have not yet undergone validation, and the specific constraints and validation procedures remain to be finalized. The next stage will apply the workflow to generate amorphous $HfO_{2\ 5}$ structure and assess its consistency with available experimental data. Ultimately, this work seeks to provide a reproducible foundation for producing atomic-scale models that can support future investigations of amorphous oxide structure and its relationship to OxRAM device behavior.

Mentor(s):
Tillmann C Kubis (Engineering); Manas Pratap (Engineering); Namita Narendra (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7041
Presentation Time: STEW 218C at 10:20 AM-10:40 AM

Effect of Cerebrospinal Fluid Albumin on Nanoparticle Aggregation, Binding, and Transport in Collagen-Based Matrices

STEM

Authors(s):
Yuan Heidi Yue† (HHS|Science|JMHC)

Abstract:
Efficient intrathecal injection for delivering drugs to the brain depends on understanding how nanoparticles interact with and move through the extracellular matrix (ECM) surrounding neural tissue. Upon intrathecal injections, nanoparticle-based therapeutics encounter two major biological barriers: (1) formation of a protein biocorona from cerebrospinal fluid (CSF) proteins and (2) binding interactions with the extracellular matrix of the arachnoid and pia mater. While these interactions are known to occur, in vitro models to study their combined impact on nanoparticle transport remain limited. This project focuses on developing in vitro experimental models using type I collagen hydrogels to investigate how CSF proteins and tissue barriers influence nanoparticle transport. Collagen gels were prepared through self-polymerization and incorporated into a modified Transwell recovery assay, enabling observation of nanoparticle diffusion through a tissue matrix. We replicate these components using a layer of nanoparticles suspended in artificial CSF (aCSF) above the hydrogel tissue mimic. Albumin concentration in aCSF varied to evaluate how disease state impacts nanoparticle transport. Nanoparticles with distinct surface chemistries, including unmodified, carboxylated, aminated, and PEGylated types, were characterized. Results demonstrate that nanoparticle diffusion depended on surface chemistry and albumin concentration. Unmodified, carboxylated, and aminated nanoparticles exhibited increased transport at higher albumin levels. In contrast, PEGylated nanoparticles showed reduced transport and higher average pixel intensity but substantially fewer binding regions. Across all nanoparticle types, average pixel intensity decreased as albumin concentration increased. This work supports the design of nanoparticle therapeutics for neurological disorders, advancing strategies that improve brain drug delivery and patient health outcomes.

Mentor(s):
Julie C Liu (Engineering); Marisa Ann Egan (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7042
Presentation Time: STEW 218C at 10:40 AM-11:00 AM

Closed-Loop Path Tracking Control for an Autonomous Racing Go-Kart

STEM

Authors(s):
Manav Nikhil Gagvani† (Engineering); Jiashu Liu† (Engineering); Jaden Tang† (Engineering); Rithvik Praveen Kumar† (Science); Aran Pandey† (Science)

Abstract:
Autonomous racing requires a vehicle to follow a planned trajectory precisely, avoid obstacles, and stay stable at high speed. The control system is the final link in that chain: it turns the planner's trajectory into physical steering and throttle commands. Racing makes this especially demanding, since every decision must be made in real time on limited onboard computing power.

The Controls subteam of Autonomous Motorsports Purdue is developing a closed-loop controller for the team's autonomous go-kart. The controller receives the vehicle's position, speed, heading, and planned trajectory in real time and converts them into steering and throttle commands. We are implementing and comparing two geometric path-tracking controllers, Pure Pursuit and Stanley, to determine which better balances tracking accuracy, computational cost, and response time on our platform. In parallel, we are building a ROS 2 simulation environment to test each controller across track layouts and obstacle-avoidance scenarios before deploying it on hardware.

We expect to deliver a controller that keeps control-loop latency under one second while holding the kart on its intended path as vehicle conditions change. Performance will be measured by loop latency, cross-track error, and response to disturbances in simulation. Validating in simulation first shortens development time, limits risk to physical hardware, and improves reliability before track testing. The result will give the kart stable path following and responsive obstacle avoidance in competition.

Mentor(s):
Reed Joseph Freer (Engineering); Andres Felipe Hoyos Moreno (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7043
Presentation Time: STEW 218D at 10:00 AM-10:20 AM

Comparing EI vs CI High-resolution Mass Spectrometry Libraries to Identify Cycloalkanes, Alkenes, and Aromatic Hydrocarbons

STEM

Authors(s):
Gauri Srinath† (Science|JMHC)

Abstract:
Electron Ionization (EI) is a hard ionization method, causing extensive analyte fragmentation, leading to a weak molecular ion. Chemical Ionization (CI) is a soft ionization method that, despite some fragmentation, results in an intact pseudomolecular ion due to lower exothermicity from ion molecule reactions. EI and CI are used to create mass spectra libraries, which serve as reference databases to identify unknown compounds. In this study, methane CI was used to create a local CH4CI MS library. These techniques are important for the characterization of complex fuels, and cycloalkane, alkene, and aromatic hydrocarbons are specifically important for renewable fuel analysis.

Two-dimensional gas chromatography/high-resolution time-of-flight (GCxGC/TOF) mass spectrometry using interchangeable EI and methane CI sources was used. Cycloalkane, alkene, and aromatic hydrocarbon model compound mixtures were prepared, separated by GCxGC and ionized using either EI or methane CI, before being transferred into the TOF HRMS for analysis. Fragment ions observed in EI and CI MS were rationalized for formula assignment and adduct tracking.

The collected mass spectra were compared to either EI or CI MS libraries and similarity scores were assigned. Through CI MS, nearly all of the mass spectra obtained displayed an intact pseudomolecular ion, and more characteristic fragment ions. The molecular weight information missing for cycloalkanes and alkenes in EI, was confirmed through CI, resulting in more reliable identification.

Mentor(s):
Hilkka Kenttamaa (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7044
Presentation Time: STEW 218D at 10:20 AM-10:40 AM

New Ways of Maintaining Drone Stability Using Computer Vision AI's

STEM

Authors(s):
Brandon Vu Loehr† (Science)

Abstract:
The purpose of my project is to understand and discover ways that drones and autonomous aircraft can use computer vision to represent what they see as a wave in a spectral physics layer. The purpose of this is to allow drones to essentially "simulate" the wind physics and turbulent forces of the world around them based on what their cameras are feeding to the neural network. The hypothesis is that a spectral-domain model can predict incoming turbulence early enough for a flight controller to act on it, and that doing so reduces attitude error compared with reactive gyro-only control, which is the current industry standard. This work involves building a suitable convolutional neural network as the backbone using PyTorch, then converting it to a spectral domain, which is necessary for the calculations to fit on small lightweight hardware inside a drone. The wave frequencies are then cleaned and fitted, and are then converted back into a spatial grid, allowing for the calculation of wind velocity and pressure. The work can then be visually shown and tested in a 3D space simulation using Python or MATLAB. 2 different types of controllers are compared across a MATLAB simulation in identical wind scenarios, a gyro-controlled drone as a control group and a spectral CNN model that fits the hypothesis.

Mentor(s):
Yexiang Xue (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7045
Presentation Time: STEW 218D at 10:40 AM-11:00 AM

Agentic Onboarding for Empirical Evaluation of Machine-Learning Defense Interactions

STEM

Authors(s):
Adarsh Siva† (Science); Aniketh P Upadhya† (Polytechnic); Arjun Jagannathan† (Science); Felipe da Paixao† (DSB); Samuel Yanqi Li† (Science); Tiffany Yung† (Science|JMHC)

Abstract:
Real world machine learning systems require more than one guarantee such as privacy, robustness, and fairness. However, defenses designed for providing individual guarantees may interact in ways unexpectedly when combined. Ultimately, this creates trade offs that vary the intended protections. Being able to study these interactions helps with the empirical framework that's used to evaluate the various defense implementations. Onboarding the research code is difficult because repositories often have different dependencies, execution procedures, configuration, and the output formats.

We're developing an agentic onboarding module that helps automate this process. Using LangChain, the module will connect a language model to tools, which help in inspecting the repository, read the paper, prepare a YAML configuration, build the docker environments, execute the experiment, and validate the results. The reusable tool and the configurations that are specific to the paper help with onboarding with various research implementations.

The module uses structured configurations that specify execution settings, metric extraction rules, reference values, and tolerances. Its tools support the configuration loading, environment preparation, execution, and numerical validation. The run history allows persisting the run information and the results for analysis.

Our future work will involve evaluating the onboarding process on various repositories, and being able to connect the obtained implementations to the combined defense experiments. By being able to reduce the manual integration effort, it'll support the empirical investigation of how ML defense interacts and how systems are able to achieve the multiple guarantees.

Mentor(s):
Zahra Ghodsi (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7046

Presentation Time: STEW 214A at 11:00 AM-11:20 AM

Co-Designing a Sensory Table: How Stakeholder Interaction Shapes Engineering Decisions

STEM

Authors(s):

Gourav Pany† (Engineering); John Regan† (Engineering); Luke Alexander Macrina† (Engineering); Nathan Robert Walsh† (Engineering); Apostolos Constantine Zachariadis* (Engineering); Trinay Ravella* (Engineering); Quinn P Murphy* (Engineering)

Abstract:

Community-engaged engineering requires students to make design decisions through both technical analysis and stakeholder interaction. This study examines an undergraduate team's design of an adjustable sensory table for an early childhood learning environment, using co-design as a lens to understand how stakeholder input shaped engineering decisions across the design process. The team worked with an early childhood specialist to identify needs related to children ages two to five, teachers, custodial staff, and facilities personnel. Project documentation, including stakeholder needs, design specifications, prototype records, decision-making artifacts, and partner feedback, was analyzed to trace how stakeholder interactions were translated into design decisions. Early discussions informed requirements for adjustable height, locking wheels, structural stability, child-safe edges, tamper-resistant drainage, chemical-resistant materials, and ease of cleaning and transportation. Co-design became most visible during prototype review and testing. Partner feedback raised concerns about wheel security and stability and prompted consideration of additional shelf space and changes in the placement of sensory features. Testing also revealed drainage leakage, leading to further redesign of the sealing system. These interactions required students to negotiate among safety, usability, manufacturability, mobility, and partner priorities. The findings illustrate co-design as an iterative decision-making process in which stakeholder knowledge reshapes requirements, prototypes, and subsequent design choices. The study highlights how community-engaged design can help undergraduate engineers justify decisions through both technical evidence and stakeholder-informed reasoning.

Mentor(s):
Aparajita Jaiswal (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7047
Presentation Time: STEW 214A at 11:20 AM-11:40 AM

Measurement of Tissue Elastography through Ultrasound on Human Kidneys to Assess Fibrosis

STEM

Authors(s):
Anna Julie Astrid Webb† (Science)

Abstract:
In the US, approximately 34 patients are removed from the transplant list because they are too sick to receive a kidney or die waiting. One significant reason for this is high discard rates of “marginal” kidneys (high KDPI score). The Kidney Donor Profile Index (KDPI) scores cold ischemic times, anatomical complications, and biopsy histopathology. Biopsy is currently the main clinical method of assessing kidney fibrosis. This study will provide a non-invasive alternative, through ultrasound elastography using the FujiFilm VisualSonics Vevo F2xc system in collaboration with 34 Lives. During ultrasound, kidneys will be kept in a chemically controlled environment, including temperature regulation, oxygenator, and perfusate system with nutrients. Urine output, temperature (ºC), and pressure (mmHg) will be measured throughout image acquisition. Ultrasound elastography images will be taken at times 30 and 120 minutes, and biopsy at 120 minutes. Ultrasound elastography acquisition involves capturing image quality and stiffness of the same area, and then tracing to obtain area (mm2), velocity (m/s), and effective Young’s modulus (kg/m3). Analysis includes stitching ultrasound images of stiffness to form 3D representations, procuring pixel values, and comparison of biopsy and ultrasound elastography fibrosis measurements. This research is currently ongoing and in its early stages. Preliminary results show kidneys with a high KDPI score have shown more stiffness with ultrasound elastography. Ability to measure kidney elastography, without invasive techniques such as biopsy, could decrease time between kidney acquisition and transplantation. Additionally, accurate fibrosis data would ensure kidney health, improving outcomes of future transplant patients with renal disease.

Mentor(s):
Meera Pancholi Doran (Engineering); Craig Goergen (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7048
Presentation Time: STEW 214A at 11:40 AM-12:00 PM

Music-Induced Cardio-Autonomic Response with Wrist-Worn Triboelectric Pulse Sensors

STEM

Authors(s):
Shashwat Goel† (Science)

Abstract:
Most wearables reduce the pulse to a heart rate, which says little about the blood vessels themselves. As per Koelsch et al.[1] and their results indicating that music shifts autonomic state by roughly 1-2 beats per minute, we can see that music can shift autonomic state, which can alter the pulse wave measured at the wrist. Therefore, we ask whether a wrist-worn triboelectric pulse sensor developed in our lab can resolve those changes during music listening. 10 participants listen to three audio blocks: tracks ordered from calm to intense, a sustained dread-inducing piece, and a quiet piece interrupted by sudden noise bursts.

The analysis pipeline segments individual beats and extracts systolic peak amplitude, radial augmentation index, heart rate, and heart rate variability. Responses are analyzed beat by beat around discrete events and as block averages. The key test is whether amplitude or augmentation index still changes after heart rate is accounted for, which would indicate a vascular response and not just a cardiac one. If it does, the sensor could track stress-related vascular changes outside the lab.

[1] Stefan Koelsch, Lutz Jäncke, Music and the heart, European Heart Journal, Volume 36, Issue 44, 21 November 2015, Pages 3043–3049, https://doi.org/10.1093/eurheartj/ehv430

Mentor(s):
Wenzhuo Wu (Engineering); Robert Jose Ccorahua santo (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7049
Presentation Time: STEW 214B at 11:00 AM-11:20 AM

Investigating Transfer Learning from Clinical to Thigh-Based ECG for Automated Signal Classification

STEM

Authors(s):
Sidh Jain† (Engineering|JMHC); Hardayal Singh Harpal Singh Bajwa† (Science); Ishaan Vijaywargiya† (DSB); Jaina Yeonho An† (DSB)

Abstract:
Electrocardiography (ECG) measures the heart's electrical activity, but conventional monitoring requires electrodes attached to the body, making long-term use inconvenient. Thigh-based ECG sensors offer a less intrusive alternative, although differences in electrode placement and signal quality create challenges for artificial intelligence (AI) models trained on clinical ECG recordings.

This study investigates whether transfer learning, which applies knowledge from one dataset to another, can improve thigh-based ECG classification. A one-dimensional convolutional neural network (CNN), a deep learning model that recognizes patterns in signals, was trained on PTB-XL, a large clinical ECG dataset, achieving 75.72% accuracy on previously unseen recordings. The pretrained CNN was then adapted to tOLIET, a thigh-based ECG dataset containing 20 participants, and compared with an identical CNN trained from scratch. Signals underwent filtering, segmentation, and normalization. Five-fold participant-level cross-validation ensured that recordings from the same individual were never included in both training and testing.

Preliminary results showed that the CNN trained from scratch achieved 65% accuracy by consistently predicting the majority class, indicating limited ability to distinguish normal from abnormal recordings. The transfer learning model achieved 50% accuracy and did not improve overall classification under the evaluated conditions. Signal quality analysis also identified substantial saturation in several recordings. Differences between clinical and thigh-based ECG signals, limited data, and class imbalance may contribute to these findings, although their effects remain uncertain.

Ongoing work focuses on improving signal preprocessing, exploring alternative transfer learning strategies, and examining how signal quality affects classification. This research aims to better understand the

challenges of adapting clinical ECG models for unobtrusive cardiac monitoring.

Mentor(s):
Soudabeh Taghian Dinani (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7050
Presentation Time: STEW 214B at 11:20 AM-11:40 AM

Modeling Dust Deposition In Equine Airways Using A 3D-Printed Negative Tracheal Mold

STEM

Authors(s):
Ken Lynch† (Science|JMHC); Nora Fatzinger† (Engineering); Skylar Grace Weinstein† (Engineering); Henry Tran† (Engineering); Nathan Crute† (Engineering); Takuto Tominari† (Engineering); Max Nepochatov* (Engineering)

Abstract:
Recurrent Airway Obstruction (RAO), affecting roughly 15% of adult horses, is a chronic respiratory condition in which inhaled dust or pollen triggers airway inflammation and allergic responses. The goal of our study is to determine where inhaled particles deposit within the airway and use that information to guide future solutions for RAO.

To model airflow, we created a negative silicone mold of a horse's trachea. We first 3D-printed a section of the trachea using water-soluble PVA filament, then cast it in clear silicone inside an acrylic box. After dissolving the PVA, the resulting negative mold provides a transparent, durable structure for airflow visualization. We plan to test the model using a water pump designed to mimic the constant ebb and flow of equine breathing. We have not yet begun testing, as we just recently found the previous years mold and are currently working to optimize the pump system so that we can obtain optimal results.

Mentor(s):
Curtis Earl Marshall (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7051
Presentation Time: STEW 214C at 11:00 AM-11:20 AM

Polynomial Trim Cryogenic CMOS Smart Temperature for Quantum Computing Applications

STEM

Authors(s):
Elijah Francis Guison-Dowdy† (Engineering); Shayna Beatrice Messler† (Engineering)

Abstract:
Quantum computing requires on-chip temperature sensing near 4 K, because millikelvin shifts alter transistor behavior and add noise to qubit readout electronics. However, existing cryogenic CMOS temperature sensors can reach roughly 1 K error, since their PTAT response becomes nonlinear below about 50 K from carrier freeze-out, and the linear calibration they typically use cannot follow this curvature. We therefore designed and simulated a 4.2 K to 296 K sensor combining a subthreshold-biased PTAT PMOS/DTMOS sensing element with a feed-forward delta-sigma ADC, and replaced linear calibration with a polynomial trim that fits both the freeze-out and normal regions. We evaluate the maximum temperature error across the full range, 4.2 K to 296K for linear trim. Results are simulation-only, and higher-order trims need more calibration points and risk overfitting. Next, we will fabricate the chip and validate it, enabling real-time thermal compensation of quantum control electronics.

Mentor(s):
Seyedehmarzieh Rouhani (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7052
Presentation Time: STEW 214C at 11:20 AM-11:40 AM

Commercial Satellite Self Defense

Business Case Study

Authors(s):
Henry Thomas Gleason† (Engineering|JMHC)

Abstract:
Most discussions involving the ethics of weaponry and self-defense in space concerns critical military satellites that support national security. However, these discussions fail to highlight the expanding impact commercial satellites have upon the health and security of the American people. Through a scholarly review of past published literature, the self-defense laws regarding cargo ships have been compared with those regarding international space treaties. Both cargo ships sailing in support of the global trade network and commercial satellites provide critical services to the health and safety of civilians. Throughout this review, the similarities between maritime law and international space treaties have failed to agree on the issue of self-defense and liability as a result of said actions. As a result, it is suggested that there may be ethical grounds for amending international space treaties to allow commercial satellites to carry self-defense measures to protect those back on Earth. While allowing for commercial satellites to remain "sitting ducks" in orbit, a foreign actor has an essentially consequence free ability to target, disrupt, and even destroy a commercial American critical infrastructure satellite. In this paper, multiple methods of self-defense are proposed for different potential satellite constellations.

Mentor(s):
Dana Tulodziecki (Liberal Arts); Frankie Knuckles (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7053
Presentation Time: STEW 214D at 11:00 AM-11:20 AM

Language as a Window into Cognition: The Real-Time Processing of Grammatical and Ungrammatical Questions

Social Science

Authors(s):
Carys Adeline Baglia† (HHS|JMHC); Deepti Aksharra Ramasamy† (Liberal Arts|Science)

Abstract:
This study investigates whether native English speakers use their knowledge of grammar to interpret sentences in real time, i.e., as sentences unfold one word at a time. In grammatical sentences such as “I know which truck Amy said that Ben once crashed a very expensive car into,” readers are known to interpret the phrase “which truck” as the object of the preposition “into,” creating a wh-dependency between the earlier and later parts of the sentence. However, it is not known whether readers create these wh-dependencies in sentences with minor ungrammaticalities, e.g., in sentences like “I know which truck Amy asked if Ben once crashed a very expensive car into”. (The specific minor ungrammaticality of interest in our study stems from the use of an embedded question, i.e., “asked if,” rather than a declarative clause, i.e., “said that.”) To examine whether native English speakers create wh-dependencies in these types of ungrammatical sentences during real-time sentence processing, participants will complete a self-paced reading task in which grammatical and ungrammatical sentences like the ones above are presented word by word. Reading times reflect the cognitive load, i.e., the amount of mental effort used to process each word. Our stimuli use a 2 x 2 design that manipulates whether a sentence contains a wh-dependency and whether it is grammatical or minorly ungrammatical, resulting in four conditions: grammatical without a wh-dependency; grammatical with a wh-dependency; minorly ungrammatical without a wh-dependency; and minorly ungrammatical with a wh-dependency. We predict that in real time participants will create wh-dependencies in the grammatical sentences but not in the minorly ungrammatical sentences. We will discuss the study's motivation, design and predictions; stimuli-writing is ongoing.

Mentor(s):
Kyle Robert Swanson (Liberal Arts)

Other Acknowledgment(s):
Vanessa Sheu* (Liberal Arts)

Talk Presentation Abstract Number: 7054
Presentation Time: STEW 214D at 11:20 AM-11:40 AM

Sociocultural Linguistic Analysis of English and Russian via the Niche Language Hypothesis

Humanities

Authors(s):
Nicholas James Berger† (HHS|Liberal Arts)

Abstract:
Language change, despite being among the most studied topics in linguistics, remains in no small part, a mystery. Researchers can guess why language changes and often reconstruct the processes by which languages change, but the directionality of change as well as the timing of both the onset of language change and the conclusion of language change lack uncontroversial predictive theories. Recently, there has been a preference for statistical qualitative analysis of thousands of languages in an attempt to find correlations that may provide greater insight into the nature of language change. Among other such hypotheses, the Niche Language Hypothesis is a direct result of this broad statistical analysis. The NLH claims to provide predictive power regarding language change on sociolinguistic and geographic grounds, though is limited both in scope and experimental evidence backing the hypothesis. As well, the recent prevalence of sociolinguistics and ethnographic linguistics seems to have resulted in a relative lack of direct inter-linguistic comparison through the lens of these new hypotheses.

The present study seeks to directly compare both the contemporary forms of Standard Russian and Standard English, as well as previous and niche forms of these languages in order to evaluate the Niche Language Hypothesis as it applies to these languages. English and Russian are good choices for comparison due to their divergent historical developments, as well as their shared linguistic ancestry allowing us to directly isolate the ways in which their sociocultural and geographic differences changed the archaic forms of each language, leading to their modern representations. We hypothesize that, while the Niche Language Hypothesis will provide an apt explanation for certain linguistic divergences observed between both languages, it will not be able to provide a full account of the morphological changes attested in each languages' previous forms.

Mentor(s):
Olga Lyanda-Geller (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7055
Presentation Time: STEW 214D at 11:40 AM-12:00 PM

Wanting What Others Have: How Social Comparison and Materialism Change from Adolescence to Adulthood

Humanities

Authors(s):
James Ren† (DSB)

Abstract:
People often compare what they have to what other people around them have. When we are younger, this could mean wanting the same shoes, clothes, phone, or other possessions as our friends. As we get older, these comparisons may shift toward things like cars, houses, income, careers, or even someone's overall lifestyle. This raises the question of whether people actually become less materialistic as they get older or if the things they compare and desire simply change.

This project will research how social comparison and the desire for material possessions change from adolescence to adulthood. It will look at why seeing what other people have can affect what we want ourselves and how factors such as self-esteem, social status, and relative deprivation influence this behavior. The project will also consider whether the people and possessions we compare ourselves to change at different stages of life.

Research will be conducted through a review of peer-reviewed studies in psychology, sociology, and consumer behavior. Research on materialism, social comparison, age, self-esteem, and social status will be compared across adolescence and adulthood. Through this research, the project aims to better understand whether people grow out of wanting what others have or whether social comparison simply takes on different forms as we get older.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7056
Presentation Time: STEW 218A at 11:00 AM-11:20 AM

Developing Adenine Base Editing to Correct a Splice-Site Variant in SCN2A and Restore NaV1.2 Function

STEM

Authors(s):
Jonathan Sam Suresh† (Science|JMHC)

Abstract:
SCN2A encodes for a voltage-gated sodium channel, NAV1.2 that is essential for neuronal excitability where variants associated with neurological disorders including autism spectrum disorder (ASD) and epilepsy. Previous studies in our lab identified a splice-site variant between Exons 21 and 22 that disrupts normal RNA splicing, resulting in Exon 22 skipping and production of a truncated or nonfunctional NaV1.2 protein. This study aimed to develop an adenine base editing (ABE) approach to correct this splice-site variant and restore Exon 22 inclusion to rescue functional NaV1.2 protein. Unlike traditional CRISPR-Cas9 approaches that generate double-stranded DNA breaks, ABE uses a Cas9 nickase and adenine deaminase to precisely modify a single nucleotide while minimizing bystander editing. Four ABE variants and ten single-guide RNAs (sgRNAs) were evaluated to identify an optimal combination for editing efficiency. A composite plasmid containing both ABE and sgRNA was introduced into patient-derived induced pluripotent stem cells (iPSCs) using Lipofectamine. DNA was extracted, amplified, and verified through gel electrophoresis before Sanger and next-generation sequencing were used to quantify editing efficiency and assess potential bystander editing. The optimized construct was packaged into AAV9 with a fluorescent reporter to confirm viral uptake in neurons through microscopy. Preliminary sequencing demonstrated approximately 8% editing efficiency in homozygous neurons carrying the variant. Although further optimization is needed, these findings establish a foundation for evaluating whether ABE-mediated correction can restore normal SCN2A splicing and NaV1.2 function. Future studies will assess this approach in humanized SCN2A rat models and human brain organoids.

Mentor(s):
Manasi Suchit Halurkar (Pharmacy); Yang Yang (Pharmacy)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7057
Presentation Time: STEW 218A at 11:20 AM-11:40 AM

Identifying Oncogenic Driver Genes in Glioblastoma to Overcome Treatment Resistance via Targeted Immunotherapy

STEM

Authors(s):
Carol Marion Hercules† (Engineering); Quazi Arisha Mahmud† (Engineering); Claire Martel† (Engineering|JMHC); Alex Adrian Rivera† (Engineering)

Abstract:
Glioblastoma (GBM) is the most aggressive primary malignant brain tumor found in adults. It is an extremely aggressive form of cancer that is considered largely incurable through traditional therapies and medical procedures. GBM is characterized by its complex tumor microenvironment (TME), high genetic variability and mutation rates, and unique growth patterns. Together, these factors contribute to GBM's increased resistance to common cancer treatments such as surgery, chemotherapy, and radiation therapy. The goal of this project is to develop new and innovative methods to effectively treat GBM. Currently, techniques utilizing targeted immunotherapy through the genetic modification of immune cells, such as natural killer (NK) cells, have shown promise in infiltrating GBM-specific TMEs. To succeed in this high-impact neuro-oncology research, it is first important to identify specific oncogenic driver genes that give GBM its inherent resistance. Using data generated through modern gene sequencing technologies, we have identified disrupted gene expression and immune signatures in GBM tumors by comparing tumor tissue with healthy tissues and those from other cancer subtypes, allowing us to better understand the molecular characteristics that distinguish GBM. By combining this approach with the development and use of three-dimensional organoid systems to simulate the complex architecture of the GBM TME, we aim to better understand the key biological mechanisms driving GBM and develop targeted cell-based immunotherapies against this disease.

Mentor(s):
Sandro Matosevic (Pharmacy)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7058
Presentation Time: STEW 218A at 11:40 AM-12:00 PM

Effects of alpha-Synuclein Variants on Synapsin 1 Condensates: Turbidity, FRAP and FRET/FLIM Analysis of LLPS

STEM

Authors(s):
Laura Sofia Gomez Toscano† (Pharmacy)

Abstract:
The presynapse is rich in intrinsically disordered proteins, including synapsin 1 (Syn1) and alpha-synuclein (aSyn), that contribute to synaptic vesicle (SV) organization and neurotransmission. Syn1 promotes SV organization by forming liquid-like condensates that recruit both SVs and aSyn. Clustering dynamics are critical for neurotransmitter release, as they influence how efficiently a neuron can sustain neuronal communication. Recent work demonstrated that excess aSyn slows Syn1/SV condensate formation in vitro, highlighting the importance of Syn1:aSyn stoichiometry in condensate assembly. How the Syn1-aSyn interaction regulates condensate dynamics, and how Parkinson disease (PD)-associated aSyn mutations affect this process, remain poorly understood. We will investigate how aSyn abundance and disease-associated variants modulate Syn1-mediated condensation. In vitro, turbidity assays will be used to quantify condensate formation at varying Syn1:aSyn ratios. In HEK cells and neuronal cultures, fluorescence recovery after photobleaching (FRAP) and fluorescence lifetime imaging microscopy (FLIM) will assess condensate dynamics and Syn1-aSyn interactions, respectively, at varying levels of Syn1 and aSyn expression. We will compare wild-type aSyn with a phosphomimetic mutant, as well as variants with familial PD mutations or C-terminal truncations, to determine how disease-relevant modifications influence these processes. We hypothesize that Syn1:aSyn stoichiometry regulates condensate assembly and dynamics, and that aSyn variants alter these properties. This work will establish a framework for studying LLPS regulation across systems, using HEK cells for controlled expression and neurons for physiological relevance. Moreover, our research will clarify how Syn1/aSyn condensates support and maintain the vesicle mobility required for neurotransmitter release, and how their disruption could contribute to PD.

Mentor(s):
Jean-christophe Rochet (Pharmacy); Bryce Colon (Pharmacy); Katie Lynn Whitcomb (Pharmacy)

Other Acknowledgment(s):
Kevin J Webb* (Engineering)

Talk Presentation Abstract Number: 7059
Presentation Time: STEW 218B at 11:00 AM-11:20 AM

Modeling the Effects of Bowden Cable Compliance and Friction on Torque Transmission in a Two-Degree-of-Freedom Robotic Ankle

STEM

Authors(s):
Parwa Alexandra Alagon Aguilar† (Polytechnic)

Abstract:
About 150,000 lower-limb amputations occur each year in the United States. To restore natural gait, we developed a robotic ankle prosthesis, featuring two degrees of freedom (2-DOF): dorsiflexion/plantarflexion (DP) and inversion/eversion (IE). It uses a tethered actuation system where body-mounted motors pull the foot through wires sliding inside flexible housings (Bowden cables). However, cable compliance and friction introduce non-linearities, causing the torque-to-current ratio to vary significantly with ankle kinematics and cable tension. To map this behavior across the ankle's workspace, the prosthesis was mounted on a custom test stand at fixed angles within a ±20° range for each motion. The foot was clamped on a force plate to measure ground reaction forces. At each angle, the motors received sinusoidal current commands from 0.1 to 10 Hz, operating in common mode for DP and differential mode for IE. Trials were conducted using a rigid wooden foot, while testing with a flexible carbon-fiber foot is planned for future work. By fitting the empirical data to a mass-spring-damper model, we identified key system parameters including torque per ampere, natural frequency, damping ratio, and bandwidth. Comparing the measured torque per ampere with the rigid-cable theoretical predictions (9.8 N·m/A for DP, 6.2 N·m/A for IE) gives the transmission efficiency. These models communicate the required torque to the actuator at every ankle angle. With that knowledge, the controller can apply accurate ankle torques, the basis for a prosthesis that responds naturally and stays stable and safe when people walk on it.

Mentor(s):
Mo Rastgaar (Polytechnic); Jorge Enrique Neira Garcia (Polytechnic)

Other Acknowledgment(s):
Darren Chang* (Engineering)

Talk Presentation Abstract Number: 7060
Presentation Time: STEW 218B at 11:20 AM-11:40 AM

How the Agentic AI Model Will Continue to Shape the Modern World

STEM

Authors(s):
Nathan Eli Adamson† (Polytechnic)

Abstract:
Agentic Artificial intelligence (“AI”) is an emerging form of Artificial Intelligence which manifests as an independent, self-governed agent capable of autonomously pursuing specified objectives with varying levels of autonomy. The proliferation of Agentic AI throughout various industries has given rise to significant technological and societal advancements, most recently inter-agent communication models, utilizing multiple agents interacting to complete more complex tasks. However, many questions have also been posed regarding its use cases, ethics, and potential future evolutions. In order to examine these developments, this paper will review and expand upon research presented by Mohamad Abou Ali and Fadi Dornaika.

Drawing on existing research of the structure and architecture of Agentic AI from available sources, combined with current industry trends and market capabilities, informed proposals for controls of the technology are hypothesized. Ethical questions that may arise from those iterations, specifically environments where multiple agents work together to accomplish a goal, are answered with actionable controls that can be implemented to help prevent adverse effects arising from task underspecification, misuse of available resources, and goal drift. These controls were tested in a multi-agent environment where a forbidden resource was accessible, yet agents were instructed not to use it for a task in three different prompts (one underspecified, one sufficiently specified, one control with no specification against the use of the resource).

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7061
Presentation Time: STEW 218B at 11:40 AM-12:00 PM

Multimodal Monitoring and Data Driven Machining Parameter Optimization for Carbon Fiber Reinforced Thermoplastic Composites

STEM

Authors(s):
Alejandro Diaz Pinales† (Engineering)

Abstract:
Large-scale additively manufactured carbon-fiber-reinforced thermoplastic molds require post-machining to meet surface quality and dimensional accuracy requirements. Yet selecting reliable cutting parameters remains difficult because heterogeneous material behavior and progressive tool wear can compromise machining quality and process stability. This research aims to develop and evaluate a multimodal, data-driven framework that links machining conditions and tool-wear progression to measurable process responses. Three-axis router experiments will vary spindle speed, feed rate, depth of cut, and cutter configuration. Surface quality, dimensional accuracy, and tool wear will serve as primary outcomes. A triaxial accelerometer, microphone, and thermal camera will capture vibration, airborne acoustic, and temperature signals. Automated cutting-event detection will isolate material-removal intervals, enabling pass-level analysis of time- and frequency-domain features. Periodic tool inspection will provide wear measurements that can be associated with sensor signatures and machining outcomes. Machine-learning models will be evaluated for identifying abnormal cutting states, estimating tool wear, and informing parameter selection. The approach will first be assessed on a carbon-fiber-reinforced thermoplastic and subsequently tested on additional composites to examine cross-material transferability. By connecting controlled machining experiments with synchronized sensing and direct tool-condition measurements, the study seeks to establish a reproducible basis for wear-aware machining optimization and future adaptive control.

Mentor(s):
Garam Kim (Polytechnic); Sucheol Woo (Polytechnic)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7062
Presentation Time: STEW 218C at 11:00 AM-11:20 AM

Calibration of Polymarket Daily Temperature Markets

Business Case Study

Authors(s):
Kayla H Lee† (DSB|Science)

Abstract:
Prediction markets are used to forecast uncertain natural events like temperature outcomes and natural disaster probabilities. There is less known about how well short duration prediction markets are calibrated and whether the patterns of earlier prediction market hypotheses continue to hold in newer markets such as Polymarket. This study examines the calibration of Polymarket daily temperature threshold markets by replicating and extending Page and Clemen (2013), who documented a favorite longshot bias in political prediction markets on Intrade. This extension covers 7,423 markets and 40 cities from January 1st, 2025 through July 31st, 2026 and the analysis evaluates calibration across multiple time expiration horizons using nonparametric reliability diagrams, a parametric Lattimore S-curve, clustered bootstrap confidence intervals, and covariate models incorporating trading volume, horizon, and city effects.

Contrary to the original hypothesis, the results provide evidence of overconfidence rather than favorite longshot bias. The estimated curvature parameter, $\hat{\gamma}$, exceeded 1 at all primary horizons and was statistically significant at the 1 hour, 6 hour, and 1 day horizons within the market closure. Therefore, the results suggest that short duration temperature markets exhibit calibration patterns that differ substantially from those documented by Page and Clemen, with trading volume appearing more important than time to expiration in explaining the observed bias.

Mentor(s):
Qifan Song (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7063
Presentation Time: STEW 218C at 11:20 AM-11:40 AM

Characterization and Stacking of 2D Materials

STEM

Authors(s):
Sri Krishna Teja Mannava† (Science)

Abstract:
This project focuses on the fabrication and low-temperature characterization of two-dimensional heterostructures based on the superconducting layered material 2M-WS_2. Thin flakes of 2M-WS_2 and hexagonal boron nitride (hBN) are mechanically exfoliated and identified before being assembled into heterostructures using a dry-transfer stacking technique. Because the quality and electronic properties of two-dimensional materials can be strongly affected by contamination and environmental exposure, exfoliation and stacking are performed inside an inert-atmosphere glovebox. hBN is used to protect the 2M-WS_2 and provide a clean interface for subsequent measurements. The fabricated devices are characterized using low-temperature experimental techniques to investigate their electronic and superconducting behavior. Electrical transport measurements are performed in a helium-3 cryogenic system, allowing measurements at temperatures where superconducting phenomena can be observed. Scanning tunneling microscopy (STM) is also used to probe the local electronic structure of the material. Through controlled fabrication and complementary transport and microscopic characterization, this work aims to better understand the low-temperature properties of 2M-WS_2 and establish reliable methods for preparing high-quality superconducting two-dimensional heterostructures.

Mentor(s):
Andres Eduardo Llacsahuanga Allcca (Engineering|Science); Leonid P Rokhinson (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7064
Presentation Time: STEW 218C at 11:40 AM-12:00 PM

Developing a Framework for Least-cost Path Modeling of Wildlife Corridors in the Northern United States

STEM

Authors(s):
Aidan Feirstein† (Science|JMHC); Julianna Victoria Vishnyakova‡ (Science|JMHC); Alden James Brinkmann* (Science); Vittal Rajagopalan* (Engineering); Ishani Roy* (Science|JMHC)

Abstract:
Habitat fragmentation caused by residential, industrial, and agricultural development reduces habitat suitability and limits movement for many species, posing a significant challenge to wildlife conservation. Wildlife corridors offer a potential solution by connecting fragmented habitats, but identifying routes that are both ecologically suitable and economically feasible requires careful consideration of environmental and financial constraints.

This project aims to establish a methodological foundation for developing a least-cost wildlife corridor model applicable across the northern United States, with the long-term objective of facilitating the movement of mesocarnivores, such as the bobcat (Lynx rufus), and supporting natural recolonization by the gray wolf (Canis lupus). During the initial phase of this research, we conducted a preliminary least-cost path analysis using landscape barriers. The output paths informed the selection of 58 sites in Indiana for remote ecological monitoring between 2023 and 2026. Using existing ecological monitoring data and findings from previous research, we will identify candidate least-cost path parameters that may be associated with bobcat presence and broader biodiversity. Additionally, we will investigate statistical methods for evaluating the predictive value of these parameters, with the goal of selecting the most informative variables for inclusion in an eventual wildlife corridor model.

The anticipated outcome of this research is a proposed framework for evaluating habitat suitability alongside land acquisition costs. These findings will inform the future development of a spatial optimization model designed to identify economically feasible wildlife corridors that facilitate movement between fragmented habitats. They will also contribute to a proposed 20-year land acquisition strategy for NICHES Land Trust, a conservation organization serving north-central Indiana, to support the establishment of such a corridor.

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Mentor(s):
Kristen Marie Bellisario (JMHC)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7065
Presentation Time: STEW 218D at 11:00 AM-11:20 AM

MVP-Tac: A Miniaturized Dual-Modal Vision and Photoelastic Tactile Sensor for Robot-Assisted Minimally Invasive Surgery

STEM

Authors(s):
Adyaa Khera† (Polytechnic); Mason A Vrshek‡ (Engineering)

Abstract:
Robot-assisted minimally invasive surgery (RMIS) offers major benefits over open and conventional laparoscopic procedures, yet it still lacks tactile feedback for palpation while operating under strict requirements to preserve reliable vision for navigation and safety. In practice, visual feedback is indispensable, and tactile solutions that cannot coexist with vision are difficult to translate into RMIS tools. To address both needs, we introduce MVP-Tac, a compact, vision-based tactile sensor that provides co-located vision and tactile sensing. MVP-Tac uses reflective photoelastic imaging: a thin photoelastic elastomer produces stress-dependent interferograms under contact that are captured by an embedded camera through a miniaturized reflective polariscope. A semi-transparent membrane and controllable illumination enable switching between visual mode and tactile mode, enabling tactile perception without sacrificing vision. We validate MVP-Tac through force calibration in the 0 to 2 N range and demonstrate its potential for tumor palpation via video-based hardness classification on tissue phantoms, achieving 97% accuracy for exposed-tumor classification and 92% accuracy for subdermal-tumor classification. Finally, we conduct a simulated colonoscopy to validate both visual and tactile modalities in a constrained lumen, including vision-guided 3D photomapping of the luminal wall and in situ hardness classification of localized nodules. Overall, MVP-Tac provides a practical path toward restoring clinically useful palpation in RMIS while maintaining essential visual feedback.

Mentor(s):
Yu She (Engineering); Md Rakibul Islam Prince (Engineering)

Other Acknowledgment(s):
Jaeeun Kim* (Engineering); Yuhao Zhou* (Engineering); Sheeraz Athar* (Engineering)

Talk Presentation Abstract Number: 7066
Presentation Time: STEW 218D at 11:20 AM-11:40 AM

Evanescent-Mode Resonators Coupling Extraction for Multipurpose Filtering Devices

STEM

Authors(s):
Nishaant Guptan Veemboor† (Engineering)

Abstract:
Recent work has demonstrated the feasibility of co-designing filtering quadrature couplers with balanced amplifier architectures. The coupler employs four high-Q evanescent-mode (EVA) substrate-integrated waveguide (SIW) cavities with contactless tuning, doubling as a power combiner and bandpass filter. Co-designing filters with power amplifiers reduces the size, loss, and interconnect overhead of RF transmitters. However, each port couples directly to a single resonator, which limits the out-of-band rejection and bandwidth. This work examines whether the coupler can be extended to higher filtering orders by inserting a cascade of three EVA-mode resonators at each port to increase the out-of-band rejection and bandwidth.

The required couplings are realized and characterized with full-wave electromagnetic simulation. The external coupling between each port and its first cascaded resonator is studied in a single cavity fed by grounded coplanar waveguide (GCPW) through arc-shaped coupling slots. With the tuning gap of 50 μm, the resonance is placed at 2.5 GHz. The slot width, slot aperture angle, and feed position are swept to map the achievable external quality factor (Qe). Inter-resonator coupling (k) along the cascade is extracted from eigenmode simulations of two cavities sharing a via wall, as a function of the inductive opening. The resulting design curves are compared against the coupling values of the cascaded coupler to determine whether the higher-order topology can be physically realized within fabrication limits.

Mentor(s):
Alex Santiago-Vargas (Engineering); Dimitrios Peroulis (PWL)

Other Acknowledgment(s):
Mohamed F Hagag* (PWL)

Talk Presentation Abstract Number: 7067
Presentation Time: STEW 218D at 11:40 AM-12:00 PM

Workload-Aware Python Code Optimization Using Local LLMs

STEM

Authors(s):
Aybars Yunusoglu† (Engineering|JMHC); Amr El Sayed Rageh† (Engineering); Ishaan Sahu† (Engineering); Ian Mitchell Yao† (Engineering); Alan H Hsi‡ (Science)

Abstract:
Large Language Models (LLMs) can make Python code faster, but a speedup on a few test inputs does not always apply to real workflows. Frameworks like PerfCodeGen, SBLLM, and FasterPy get better at finding faster code, but their reported experiments rely on predefined inputs. A change that performs well on those inputs may be slower on others. This is especially relevant for local open-weight models, which may need several attempts to find a useful optimization, making reliable performance checks even more important.

We built a baseline that takes Python code, its tests, and a target workload, then asks a local model to suggest performance improvements. The system keeps the change if the generated code passes the tests, matches the original's outputs on tested inputs, and runs faster across repeated measurements. If a change fails, the model receives feedback and tries again. The final candidate is checked on inputs held out during the search. To test this approach, we wrote an optimization that is fast on small inputs and slow on large ones. The baseline measured a 50x speedup and accepted it; however, on larger unseen inputs it took two to three times longer than the original.

We are now extending the baseline, making it choose what to measure, rather than relying on fixed inputs. The tool will check if the code stays faster on larger inputs, generate new inputs when there is no clear winner between candidates, and track memory use when an optimization trades memory for speed, feeding results back to the model. We are improving profiling, multi-candidate search, and behavior checks. We hypothesize that this will reduce accepted changes that are slower on unseen inputs. We will compare it with the fixed-input approach using the same model and time budget on COFFE, SWE-fficiency, and other open-source Python projects, reporting speedup, memory, failures, and cost.

Our goal is to make Python code optimization using local LLMs more reliable across workflows.

Mentor(s):
James C Davis (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7068
Presentation Time: STEW 214A at 12:00 PM-12:20 PM

Food Volume Estimation Using Stereo Video from Smart Glasses

STEM

Authors(s):
Vivan Kumar† (Science|JMHC)

Abstract:
Convenient and accurate methods for food portion estimation are crucial for creating personalized nutrition plans and managing diet-related conditions such as diabetes and obesity. While systems like vision-language models (VLMs) are increasingly successful at recognizing food types from images and videos, estimating the portion volumes needed to compute a meal's caloric content requires deriving the food's true size and 3D shape; this remains challenging for approaches that rely on a single image. We introduce a method that automatically reconstructs 3D models of food items from stereo video — footage from two cameras located a fixed distance apart — recorded on wearable smart glasses as the wearer makes a "scanning" motion around the plate. Stereo video provides a natural cue, much like human vision, for understanding how far objects are from the camera in a scene; we leverage it along with the trajectory of the glasses to "fuse" multiple views of a food item into a single 3D model. The resulting models are visually accurate and in true physical scale, allowing for portion estimation that eliminates the user burden of holding a phone to capture images or placing an object with known dimensions in the scene as a scale reference. On six everyday food items, ranging from an apple to a sub sandwich, our approach estimates volume with a mean absolute percentage error of 8.5%. These results demonstrate our approach's viability as a step towards completely passive food intake monitoring. Because none of the steps in our pipeline are specific to food, our method also produces realistic, true-scale 3D replicas of everyday objects such as a pill bottle and a cardboard box, with potential applications in robotics and augmented reality. Future work will remove the need for a deliberate scanning motion around the food item and adapt the approach to natural videos of eating episodes where the wearer's hands and utensils frequently block the food.

Mentor(s):
Fengqing Zhu (Engineering); Gautham Vinod (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7069
Presentation Time: STEW 214A at 12:20 PM-12:40 PM

Analyzing Patterns to Develop Successful Studying Habits

STEM

Authors(s):
Erich Hetz† (Science)

Abstract:
College students are often focused on gaining information to succeed on the tests administered to them. In this exploratory research project, I investigate which studying methods are most applicable to students trying to achieve their best scores, highlighting disparities in efficiency among the different techniques. I found this information through researching statistics and reputable articles found through the Purdue Libraries that contribute to the overall analysis of the processes. The research will allow students, instructors, and administrators to see what methods work for studying, so they can create a learning environment that maximizes success and understanding.

Keywords: Psychology; Statistics; Memory; Learning; Studying

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7070
Presentation Time: STEW 214A at 12:40 PM-1:00 PM

The Effect of Kabuki Syndrome on the MAP-Kinase Cascade and its Implications

STEM

Authors(s):
Lillian Deetz† (Science)

Abstract:
Kabuki Syndrome (KS) is a rare neurodevelopmental disorder commonly caused by mutations of the genes encoding the chromatin regulators KMT2D and KDM6A. Kabuki Syndrome encompasses many symptoms and is often studied in case-by-case fashion rather than on a large scale due to the considerable variety of differences within both the genotypic and phenotypic presentations of the disorder. The spectrum of phenotypes displayed has long been an issue in medical treatment of Kabuki Syndrome. While much about Kabuki Syndrome remains unknown and unresearched, recent investigations into cell signaling pathways within these patients suggest a direct correlation between KS-associated genes and MAPK/ERK signaling pathways. The MAPK/ERK pathway activates the MAP-Kinase cascade which has been implicated in the process of human development, and its perturbation has been implicated in the causation of developmental delays. Through the review and collection of pre-existing literature, this research aims to examine the mutations within the MAPK/ERK pathway that can cause symptoms associated with developmental disorders such as KS. This research also aims to identify potential treatments for KS, such as administration of small molecule inhibitors focused on the MAPK/ERK pathway. Effective treatment of KS symptoms through the MAPK/ERK pathway could establish standards of care for KS that currently do not exist.

Key Words: Kabuki Syndrome, Genetic Abnormalities, Cell Signaling, Neurodevelopmental Disorders, Chromatin Regulators, KMT2D, KDM6A, MAPK/ERK pathway, MAP-Kinase cascade

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7071
Presentation Time: STEW 214B at 12:00 PM-12:20 PM

Evaluating Moral Reasoning Across Large Language Models and Model Generations

STEM

Authors(s):
Srikrishna Brihadishwara Rajarajan† (Engineering); Kelvin Sam Zebah Singh Alfred‡ (Texas A&M)

Abstract:
As artificial intelligence (AI) and large language models (LLMs) increasingly integrate into society, their growing involvement in ethically sensitive domains highlights the need to evaluate their moral reasoning capabilities. Kohlberg's Theory of Moral Development provides a framework for classifying ethical reasoning based on responses to moral dilemmas. Building upon our previous work evaluating ChatGPT, Gemini, Perplexity, and DeepSeek, we expand our analysis to newer versions of these models while also testing three additional LLMs: Claude, Grok, and Copilot. By presenting each LLM with moral dilemmas and classifying their responses using Kohlberg's Theory of Moral Development, we evaluate differences across the LLMs and their model generations. Our research questions include: (RQ1) Which of Kohlberg's Stages of Moral Development do different large language models show signs of?; (RQ2) To what extent does the specific context of a moral dilemma affect the moral development stage(s) that the large language models demonstrate in their responses?; and (RQ3) How do moral reasoning patterns and their corresponding Kohlberg Stages of Moral Development differ between earlier and newer versions of the same LLM? Our previous findings indicated that LLMs typically reflected characteristics associated with Stage 6 (Universal Ethical Principle Orientation) and Stage 4 (Law and Order Orientation). This expanded study investigates whether this pattern persists across the newer model versions and additional LLMs.

Mentor(s):
Pragathi Durga Rajarajan (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7072
Presentation Time: STEW 214B at 12:20 PM-12:40 PM

Automated Radio Evaluation Suite: Multi-port Antenna Measurements

STEM

Authors(s):
Joseph Timothy Kritenbrink† (Engineering)

Abstract:
Every wireless system, from satellites to 5G networks, depends strongly on antenna performance, making accurate characterization essential to developing new designs. Modern antenna systems, including multiple-input multiple-output (MIMO) designs, require measurements across multiple ports and signal directions. However, most antenna-characterization software, including earlier versions of our own Automated Radio Evaluation Suite (ARES), assumes a two-port measurement with one connection to the antenna under test and one to a reference antenna, limiting its ability to characterize multi-port designs. We extended ARES to support an arbitrary number of ports, each assigned a role (test antenna or reference) and a direction (transmitting or receiving). From this configuration, the software automatically collects the required measurements and reports per-path gain, isolation, and efficiency, measuring both directions of each path independently rather than assuming reciprocal behavior. We validated the system in an anechoic chamber from 2 to 3 GHz using a two-port quad-ridged horn and a single-port reference antenna. The measurements recovered path gains of approximately 6-9 dBi and greater than 90% power acceptance at the test port. Because both antennas are reciprocal, forward and reverse measurements should agree; observed differences remained within 0.35 dB and 2.2 degrees, demonstrating directional measurement consistency. ARES is being released as a free, open-source software to support adoption and extension by others. Future work will apply the generalized framework to examine the non-reciprocal radiation characteristics of a topological leaky-wave antenna.

Mentor(s):
Alex Santiago-Vargas (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7073
Presentation Time: STEW 214B at 12:40 PM-1:00 PM

Reducing Data Transmission Latency in Autonmous Racing Systems

STEM

Authors(s):
Christian Scheckel† (Engineering); Brandon Christopher de Jong† (Engineering); Isaac Paul Grosman† (Engineering); Marcus Milewski† (Engineering)

Abstract:
The purpose of this research is to find and develop optimal electrical solutions to reduce latency (delay) for the transmission of data from sensor to actuation of an autonomous driving system, specifically within the constraints of a go-kart platform.

Autonomous driving systems require information to be recorded and interpreted incredibly quickly to keep up with the rapidly changing environment surrounding a moving vehicle. Data must travel through several different stages from sensor, to processor, to controller, to control devices, which introduces many potential points for slow downs and delays to occur. These delays can cause the system to have delayed or erroneous reactions, which can result in a crash.

The existing controls and data transmission systems on Autonomous Motorsports Purdue competition kart will be studied and tested to provide a baseline for data transmission performance. Latency in each layer will be measured, and the component responsible identified. For each of these components, both custom and Commercial off the Shelf (COTS) solutions will be proposed, and the fastest feasible solution will be fabricated and implemented on the platform. These solutions will be iteratively tested and altered with the goal of reducing end to end latency to provide the highest speed and most reliable data transmission system possible.

Any autonomous controls system relies on being able to send and receive up-to-date information rapidly and reliably, and this research aims to find the best way to do this for onboard systems. The knowledge gained through this research can benefit fields far beyond autonomous racing, such as manufacturing, agriculture, and healthcare.

Mentor(s):
Richard Ajagu (Engineering); Reed Joseph Freer (Engineering); Andres Felipe Hoyos Moreno (Engineering); Samuel Labi (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7074
Presentation Time: STEW 214C at 12:00 PM-12:20 PM

A Machine Learning Approach to Automatic Music Transcription for Guitar

STEM

Authors(s):
Arnav Ashish Kalekar† (Engineering); Vishaal Iyer† (Science); Sooji Lee† (Science); Ricky Wong† (Science)

Abstract:
Automatic Music Transcription (AMT) refers to the process of automatically converting audio into symbolic formats like sheet music or MIDI, typically utilizing machine learning methods to do so. For guitar, audio-only AMT approaches to generate tablature have limitations. Unlike the piano, the same octave note on the guitar can be played on multiple different strings and in multiple different fretboard positions, causing potential confusion when analyzing only audio. Audio-based methods also struggle with polyphonic passages because of overlapping frequencies. To address these challenges, we investigate an audio-visual approach that uses video to identify fretboard and fingertip positions alongside audio-based note analysis. Based on our review of the existing literature on vision-based guitar transcription, we decompose the problem into string detection, fret detection, fingertip tracking, and audio analysis. We evaluated different approaches to deal with these components, using image augmentation methods, methods relying on guitar construction, object segmentation models, template-matching, and more. Our string detection pipeline localizes about 74% of strings within half a string spacing on held-out frames, and our fret detection pipeline achieves a F1 score of 0.966. Furthermore, we achieve an average precision of 95.7% on our fingertip tracking, while our audio component correctly analyzes notes about 70% of the time. In the future, we aim to expand this with a model to generalize to other similarly played string instruments and eventually polyphonic music transcription. Our current model is also focused on individual notes, whereas future implementations aim to transcribe open and barre chords first using hand tracking rather than assembling them from fingertip positions, hopefully leading to reduced processing times.

Mentor(s):
Yung-Hsiang Lu (Engineering); Ojas Chaturvedi (Science|JMHC); Kayshav Bhardwaj (Liberal Arts|Science); Yeon Ji Yun (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7075
Presentation Time: STEW 214C at 12:20 PM-12:40 PM

Process Development of Chemical Mechanical Planarization (CMP) and Wafer Thinning for Through-Silicon Vias (TSVs)

STEM

Authors(s):
Sabastian Hunter Hamilton† (Engineering); Roxsonna Nika Janiszewski† (Engineering); Athavan Arvind† (Engineering); Aarav M Shah† (Engineering); Ava R Assante† (Engineering); Rushabh Rahul Shah† (Engineering)

Abstract:
The purpose of this project is to develop a standardized process for fabricating through-silicon vias (TSVs), which are critical components for 2.5D and 3D advanced packaging. This study focuses on removing excess surface copper and the backside silicon substrate beneath the vias to expose the via terminals for reliable wafer bonding.

The process flow begins on the top side by pre-thinning the electroplated copper layer to reduce run time and slurry usage during chemical mechanical planarization (CMP). The remaining surface copper is removed using CMP with a controlled overpolish down to the silicon oxide layer underneath. In the following step, backside wafer grinding thins through the silicon substrate to reveal the lower via surfaces. The processes must be parameterized to account for variations in via etch depth, deposited film thickness, electroplating efficiency, and via opening diameter.

To evaluate process success, key quality metrics are tracked, including silicon oxide thickness and uniformity, surface roughness, as well as the final sample thickness. The goal of this study is to improve planarization yield, surface quality, and process efficiency at each step, facilitating the fabrication of high-density vertical interconnects and enabling the seamless integration of heterogeneous devices.

Mentor(s):
Peter Bermel (Engineering)

Other Acknowledgment(s):
Joon Hyeong Park* (Centers & Institutes); Guy J Telesnicki* (Purdue University); Noah F Opondo* (Centers & Institutes)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7076
Presentation Time: STEW 214C at 12:40 PM-1:00 PM

Process Development and Integration of Through-Silicon-Vias (TSVs) for Advanced Packaging and Heterogeneous Integration

STEM

Authors(s):
Rex Wu† (Engineering); Changyun Lee† (Engineering); Wei Lun Chang† (Engineering); Owen Chen† (Engineering)

Abstract:
As electronic devices continue to require greater computing capability within smaller form factors, advanced packaging techniques are needed to increase device density while maintaining reliable and high-performance electrical connections. This project focuses on developing and validating an integrated fabrication process for Through-Silicon Vias (TSVs), which provide vertical electrical interconnections for 2.5D and 3D advanced packaging. By allowing devices to be connected vertically rather than only across a planar surface, TSVs can reduce interconnect length, increase packaging density, and improve overall system performance.

The fabrication sequence includes lithography, reactive ion etching (RIE), which also includes Bosch deep reactive ion etching (DRIE), thin-film deposition, copper electroplating, and chemical mechanical planarization (CMP). Samples are tracked through the full process using process travelers. The measurements and observations are recorded after each fabrication stage. Key characteristics such as feature dimensions, etch depth, surface condition, material coverage, and process yield are evaluated to identify where defects and/or incompatibilities first occur. Results from each run are then used to support new adjustments to existing fabrication steps.

Initial process development has demonstrated the ability to carry samples through multiple stages of the TSV fabrication sequence while identifying process limitations that affect downstream steps. Lithography and Bosch etching trials, for example, have been used to evaluate photoresist thickness and durability during deep silicon etching and to determine how these conditions affect later fabrication steps. By establishing a repeatable and traceable fabrication workflow, this work supports the development of more compact and higher-performance

heterogeneous systems, including applications in mobile devices, wearables, and other space-constrained electronics.

Mentor(s):
Peter Bermel (Engineering); Zhihong Chen (Engineering); Joerg Appenzeller (Engineering); Saeed Mohammadi (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7077
Presentation Time: STEW 214A at 1:00 PM-1:20 PM

Service Life Assessment of a Multilayer Metamaterial Composite Antenna System for Low Earth Orbit Satellite Constellations

STEM

Authors(s):
Changho Lee† (Engineering)

Abstract:
Satellites in low Earth orbit constellations undergo a thermal cycle on every pass between sunlight and eclipse, and exterior components must sustain this loading throughout the mission. This study assesses the service life of an antenna system under development employing a multifunctional metamaterial composite for communication, thermal and radiation control, an electromagnetic hexaferrite epoxy composite bonded to a thin fused silica layer for passive thermal management. The coefficient of thermal expansion mismatch between the layers induces cyclic curvature and strains the brittle silica, so the assessment focuses on the likelihood of structural damage. Finite element models can predict the strain and warpage of the stack, but experimental verification remains limited; the work therefore proceeds through characterization, experiment, simulation and validation. Strip specimens of a particulate baseline composite or a glass fabric reinforced laminate were bonded to fused silica with a 0.1 mm epoxy bond line. Each strip was characterized before bonding so that its multilayer could be simulated with specimen-specific rather than generalized properties. Thermal bending was measured from 30 to 80 °C under two boundary conditions, constrained three-point bending in a dynamic mechanical analysis (DMA) and free cantilever bending tracked by digital image correlation (DIC), and the model was validated against both. Deflection increased with temperature, the fabric reinforced laminate bent substantially less than the baseline, and specimen-specific properties yielded predicted stiffness in close agreement with measurement. The validated model enables prediction of strain, warpage and ultimately failure stress, supporting design of the antenna system for its full service life.

Mentor(s):
Garam Kim (Polytechnic); Eduardo Barocio Vaca (Engineering)

Other Acknowledgment(s):
Anand D Tiwari* (Polytechnic)

Talk Presentation Abstract Number: 7078
Presentation Time: STEW 214A at 1:20 PM-1:40 PM

NEURAL SPACE CAP: A NOVEL FRAMEWORK FOR INTEGRATING BIOMETRICS TO ADVANCE HUMAN SPACEFLIGHT HEALTH

STEM

Authors(s):
Hetasri Galla† (Science); Farah Elbohofy† (Engineering); Soumil Bhandari† (Engineering); Sravani Mahankali† (Engineering); Aishi Lalitha Garimella† (Engineering)

Abstract:
The Neural Space Cap is a soft-shell wearable designed to fit beneath an extravehicular activity (EVA) helmet and monitor brain activity, heart rate, and body temperature. Intended for a more diverse population of space travelers, it aims to support early detection of cardiovascular and neurological abnormalities in microgravity. Its 3D-printed framework incorporates EVA foam, carbon fiber fabric, and embedded electronics. A photoplethysmography (PPG) sensor measures heart rate, while a filtered EEG circuit targets alpha activity (8–13 Hz). Biosignals are synchronized through Lab Streaming Layer and processed in MNE-Python. Initial bench testing identified 60 Hz interference, which was reduced using a Faraday cage. Ongoing work includes refining EEG circuitry, transitioning to PCB design, and preparing an IRB protocol for human testing. Future development will expand sensing capabilities and enable wireless transmission for real-time anomaly detection, advancing integrated physiological monitoring for spaceflight.

Mentor(s):
Curtis Earl Marshall (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7079
Presentation Time: STEW 214A at 1:40 PM-2:00 PM

Design of a Radiation-Hardened by Design X-Band Receiver in 90nm FDSOI

STEM

Authors(s):
Arthur Prudius† (Engineering); Randolph Nathan Ha† (Engineering|JMHC); Andrew Paul Becker† (Engineering|JMHC); Nezar Fahmi† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Andrew Owen Fewell (Engineering); Boyuan Chen (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7080
Presentation Time: STEW 214B at 1:00 PM-1:20 PM

Understanding the Phase Formation of M4AlC3 MAX Phase for the Synthesis of Novel 2D MXenes

STEM

Authors(s):
Paula Andrea Zapata Palmezano† (Engineering); Juan Esteban Torres Ramos†

Abstract:
MAX phases are layered ternary carbides and nitrides with the general formula Mn+1AXn, where M is an early transition metal (typically from groups 4-6 of the Periodic Table), A is an element from groups 13-16, and X is carbon (C) and/or nitrogen (N). MAX phases serve as precursors of MXenes, a rapidly growing family of two-dimensional materials with applications in energy storage, catalysis, sensing, and electromagnetic shielding. Together, MAX and MXene phases provide a unique materials platform in which compositions range from a single metal to as many as nine metals (M), enabling investigation of how increasing compositional complexity influences phase formation. However, the effects of composition on phase evolution and the underlying reaction pathways leading to M4AlC3 MAX phase formation remain poorly understood. To address this gap, seven M4AlC3 compositions of varying complexity were selected: Ta4AlC3 (single metal); Mo2Nb2AlC3 and Mo2Ti2AlC3 (two metals); (VNbTa)4AlC3 and (TiNbTa)4AlC3 (three metals); (TiVNbMo)4AlC3 (four metals); and (TiVNbMoW)4AlC3 (five metals). Elemental precursor powders were mixed and subjected to solid-state reactions under flowing argon, with stepwise temperature increases between 800 and 1600 °C. Phase evolution is investigated by X-ray diffraction (XRD) with Rietveld refinement to identify and quantify crystalline phases, while scanning electron microscopy (SEM) will be used to examine microstructural development. Thermogravimetric analysis (TGA) will be used to monitor precursor decomposition, volatilization, and potential reaction stages associated with MAX phase formation. This study aims to determine how compositional complexity and synthesis temperature govern M4AlC3 phase formation pathway and to identify the conditions that favor phase purity. This work will guide the selection of synthesis conditions for complex M4AlC3 MAX phases to promote the formation of high-quality MAX precursors for subsequent MXene synthesis.

Mentor(s):
Babak Anasori (Engineering); Muhammad Sharif Uddin (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7081
Presentation Time: STEW 214B at 1:20 PM-1:40 PM

External Validation of a Deep Learning Aortic Root Segmentation Model on an Independent Echocardiographic Cohort

STEM

Authors(s):
Julia Kang† (Science); Ojas Chaturvedi‡ (Science|JMHC); Julian Vuong* (Engineering)

Abstract:
Accurate analysis of aortic root structure from parasternal long-axis transthoracic echocardiography (TTE) is essential for monitoring disease progression in pediatric patients with aneurysms linked to genetic connective tissue disorders such as Marfan syndrome (MFS). Our laboratory previously developed a cascaded spatiotemporal deep learning model (ConvNeXt-V2 encoder, bidirectional convolutional LSTM) to segment the aortic root in ultrasound videos. Trained on 90 patients (45 control, 45 MFS, ages 5-15), it achieved a held-out median per-case Dice of 0.90. To measure how much accuracy survives, the model was applied with weights frozen and no retraining or fine-tuning to a second dataset of 140 independent TTE studies spanning five diagnostic categories: MFS, suspected MFS, bicuspid aortic valve, idiopathic thoracic aortic aneurysm, and other syndromic conditions. The median per-case Dice was 0.87 at a probability threshold of 0.5 (5th-95th percentile 0.59-0.92), which was 0.03 below internal performance. The mean fell lower at 0.82, suggesting the loss was concentrated in a small minority of cases rather than spread evenly. Five cases fell below a Dice of 0.5, with four showing the predicted mask splitting into disconnected components (an anatomically impossible result that can be flagged as a predictive failure). In conclusion, segmentation accuracy largely transfers to an independent cohort of study participants. Future work will extend evaluation from segmentation overlap to automated aortic root diameter and strain measurement, validate fragmentation-based quality control for unreliable studies to be routed to manual review, and test targeted fine-tuning to recover the accuracy gap.

Mentor(s):
Shubh Parag Mehta (Engineering); Craig Goergen (Engineering); Benjamin Landis (Indiana University)

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7082
Presentation Time: STEW 214B at 1:40 PM-2:00 PM

BTact: A Rounded Vision-Based Tactile Sensor for Multidirectional Contact Sensing and 3D Reconstruction

STEM

Authors(s):
Akimizu Sugiyama† (Engineering)

Abstract:
We are developing BTact, a round vision-based tactile sensor designed to provide multidirectional tactile feedback for robotic manipulation. While many existing vision-based tactile sensors utilize flat sensing surfaces, their planar geometry limits the directions from which contact can be detected. In contrast, a round tactile sensor can detect interactions across different regions of the fingertip, similar to the sensing capabilities of a human finger. By incorporating a high-resolution camera, BTact aims to capture detailed surface deformation and provide information about both normal and shear forces during contact.

However, round vision-based tactile sensors also introduce challenges in three-dimensional (3D) surface reconstruction. Conventional photometric stereo techniques are more readily implemented on flat sensing surfaces, making their application to curved geometries challenging. To address this limitation, BTact employs an alternative 3D reconstruction method that relies exclusively on the single channel of the camera image, eliminating the need for multicolor illumination.

The fabrication process and initial calibration of BTact have been completed. The calibration procedure consists of two main steps. First, a brightness map is generated to characterize the sensor's optical response. Second, a spherical reference geometry is used to establish a relationship between image brightness and surface depth. Using these calibration results, the sensor reconstructs the three-dimensional geometry of the deformed sensing surface.

Mentor(s):
Yu She (Engineering); Md Rakibul Islam Prince (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7083
Presentation Time: STEW 214C at 1:00 PM-1:20 PM

FEA of the Compressive Behavior of Multilayer 316L Stainless Steel with Localized Peening-Induced Hardening

STEM

Authors(s):
Mirza Orunav Shahper† (Engineering)

Abstract:
This research investigates material properties affected by Hybrid Additive Manufacturing (Hybrid AM) combined with an interlayer surface treatment strategy. Specifically, Laser Powder Bed Fusion (LPBF) of 316L Stainless Steel combined with interlayer shot peening is investigated. Finite Element Analysis (FEA) paired with material properties obtained from micropillar compression tests and hardness mapping is used to simulate the compression of samples with thin bands of hardened layers. The study specifically examines how the percent volume peened and geometric arrangement affects the cumulative strength of the specimen. This research establishes a framework that allows for the extension of the Rule of Mixtures to account for plastic deformation inherent in layer-by-layer cold-worked additively manifested metals.

Mentor(s):
Shreejith Ravisankar (Engineering); Michael P Sealy (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7084
Presentation Time: STEW 214C at 1:20 PM-1:40 PM

Design and Performance of a 1.0 W PocketQube Direct-Sampling Receiver for Soil Moisture Sensing using Signals of Opportunity

STEM

Authors(s):
Elena Anne Lehner† (Engineering|JMHC); Sebastian Enrique Pirela† (Engineering|JMHC)

Abstract:
Root zone soil moisture (RZSM) is a critical variable in agriculture, drought forecasting, wildfire risk assessment, and climate modeling. Current space-based systems capable of measuring moisture at this depth (3 to 6 feet) are often large, complex, and expensive. This work presents a compact and affordable spaceborne receiver for a satellite which performs Earth remote sensing to measure RZSM. Acting as a purely passive receiver, the system leverages 137.5 MHz VHF communication signals from non-cooperative satellites to measure its opportunistic signals that reflect off the Earth's surface, a technique known as ‘Signals of Opportunity,’ which allows for major reductions in size, weight, and power. Keysight Genesys simulations were utilized to evaluate receiver configurations, with results demonstrating that a direct-sampling architecture was optimal against superheterodyne. The simulated RF receiver chain achieves a cascaded noise figure of 5.2 dB, input return loss of -9.8 dB, and forward gain of 66.6 dB. Satisfying strict requirements, the direct-sampling receiver design achieves a gain range of 68.1 dB - 83.6 dB, performs onboard instrument calibration, and consumes only 0.948 W of power at max conditions, all within a 5 x 5 x 5 cm PocketQube form factor. The resulting printed circuit board includes dedicated power regulation and shutoff features for maximum power conservation. Serving as a flight-ready prototype for upcoming mission deployments, this low-cost instrument architecture supports scalable Earth observation missions, providing root-zone moisture data that drastically reduces uncertainties in regional drought and wildfire risk assessment models.

Mentor(s):
James Garrison (Engineering); Benjamin Nold (Purdue University)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7085
Presentation Time: STEW 214C at 1:40 PM-2:00 PM

Audio Source Separation Using Artificial Intelligence

STEM

Authors(s):
David Dang† (Science); Haoxuan Tong† (Science); Shashwat Goel† (Science)

Abstract:
We present a two-stage pipeline for separating instruments from mixed recordings, where overlapping sources make isolation difficult. Hybrid Transformer Demucs splits a track into vocals, drums, bass, and other, and SAM Audio then uses text prompts to isolate specific instruments, particularly piano, from the remaining stem. We tested four- and six-stem Demucs configurations in sequence. Reconstruction analysis yielded an MSE of about 0.0002055 and an SNR of 15.64 dB. These early results show the combined approach is feasible. We plan to run controlled experiments comparing it against direct SAM Audio separation to measure how Demucs preprocessing affects instrument isolation.

Mentor(s):
Yung-Hsiang Lu (Engineering); Yeon Ji Yun (Liberal Arts); Ojas Chaturvedi (Science|JMHC); Kayshav Bhardwaj (Liberal Arts|Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7086
Presentation Time: STEW 214D at 1:00 PM-1:20 PM

Assembly and Transfer of Striped-Phase Polydiacetylene onto Biocompatible Hydrogels

STEM

Authors(s):
Sarah Elizabeth Bohne† (Science|JMHC)

Abstract:
Biocompatible hydrogels are useful in applications requiring mechanical flexibility and functional surfaces. Transferring ordered polymer monolayers onto these hydrogel surfaces can introduce additional surface functionality while aiming to preserve the mechanical properties of the underlying hydrogel material. This project studies the transfer of a striped-phase polydiacetylene (sPDA) monolayer onto biocompatible hydrogels to functionalize their surfaces.

The experimental process consists of three stages: monolayer assembly, hydrogel integration and exfoliation, and characterization and evaluation. During monolayer assembly, the Langmuir-Schaefer method is used to assemble a standing phase film at an aqueous subphase, orienting the molecules vertically. Highly oriented pyrolytic graphite (HOPG) substrates then contact the film, triggering the molecules to rearrange into a flat, ordered striped phase on the HOPG. This reorientation produces an ordered sPDA layer. In the second stage, sPDA patterns are transferred from HOPG substrates onto polyacrylamide (PAAm) by covalently linking the sPDA backbone to the hydrogel mesh as it cures. Peeling the cured PAAm off the substrate exfoliates the monolayer, leaving the sPDA patterns intact. The third stage evaluates transfer effectiveness by evaluating monolayer imaging through Atomic Force Microscopy (AFM) and measuring fluorescence distribution with a Confocal microscope. AFM was used to characterize the nanoscale organization of the sPDA monolayer and its ordered structure, and confocal microscopy revealed substantial fluorescence across hydrogel samples, providing preliminary evidence of successful monolayer transfer.

These findings explore a potential method into how sPDA monolayers can be transferred onto hydrogels for additional surface functionality. Future research aims at applying the sPDA monolayers on hydrogels to tissue engineering, specifically in applications with muscle cells.

Mentor(s):
Denniell Ann Hurboda (Science)

Other Acknowledgment(s):
Shelley A Claridge* (Engineering|Science)

Talk Presentation Abstract Number: 7087
Presentation Time: STEW 214D at 1:20 PM-1:40 PM

The Hallucination Cascade: Measuring State Tracking Collapse in Multi-Agent LLMs

STEM

Authors(s):
Brook Netsanet Animut† (Science)

Abstract:
When AI chatbots interact without human intervention, it tends to cause problems. While frontier large language models pass static benchmarks with ease, what happens when they are trapped in closed conversational loops or games under strict, unforgiving constraints? To find out, this study deploys an automated simulation arena pitting models like GPT-4o and Claude 3.5 against deterministic state engines, from zero-sum board games to roleplay-type nuanced games where a single slip breaks the entire system. Tracking these multi-turn interactions through survival analysis, we use the "Weird Index" to expose and “grade” the precise turn point where machine logic caves to fabrication and runaway hallucinations. The conclusion of this research tells us more about where we can integrate AI into our lives without any hesitation, and where we may want to be more skeptical in doing so.

Mentor(s):
Garrett Ivan Colon (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7089
Presentation Time: STEW 218A at 1:00 PM-1:20 PM

Eurocentrism in Medicine and the Effects On Marginalized Communities

STEM

Authors(s):
James LeClerc† (HHS)

Abstract:
Medicine and medical systems have a tendency of being Eurocentric, focused mostly on Western and European philosophies. For example, studies were often conducted with Caucasian males as the target demographic. This has led to a knowledge gap when it comes to how medicine affects minorities which has led to minorities being under-researched. With white males often being both in charge and the focus of most medicine, a large portion of medicine, research and people are largely ignored because they fall outside of typical western philosophies and culture. This oversight affects the framework of how medicine is made, who it is supplied to, who is used in studies, and how it has lasting effects on communities.

The research I'm using looks at the framework of how western medicine is underdeveloped from a lack of outside perspective and how it also hurts marginalized communities and could give ideas to improve the current systems in place when it comes to western medicine.

Keywords: Eurocentrism, minorities, medicine.

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7090

Presentation Time: STEW 218A at 1:20 PM-1:40 PM

Extracurricular Activity Participation and Adolescent Substance Use: Examining Differences by Activity Type

Social Science

Authors(s):

Nicole C Ibarra† (HHS); Vaibhavi Goyal† (HHS); Gavin Fleming‡ (HHS); Avery Ann White‡ (Liberal Arts|Science); Ashley Kathleen Pentsos‡ (HHS)

Abstract:

Adolescent substance use remains a significant public health concern in the U.S. Substance use in this life stage can have lasting physical, mental, and behavioral consequences. Research suggests that participation in extracurricular activities can help prevent/reduce adolescent substance use; less attention has been given to whether associations vary by activity type beyond sports. Our study aimed to characterize adolescents' participation in different types of extracurricular activities and examine associations between activity type and substance use. We used the 2024 National Survey on Drug Use and included adolescents 12 to 17 y.o (n = 11334, 51.15% boys, 48.67% non-Hispanic White). Descriptive analyses were conducted to characterize substance use and extracurricular activity participation. Four multivariable logistic regression models examined associations between activity type and cigarette, e-cigarette, alcohol, and cannabis use. Models controlled for age, sex, education, income, and religiosity. Analyses incorporated study weights and were conducted in Stata 19. Participation was highest in school-based activities (78.5%), followed by community-based (69.8%), faith-based (51.4%), and other activities (35.6%). Past 30-day cigarette, e-cigarette, cannabis, and alcohol use were reported by 1.26%, 5.27%, 5.68%, and 6.20% of adolescents, respectively. Participation in faith-based activities was associated with lower alcohol (OR = 0.58, p = 0.013) and marijuana use (OR = 0.70, p = 0.044). Participation in community-based activities (OR = 0.74, p = 0.033) and other types of activities (OR = 0.74, p = 0.025) were associated with lower nicotine vaping. These findings suggest that extracurricular participation is not uniformly associated with adolescent substance use; rather, associations vary by the type of activity. Prevention strategies should account for differences across activity types rather than assuming extracurricular involvement is universally protective.

Mentor(s):
Shandey Derisa Malcolm (HHS); Madeline Elise Moser (HHS)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7091
Presentation Time: STEW 218A at 1:40 PM-2:00 PM

Evaluating Insurance for Dietician Services

Social Science

Authors(s):
Aaron Jafri† (HHS)

Abstract:
The purpose of this research project is to examine whether health insurance providers and Medicare should be legally mandated to cover Medical Nutrition Therapy supplied by registered dieticians regarding chronic disease prevention. Research will be gathered through a literature review analyzing how early nutrition counseling can save money compared to late-stage medical treatments, current Medicare coverage restrictions on who can get care, and the efficacy of dietary chances for conditions like high blood pressure and prediabetes. Primary research will be interviewing Purdue Nutrition Science professors and faculty to understand firsthand how a lack of insurance coverage funding creates barriers for patients. Additionally, if needed, a survey of Purdue students will help understand how out-of-pocket costs affect adults' decisions to meet with dieticians. The findings will be used to evaluate potential laws and give recommendations of integrating professional nutritional guidance into routine preventative care.

Mentor(s):
Catherine Jean Shukle (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7092
Presentation Time: STEW 218B at 1:00 PM-1:20 PM

Enhancing the DMAIC Framework in Aerospace Manufacturing Through Artificial Intelligence (AI)

STEM

Authors(s):
Ronan Edward Lang† (Polytechnic|JMHC); James Tyler Lyuke† (Polytechnic); Michael Martin Zielinski† (Polytechnic); Jaehu Lee† (Polytechnic|JMHC)

Abstract:
Much of the Aerospace Manufacturing industry relies on highly controlled and efficient production processes, yet identifying inefficiencies, bottlenecks, and process variation can be challenging within complex manufacturing environments. Lean Six Sigma (LSS), particularly the Define, Measure, Analyze, Improve, and Control (DMAIC) framework, provides an organized methodology for addressing these challenges. However, the increasing availability and use of manufacturing data and advances in Artificial Intelligence (AI) generate opportunities to enhance the traditional DMAIC framework through automated data collection, pattern recognition, predictive analytics, and continuous process monitoring. This paper investigates how AI can be integrated into the DMAIC framework to support process improvement in aerospace manufacturing. The research evaluates potential applications of AI across each phase of the DMAIC framework. AI may assist the Define phase by identifying recurring process issues, the Measure phase through automated data collection and monitoring, and the Analyze phase through pattern recognition and root-cause analysis. During Improve, AI can support process optimization and prediction of potential outcomes, while the Control phase can utilize AI for continuous monitoring and early detection of process deviations. This paper also considers how these capabilities can help support Lean principles, such as waste reduction, improved process flow, and bottleneck identification. Through examination of existing research and manufacturing applications, this research proposes a conceptual framework for AI-enhanced DMAIC in aerospace manufacturing. It emphasizes AI as an augmentation to engineering expertise and explores possible implementation challenges, including data quality, explainability, cybersecurity, and human oversight.

Mentor(s):
Abner Del Cid Flores (Polytechnic)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7093
Presentation Time: STEW 218B at 1:20 PM-1:40 PM

Effect of Bead Orientation and Bolt Preload on Adhesively Bonded Joints in 3D-Printed Composite Tooling Under Thermal Cycling

STEM

Authors(s):
Paul Kyu-Hwan Park† (Polytechnic); Changho Lee‡ (Engineering)

Abstract:
Large-format extrusion deposition additive manufacturing of thermoplastic composites is increasingly used for tooling because it enables rapid, customizable fabrication with less waste than metallic tooling. Because printer build volumes are limited, large tools must often be printed in sections and joined into modular assemblies, typically by adhesive bonding. These bonded seams must maintain vacuum integrity through repeated high-temperature processing. Printed composites are anisotropic, with coefficients of thermal expansion (CTE) that differ along the print, transverse, and stacking directions. The resulting CTE mismatch with the adhesive can produce incompatible thermal strains, interfacial stresses, and local deformation during thermal cycling, potentially causing adhesive degradation, interfacial debonding, or interbead damage. These effects likely depend on bond orientation, but this dependence, and its interaction with the mechanical fasteners often used in modular tools, remains poorly characterized. This study examines how bond orientation and mechanical constraint affect the thermal durability and vacuum integrity of carbon-fiber-reinforced polyethersulfone (CF-PESU) specimens joined with a two-part epoxy paste adhesive. Three bond orientations (print-transverse, print-stacking, and transverse-stacking) were tested unconstrained and constrained by preloaded through-thickness bolts over 10 thermal cycles to 177°C with 2-hour holds, representative of a composite cure cycle. Vacuum integrity, surface condition, and bondline damage were assessed by visual and stereoscopic inspection, supported by material characterization. Finite element analysis with cohesive-zone modeling predicted thermally induced deformation and interfacial stresses under constrained conditions. Together, the experimental and numerical results show how orientation, CTE mismatch, and mechanical constraint govern the durability and vacuum performance of modular composite tooling.

Mentor(s):
Garam Kim (Polytechnic)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7094
Presentation Time: STEW 218B at 1:40 PM-2:00 PM

Spectrally Selective Transparent Materials for Solar - Thermal Heat Retention and Reflection

STEM

Authors(s):
Japteg Singh Bamrah† (Polytechnic)

Abstract:
Sunlight reaching Earth’s surface covers a broad range of wavelengths, and materials interact with this radiation in different ways. Some materials allow visible light to pass while absorbing or reflecting parts of the infrared spectrum, whereas others can separate and effectively split these wavelength regions more sharply. Understanding these differences between reflectance and transmittance across wavelengths is important for systems that need to exploit the solar spectrum effectively . This paper presents a comparative review of transparent and spectrally selective materials, including borofloat glass, coated glass, multilayer mirrors, and dielectric-metal-dielectric films. Published values for transmittance, reflectance, absorptance, and emittance are examined across the visible (380–780 nm), solar-infrared (780–2500 nm), and long-wave infrared regions above 3 μm. The materials are also compared based on their thermal stability, response to changes in the angle of incidence, durability, availability, and manufacturing requirements. Materials are specifically examined on their ability to reflect and absorb infrared radiation, since absorption increases the temperature of the material and may affect its overall performance. This review aims to identify the optical characteristics most suitable for applications requiring visible-light transmission with the ability to reflect infrared radiation in order to provide a practical basis for selecting materials for future optical and thermal-management systems.

Mentor(s):
Anne M Lucietto (Polytechnic)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7095
Presentation Time: STEW 218C at 1:00 PM-1:20 PM

Large Scale Quasi-Steady State Industrial Dual Module Humidity Pump Dryer Prototype

STEM

Authors(s):
Ishan Gopu Nair† (Engineering); Md Sadat Aarik* (Engineering); Mudit Pandey* (Engineering)

Abstract:
Traditional heat pump-based convective drying systems are extremely energy intensive due to the requirement of achieving dew point temperature to condense out moisture therefore requiring reheat energy. A promising alternative is membrane dehumidification which removes water vapor through the use of water vapor partial pressure gradients without requiring energy intensive phase changes. The use of a dual module humidity pump (DMHP) within this configuration along with optimized water vapor compressor hardware can improve this process. Specimens utilized in drying often experience significant changes in volume, moisture and thermal properties through the course of this process. To improve this gap, a dynamic simulation model was developed using the finite difference method to predict transient profiles along the dryer in order to minimize excess energy use during the course of the system. The model's predicted average moisture was successfully validated against experimental literature for banana slices with inlet air velocity from 0.5 m/s to 2 m/s. Utilizing this theoretical framework with optimized water vapor compressor hardware, this work aims to experimentally validate this integrated transient dual module humdity pump system through the construction of a large scale industrial dryer prototype.

Mentor(s):
David Warsinger (Engineering); Junyan Ren (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7096
Presentation Time: STEW 218C at 1:20 PM-1:40 PM

TRON STARS Chip Design Project

STEM

Authors(s):
Maximillian Li† (Engineering); Vikram Madhusudan Chakrabhavi† (Engineering); Kerry Zhang† (Engineering); Andruw Kuang-Le Lin† (Engineering)

Abstract:
This project explores the complete digital hardware design process by implementing the 8-bit version of the video game TRON, with the goal being to prepare this design for chip tapeout and fabrication. To start, we developed register-transfer-level diagrams to define each module's architecture and functions. We then implemented the ideas from the diagram in SystemVerilog, and created testbenches for each implemented module as we developed them. While the full project is not finished yet, we have verified all individual modules through testbenches and waveforms, and they have produced appropriate, expected results. We plan to deploy the game on a VGA display, and eventually tape it out as an ASIC after thorough testing on an ice40 FPGA. Ultimately, we aim to inform others of how complex games/tasks can run faster and more efficiently through an ASIC, rather than a multi-purpose processing unit.

Mentor(s):
Alexander J Weyer (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7097
Presentation Time: STEW 218C at 1:40 PM-2:00 PM

Streaming Failure Forecasting: Closed-Form Online Learning of VLA Failure Monitors under Drift

STEM

Authors(s):
Shaurya Beriwala† (PFW); Amit H Jadhav† (PFW)

Abstract:
State-of-the-art failure monitors for vision-language-action (VLA) policies are trained offline and then frozen, but deployment conditions drift without notice: lights dim, objects change, cameras are bumped, grippers wear. We present Streaming Failure Forecasting (SFF), a monitor that keeps learning during deployment from the one label each episode provides: whether it succeeded. SFF keeps the offline monitor's network as a fixed feature map, refits only its linear head after each episode in closed form, and moves its alarm threshold only after successes, which keeps the long-run false-alarm rate near target. It uses constant memory and is never told when conditions change. On recorded SmolVLA rollouts in LIBERO and LIBERO-Plus under drift, with all settings locked before testing, SFF ranked failures better than the same monitor frozen on 4 of 5 test suites, including the pre-registered primary test (LIBERO-10: within-task AUROC 0.707 → 0.736), showed no clear gain on the fifth, and beat resetting on detected drift on every suite. A deployed VLA failure monitor need not stay frozen: refitting its readout from outcomes is cheap and pays.

Mentor(s):
David Liu (PFW); Yanfei Liu (PFW)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7098
Presentation Time: STEW 218D at 1:00 PM-1:20 PM

Establishing an Evidence-Based Hierarchy of Immunodominant B-Cell Epitopes on the Human Metapneumovirus Fusion Protein

STEM

Authors(s):
Chaeyeon Lee† (Science)

Abstract:
Human metapneumovirus (hMPV) is a respiratory pathogen for which the fusion (F) glycoprotein is a major target of the antibody response. Although multiple B-cell epitopes on hMPV F have been identified, establishing a consistent hierarchy of immunodominant epitopes across published studies remains challenging. Differences in experimental approaches and the types of evidence used to characterize antibody recognition may complicate comparisons between epitopes. This project investigates whether published experimental evidence can be synthesized to establish a consistent and evidence-based ranking of immunodominant B-cell epitopes on the hMPV F protein.

I will conduct a literature-based analysis of peer-reviewed studies that characterize hMPV F-specific antibodies and identify their binding sites. Evidence from antibody-binding assays, epitope binning, mutational mapping, structural studies, and cryo-electron microscopy will be compared to evaluate the consistency and strength of support for different epitopes. The analysis will focus on antibody binding and immune recognition as evidence of immunodominance, rather than defining immunodominance by neutralization activity. I will develop a proposed hierarchy of hMPV F epitopes based on the frequency and consistency of supporting evidence across studies and consider how these rankings compare with available neutralization and protection data. By systematically evaluating the evidence for epitope immunodominance, this research aims to clarify patterns of antibody recognition across the hMPV F protein and identify gaps in the current literature. Although immunodominance alone does not establish protective function, a clearer understanding of which epitopes are preferentially recognized may provide a foundation for future research into hMPV immune responses and inform vaccine design strategies.

Mentor(s):
Harris J Bras (Liberal Arts); Bradley Keith Broyles (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7099
Presentation Time: STEW 218D at 1:20 PM-1:40 PM

Stochastic Risk Analyses: HJB-embedded AKF PINNs with the AS Model for Multi-Asset Portfolio Operations

STEM

Authors(s):
Ashrith Ponna† (Science|JMHC)

Abstract:
The premise of this analysis is to monitor execution behaviors of market operator agents, specifically in context to decision-making in a multitude of environments. Some examples of financial environments pertain to "heavy-tailed distribution events" and "continuous-regime events". The standardized model in the status quo will be compared, in terms of performance, to the newly created variant. For this inquiry, there is a utility for the HJB (Hamilton–Jacobi–Bellman) equation, a model that projects a "most viable" decision, based on parameters of time decay, and received profits and portfolio value, a PINN (Physics-Informed Neural Network), a neural network that back-propagates based on loss correction; this is mainly based off of the optimal value of a portfolio that is derived from the HJB equation, the AS (Avellaneda-Stoikov Model), a model that allows risk to be calculated via bid-ask spread determinant, and the AKF (Adaptive Kalman Filter) model, a model that removes noise, projected to remove minor erratic market volatility-based movements. Through this combined model, multi-asset portfolio operations will be observed through the integration of statistical arbitrage. Financial metrics such as the residual loss value for the HJB equation, inventory variance, spread capture efficiency, order-to-trade ratio, maximum draw-down, draw-down duration, will be collected and measured accordingly. In order, the values garnered (exactly and ranges) are as such: 0.00627, 0.01-0.045, 0.281-0.478, (approximately) 3.00, 0.67%-3.73%, 31.8-142.8. The baseline threshold model reacted more effectively to market conditions. The data used wasn't active market data; rather, it was synthetic. The portfolio only entailed singular trade distributions via pairs instead of multiple trade distributions via pairs, representative of a realistic market portfolio. The HJB-embedded PINN equation was of a basic variant and not derived to take into account all possible market conditions.

Mentor(s):
Yexiang Xue (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7100

Presentation Time: STEW 218D at 1:40 PM-2:00 PM

Standardizing Bioacoustic Data Processing: Evaluating a Single-Step Pipeline in StreamCI

STEM

Authors(s):
Julianna Victoria Vishnyakova† (Science|JMHC); Alden James Brinkmann‡ (Science); Vittal Rajagopalan‡ (Engineering); Phol Jiraphasuksakul‡ (Engineering); Ishani Roy‡ (Science|JMHC)

Abstract:
Timely, well-structured data is essential for ecological decision-making, yet much bioacoustic research still relies on multi-step workflows that vary from one researcher to the next. Acoustic indices, which estimate metrics like biodiversity and species richness, can differ widely depending on the software and languages used to compute them. Automated species identification tools, like BirdNET, also produce different results depending on how each user configures them. As a result, researchers working with similar data in different places often cannot compare their findings.

A minimum viable product (MVP) portal is being developed within StreamCI, an NSF-funded open-source streaming data management platform. Current processing is split across Teable, a PostgreSQL database that organizes site metadata and tracks data sources and variables; Box, the main data repository; and separate analysis tools (e.g., R, Python). This project explores whether these steps can be combined into a standardized pipeline. The working hypothesis is that projects with a similar scope, such as those in the same habitat type, should be processed using the same suite of parameter settings.

The central question is how a standardized pipeline affects the consistency and efficiency of producing bioacoustic results compared to the current workflow. To answer it, the research team will compare task metrics between the current workflow and the StreamCI MVP portal. The standardized pipeline is expected to reduce processing time and the number of steps required, produce more consistent results across researchers, and show stronger agreement between species detections and acoustic indices across habitat types. A possible outcome is a biome-based framework for grouping sites and assigning parameters. The goal is to lay the groundwork for a shared platform that bioacoustic researchers anywhere can use to generate comparable findings.

Mentor(s):
Kristen Marie Bellisario (JMHC)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7101
Presentation Time: STEW 214A at 2:00 PM-2:20 PM

Developmental Neurotoxicity of Trifluoroacetic Acid (TFA) in Zebrafish: Cellular, Mitochondrial and Neurotransmitter Response

STEM

Authors(s):
Maxwell J Gootee† (HHS|JMHC); Agampreet Kaur‡ (HHS|JMHC)

Abstract:
Trifluoroacetic acid (TFA) is an ultrashort-chain per- and polyfluoroalkyl substance (PFAS) formed from the degradation of certain fluorinated chemicals. Despite increasing environmental TFA contamination, little is known about its effects during early development. Therefore, this study used the zebrafish (Danio rerio) model to investigate the effects of TFA on cell viability, mitochondrial function, and neurotransmitter responses. Zebrafish embryos were exposed to 0, 0.04, 0.4, 4, 40, or 400 ppb (µg/L) TFA beginning within 0–2 hours post-fertilization (hpf) and maintained in the exposure solutions until 72 hpf (i.e., throughout embryogenesis). At 72 hpf, larvae were washed three times with fresh embryo water and maintained until 120 hpf. Cell death was assessed using SYTOX Blue staining. Mitochondrial superoxide, mitochondrial membrane potential, MitoTracker fluorescence, and ATP were assessed using fluorescence-based assays. Dopamine and glutamate levels were measured using ELISA-based assays. Data were analyzed using one-way ANOVA followed by Tukey's multiple comparisons test in SAS 9.4 (α=0.05). TFA exposure increased cell death at 40 and 400 ppb. No significant changes were observed in mitochondrial superoxide, MitoTracker fluorescence, dopamine, or glutamate. These findings suggest that TFA exposure increases cell death at higher concentrations, while the mitochondrial and neurotransmitter endpoints measured in this study were not significantly altered. Further studies are needed to understand the mechanisms underlying the increased cell death following developmental TFA exposure.

Mentor(s):
Jennifer Freeman (HHS); Umamaheswari Sathisaran (HHS)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7102
Presentation Time: STEW 214A at 2:20 PM-2:40 PM

Developing a Sycophancy Index for AI Career Advice: Emotional Framing and Plan Quality

Humanities

Authors(s):
Ananya Reddy Depa† (HHS)

Abstract:
Artificial intelligence (AI) is becoming more common in career guidance, but there are concerns about whether AI provides realistic advice or simply agrees with what users want to hear. This ongoing study focuses on developing and evaluating a Sycophancy Index to examine two types of responses: sycophantic validation, when AI agrees with a user's beliefs or plans without enough justification, and optimism bias, when AI gives overly positive predictions about success. The study will examine whether these response patterns can be measured consistently across different emotional states and levels of career-plan quality.

The study will use simulated clinical psychology career scenarios with three emotional profiles: excitement, neutrality, and anxiety. Each profile will be paired with either a high- or low-quality career plan. Plan quality will be based on factors such as GPA and relevant experience. ChatGPT will respond to each scenario, and two undergraduate evaluators and one faculty expert will independently evaluate the responses using a structured coding rubric. Reliability and validity analyses will be used to determine how consistently the responses can be scored and whether sycophantic validation and optimism bias can be measured as separate concepts. The study will also examine whether emotional framing affects how much AI validates lower-quality career plans. We expect that emotionally invested users may receive more unwarranted agreement compared to neutral users. Overall, this study aims to help distinguish between helpful encouragement and reassurance that may be misleading when people use AI for career guidance.

Mentor(s):
Marisa E Exter (Education)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7103
Presentation Time: STEW 214A at 2:40 PM-3:00 PM

Learning by Doing: Initial Qualitative Analysis of Emergency Responders' Perceptions of an Equine-assisted Learning Program

Social Science

Authors(s):
Kelly Marie Makovic† (HHS|JMHC)

Abstract:
In the U.S., emergency responders include police officers, firefighters, paramedics and emergency medical technicians (EMTs), suicide crisis line staff, and additional healthcare workers that directly impact citizen welfare and safety in emergent situations. This population frequently encounters high-stress or potentially traumatic events or conversations on a daily basis at their place of work. Due to this potential daily exposure, the emergency responder population often experiences higher rates of anxiety, depression, PTSD, and varying other mental health concerns in comparison to the general population. While there are established clinical interventions that may benefit an emergency responder's mental status, an underexplored complementary intervention is equine-assisted learning (EAL). EAL is the interworking of horses and participants under the guidance of an equine professional for personal development. This qualitative study analyzes emergency responders' perceptions of the psychosocial impacts of an 8-week EAL program at the Horsemanship for Heroes program in Nevada. Post the 8-week intervention, emergency responders participated in semi-structured interviews (n=14) and described their experiences with the program. A qualitative content analysis was used to analyze the interview transcripts. Results revealed themes of belongingness and activity-based intervention. Findings suggest that if participants experience a trust-filled community with both horses and humans in the context of an active EAL program, they may experience greater emotional well-being, improved functioning, and self-awareness. Future programs should consider basing their programming around a shared community culture, focusing on active engagement, and encouraging a trusting relationship with the equine in order to best benefit their participants.

Mentor(s):
Leanne Nieforth (HHS)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7105
Presentation Time: STEW 214B at 2:20 PM-2:40 PM

Bone-Targeted Radiotherapy for the Treatment of Multiple Myeloma

STEM

Authors(s):
Parvesh Venugopallavanya† (Agriculture); Erin Elizabeth Bigelow† (HHS)

Abstract:
Multiple myeloma (MM) is a blood cancer that affects plasma cells in the bone marrow, causing bone damage and frequent relapse after treatment. The bone marrow microenvironment supports myeloma cell survival and therapeutic resistance, making it an important target for new therapies. In this study, we investigated LT17, a bone-targeting peptide linked to a chelator carrying lutetium-177 (^{177}Lu), designed to deliver radiation directly to areas of bone damage.

We first tested the ability of LT17-^{177}Lu to bind hydroxyapatite, the main mineral component of bone. After incubation and washing, more than 45% of the radioactivity remained bound to hydroxyapatite. We then used SPECT/CT imaging in mice with intratibial 4T1 tumors to evaluate bone targeting. Images taken 24 hours after injection showed accumulation of LT17-^{177}Lu at the affected tibia. To test treatment effectiveness, we injected NSG mice with MM1.S myeloma cells and administered LT17-^{177}Lu following myeloma cell localization to bone. We monitored disease progression and tolerability through longitudinal measurements of tumor-associated bioluminescence, survival, body weight, blood counts, and bone damage.

At the study endpoint, treated mice had significantly lower tumor-associated bioluminescence than untreated mice (3.03×10^6 vs. 5.16×10^7 photons/s/cm²/sr; $p = 0.0187$). All treated mice survived through the monitoring period, while survival decreased in the untreated group. Micro-CT images also suggested reduced bone destruction in treated mice. Platelet counts initially decreased in both groups; however, the treated group showed signs of recovery while counts continued to decline in untreated mice.

These results suggest that LT17-^{177}Lu can target areas of bone damage and reduce myeloma tumor burden. Future studies will focus on

developing bone-targeted immunotherapies that can release treatment directly within the bone microenvironment.

Mentor(s):
Charles Key Stone (Science); Madduri Srinivasarao (Centers & Institutes)

Other Acknowledgment(s):
Losha Dasol Jung* (Science)

Talk Presentation Abstract Number: 7106
Presentation Time: STEW 214B at 2:40 PM-3:00 PM

WordFinder: A Word Retrieval Tool for Individuals with Aphasia Using Large Language Models

STEM

Authors(s):
Adikesh S Nathan† (Science)

Abstract:
Aphasia, a language disorder affecting about 2 million people in the United States, is most often caused by stroke. It leaves intelligence intact but makes it hard to reliably find intended words. This word-finding difficulty, called anomia, is among the most frustrating symptoms. Speech-language pathologists address it with cueing: the first sound of a word (phonemic), a hint about its meaning (semantic), or a link to something personally familiar. The cue that works best varies by sentence. Large language models can help people with aphasia communicate, but existing tools generate one kind of help for everyone and do not learn which cue leads each person to the right word, so patients must sort through wrong guesses.

We present WordFinder, a communication co-pilot that helps people with aphasia retrieve words during live conversation. When the person signals they are stuck by button or voice, it combines the preceding conversation, any partial word or sound produced, and a personal vocabulary to generate a ranked list of candidate words. The personal vocabulary tracks preferences and family relationships, such as a spouse's or grandchild's name, which general language models do innately know, addressing the lack of personalization in existing aids. In a preliminary test on a recorded video of a speaker with anomic aphasia describing a picture, the correct word appeared in the top five suggestions at all word-finding moments, and was the top suggestion at 4 of 7.

Next steps include evaluating on a larger set of recorded aphasic speech, testing the personal-vocabulary cue further, and gathering speech-language pathologist feedback on safety and appropriateness. We then plan a study with people with aphasia, each completing repeated sessions so effects can be assessed within each person. By matching the cue to the individual, the tool aims to help people reach the right word faster and with less frustration.

Mentor(s):
Shaiv Mehra (Engineering); Bradley S Duerstock (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7107
Presentation Time: STEW 214C at 2:00 PM-2:20 PM

Investigating the Effects of VPS35 Knockdown on Organelle Morphology in Human iPSC-Derived Astrocytes

STEM

Authors(s):
Leonel Baskin Sesuraj Baskin† (Science); Rohan Joseph Eapen† (Engineering|Science)

Abstract:
Alzheimer's disease (AD) is the most common cause of dementia, affecting millions worldwide. Growing evidence suggests that disruptions in intracellular protein transport and recycling contribute to AD progression. VPS35, a key component of the retromer complex, plays an important role in maintaining proper protein trafficking and cellular function. Reduced VPS35 expression has been associated with Alzheimer's disease, but its effects on astrocyte morphology and extracellular levels of Tau and Amyloid, as well as intercellular organization, remain poorly characterized. This project investigates how VPS35 knockdown affects each organelle and distribution in human induced pluripotent stem cell (iPSC)-derived astrocytes, with a particular focus on lysosomal organization. CRISPR interference was used to reduce VPS35 expression in cells subsequently differentiated from iPSCs into astrocytes. Following antibiotic selection, cell growth and morphology were monitored, and RNA was isolated for subsequent analysis of VPS35 expression. Fluorescent staining techniques, including lysosomal markers, fluorescent dextran, Hoechst, and MitoTracker, were incorporated into a cell painting approach to examine organelle morphology, distribution, and intracellular cargo trafficking. Cells remained viable and successfully differentiated into astrocytes with typical morphology. RNA was isolated for subsequent VPS35 expression analysis, although yields were lower than expected. Fluorescence-based cell painting and lysosomal assays are being used to investigate potential differences in organelle organization between VPS35-targeted and control astrocytes. Investigating the morphological consequences of VPS35 knockdown may reveal how altered retromer function affects lysosomal organization and intracellular trafficking in human astrocytes, providing insight into cellular pathways implicated in Alzheimer's disease.

Mentor(s):
Matthew Thomas Tegtmeyer (Science); Md Nazmul Hasan (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7108
Presentation Time: STEW 214C at 2:20 PM-2:40 PM

Intersections of Curves and Arcs on Orientable Surfaces with Boundary

STEM

Authors(s):
Sam William Pierce† (Engineering); Ailesh Verma† (Engineering); Karthik Karuna Datta Duvvuri† (Engineering|JMHC)

Abstract:
Curves and arcs on surfaces provide a natural way to study the topology and geometry of surfaces. In this project, we study how closed curves and properly embedded arcs intersect on orientable surfaces with boundary. Using combinatorial representations of curves and arcs, we explore how their intersection numbers can be understood and computed. Our current work focuses on learning the relevant background through Rachel Zhang's paper and developing an understanding of the combinatorial methods used to study these intersections. Our broader goal is to investigate patterns and questions that arise from intersection counts of curves and arcs on surfaces.

Mentor(s):
Thi Hanh Vo (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7109
Presentation Time: STEW 214C at 2:40 PM-3:00 PM

Prediction Markets Are Not Stock Markets: Evidence from 86 World Cup Contracts

STEM

Authors(s):
Prabhat Mani James Nayagam† (Science)

Abstract:
Prediction markets are exchanges for contracts paying $1 if an event occurs and nothing otherwise, and they borrow the visible machinery of equity markets: limit order books, bid-ask spreads, market makers, and arbitrageurs. They do not, however, share the structural properties that equity trading strategies depend on. Contracts settle at a known terminal value, prices are bounded within a single dollar so that transaction costs consume a far larger share of any spread, contracts on unrelated events are nearly uncorrelated and therefore cannot be hedged against one another, and capital remains locked until resolution. This study tests whether a strategy imported directly from equity trading, arbitraging price differences for identical assets across venues, survives those conditions. Order book data were captured at tick frequency across two venues for 86 matches of the 2026 World Cup and analyzed using cointegration-based price discovery estimators on de-vigged mid-prices, with each venue's embedded margin removed under three independent methods to test sensitivity. Eleven predictions were registered publicly before the tournament and graded afterward. The raw cross-venue price gap averaged 3.98 percentage points but fell to roughly 0.15 after de-vigging, and a pre-committed relative-value strategy returned negative risk-adjusted returns. Separately, placebo tests on contracts where no lead should exist reproduced the same signature, showing that estimates of which venue moves first can be manufactured by asymmetric message rates between data feeds. Ongoing analysis examines which remaining strategy classes, particularly market making, transfer more successfully.

Keywords: Price Discovery; Cointegration; Market Microstructure; Prediction Markets; Limits To Arbitrage

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7110
Presentation Time: STEW 214D at 2:00 PM-2:20 PM

OFDM Synchronization for Satellite Communications: Software Simulation and FPGA Implementation

STEM

Authors(s):
Sourish Manthati† (Engineering); Tanmay Deshmukh† (Engineering); Paul C Bergeson-dana† (Engineering|JMHC); Paul Shannon Slack† (Engineering|JMHC); Donovan Joseph Bechi‡ (Engineering)

Abstract:
Orthogonal frequency-division multiplexing (OFDM), the modulation behind Wi-Fi, LTE, and 5G, is highly sensitive to synchronization errors. If a receiver misjudges where a symbol begins or how far the carrier frequency has drifted, the subcarriers stop being orthogonal and data is lost. The widely used Schmidl–Cox method detects frames with a two-part training symbol, but its timing metric forms a flat plateau that leaves the symbol start ambiguous. This project implements in hardware an alternative proposed by Minn, Bhargava, and Letaief. Their training symbol is built from four identical segments with a chosen sign pattern, so the timing metric falls off sharply around the correct timing point. The same symbol also supports carrier-frequency-offset (CFO) estimation over ±2 subcarrier spacings. The synchronizer was designed in SystemVerilog as part of an OFDM, on a Xilinx Artix-7 FPGA. It contains [a sliding correlator and energy accumulator for the normalized timing metric, a peak detector, and a phase-based frequency-offset estimator]. Each block was verified bit-exact against a Python golden reference.

Mentor(s):
Priya Adiga (Engineering|JMHC); Andrew Owen Fewell (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7112
Presentation Time: STEW 214D at 2:40 PM-3:00 PM

Automated Pipeline for Benchmarking Computer Vision Models on Authentic, Synthetic and Tampered Image Datasets

STEM

Authors(s):
Li-Yen Lai† (Polytechnic); Dongyun Lim† (Engineering); Thirukumaran Veleyudham† (Science); Ryan Reddy† (Science); Vedant Arora† (Science); Paridhi Agarwal* (Engineering)

Abstract:
The overall aim of our project is to develop and validate a standardized evaluation pipeline to systematically benchmark candidate computer vision models on classification fidelity, segmentation precision, and hardware resource overhead. Specifically, we seek to establish a rigorous benchmarking framework capable of evaluating model robustness across authentic, synthetic, and digitally manipulated imagery. Currently, we are constructing an automated data pipeline to curate, synthesize, and annotate diverse image manipulation datasets and building an automated benchmarking tool to evaluate how well vision language models can detect and locate tampered images on mobile devices.. However, automated dataset generation introduces critical engineering bottlenecks in visual realism, segmentation boundary quality, and inference payload efficiency. To eliminate coarse contour artifacts from the Segment Anything Model (SAM), we engineered structured guidance prompts via LLM to sharpen boundary delineation along fine object edges. To reduce token consumption and operational latency, we optimized data payloads by downscaling intermediate masks, transmitting sparse bounding coordinates, and enforcing system prompt constraints to restrict generation strictly to salient, unambiguous targets. In parallel, for the model profiling, current open-weight models struggled to tell real images apart from tampered ones, highlighting the need for fine-tuning or specialized models. This automated framework establishes the necessary ground truth to replicate state-of-the-art detection architectures and baseline their performance across classification accuracy, segmentation means Intersection-over-Union (mIoU), and edge compute efficiency.

Mentor(s):
Yung-Hsiang Lu (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7113
Presentation Time: STEW 218A at 2:00 PM-2:20 PM

Student Perceptions of Learning With and About AI: A Qualitative Analysis Using Keller's ARCS Model

STEM

Authors(s):
Shivani Ramkumar† (Engineering)

Abstract:
Engineering education has lower completion rates than many other fields, and as artificial intelligence (AI) reshapes the workforce, colleges face growing pressure to prepare students to use AI thoughtfully and effectively. Understanding how students experience learning with AI may help improve both persistence in engineering and career readiness. Yet little is known about how AI-focused learning experiences shape student motivation. Keller's ARCS model of motivation (Attention, Relevance, Confidence, and Satisfaction) offers a framework for understanding how instruction engages learners. This qualitative study examined student perceptions of AI and their intentions to use it in the future after participating in AI-focused learning experiences. Students' online written reflections and discussion posts were analyzed using qualitative content analysis, with excerpts coded into the four ARCS categories and twelve sub-codes. Students' attention was captured when AI did something unexpected, sparking curiosity about both its uses and how it works behind the scenes. Students found AI relevant as they connected it to everyday tasks, future careers, and responsible, ethical use. Some students gained confidence after discovering new features and felt ready to apply AI immediately and in future professional settings. Others expressed satisfaction, appreciating what they learned and valuing its lasting usefulness. These findings suggest that AI-focused learning experiences can spark curiosity and help students see AI as personally meaningful. Educators integrating AI into coursework may benefit from guided, hands-on practice that builds confidence and supports student persistence and career readiness.

Mentor(s):
Lisa B Bosman (Polytechnic)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7114
Presentation Time: STEW 218A at 2:20 PM-2:40 PM

Evaluating Performance-Based Drift Detection for Localizing Data Corruption in Machine Learning Pipelines

STEM

Authors(s):
Bo-Cheng Lu† (Polytechnic|JMHC)

Abstract:
Machine learning models deployed in dynamic environments are vulnerable to distribution shifts and data-quality errors that can degrade predictive performance. Although existing drift-detection methods identify changes in input distributions, distinguishing harmful shifts from benign variations remains challenging. Recent approaches address this problem by monitoring historically low-performing regions of the feature space. However, whether these regions can also effectively localize corrupted observations remains unclear. This study investigates the relationship between regional prediction accuracy and data corruption under controlled population shifts. Using the Adult income dataset, we implement decision-tree-based error partitioning and develop a corruption-localization evaluation framework incorporating synthetic missing values, numerical outliers, and mixed feature corruption. Experiments track corrupted observations across detected regions while measuring predictive accuracy, regional corruption enrichment, and detection coverage. Results reveal that corruption severity and regional localization are not necessarily aligned. Extreme outliers reduced classification accuracy by 4.77 percentage points, compared with 0.11 percentage points for median-imputed missing values. Despite this difference, detected regions captured an identical 42.54% of injected corruption events across both scenarios. Additional mixed-corruption experiments provided no consistent evidence that detected regions were more enriched with corrupted observations. These findings highlight the limitations of using historically low-performing regions as proxies for data-quality anomalies and demonstrate the importance of distinguishing distribution-shift detection from corruption localization when evaluating machine learning reliability.

Mentor(s):
Jahid Hasan (Polytechnic); Romila Pradhan (Polytechnic)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7115
Presentation Time: STEW 218A at 2:40 PM-3:00 PM

Simulation-Driven Design of a Steel Beam Fastening End Effector

STEM

Authors(s):
Megan Amy Rudo† (Engineering|JMHC); Nicolas Sosa Fraga† (Polytechnic); Madison Jeanne Gomes† (Engineering)

Abstract:
Bolting is favored over field welding for joining structural steel, yet it remains a manual task, usually performed at great heights, which could be unsafe and inefficient. Robotic automation could reduce the need for workers to handle tools at dangerous heights while decreasing bolt-fastening time and, consequently, the overall duration of steel construction projects. Existing robotic bolting devices rely on dedicated platforms and customized infrastructure, limiting their adoption in conventional construction. This paper presents the design of an end effector that automates the bolting of beam-to-column connections using a UR20 collaborative robot.

The end effector comprises a mechanically actuated prismatic mechanism with a nutrunner and a bolt-retention fixture mounted at opposing ends of a linear actuator mounted to an end effector adaptor to the UR20. Actuating the mechanism closes the tool around the targeted beam connection, bringing the bolt and nut into coaxial alignment. A computer vision system locates the holes on the steel members to guide bolt placement. The system is evaluated in NVIDIA Isaac Sim in terms of component integration, controllability, operational capabilities and limitations, and overall functionality, prior to fabricating a prototype and validating it in a laboratory setting.

By coupling a purpose-designed bolting tool with an off-the-shelf manipulator, this work establishes a design basis for robotic bolting of structural steel connections, a step toward fully automated steel assembly.

Mentor(s):
Jiansong Zhang (Polytechnic); Meta Soy (Polytechnic); Jingyi Lai (Polytechnic)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7116
Presentation Time: STEW 218B at 2:00 PM-2:20 PM

The application of Magnetic Sugarcane Bagasse on Methylene Blue adsorption

STEM

Authors(s):
Nguyen Khanh† (Science)

Abstract:
[Abstract Redacted]

Mentor(s):
An Thien Nguyen (Science)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7117
Presentation Time: STEW 218B at 2:20 PM-2:40 PM

Aligning ATC Communications with Aircraft State Data for UAV Language Models

STEM

Authors(s):
Debarya Saha† (Engineering); Daksh Santhosh† (Science); Aaron Yuncong Zhang† (Engineering); Leo-Paul Perrin† (Engineering)

Abstract:
Unmanned aerial vehicles (UAVs) are paving the way for future aviation but cannot reliably perform complex tasks such as communication with air traffic control (ATC) agents in constrained natural language (ATC phraseology). While some datasets contain ATC speech and annotated human transcriptions, no existing datasets align these communications with aircraft state vectors in three-dimensional space. Our goal differs from other datasets' goals because we aim to support the development of a large language model (LLM) which can interpret and communicate with control towers, unlike current research which aims to understand ATC phraseology. The purpose of this project is to bridge this gap by creating a dataset combining ATC audio, its transcription, and corresponding Automatic Dependent Surveillance-Broadcast (ADS-B) state vectors. The process will involve collecting live aircraft surveillance data from the OpenSky Network API and ATC audio recordings from LiveATC. The LiveATC audio will be transcribed using OpenAI's Whispr model and aligned using time and relevant callsigns to match the transcribed LiveATC speech to the corresponding ADS-B state vectors. This dataset is intended to support the future development and evaluation of LLMs for communication between UAVs and ATC towers, and to enable further reasoning in LLMs for spatial and temporal understanding of this constrained natural language.

Mentor(s):
Christopher Rashidian (Polytechnic); Sabine Brunswicker (Polytechnic)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7118
Presentation Time: STEW 218B at 2:40 PM-3:00 PM

Life Cycle Assessment of Recovering Paracetamol from End-of-Use Over-the-Counter Pharmaceuticals for Circular Reuse

STEM

Authors(s):
Jijnasu Prakash Rout† (Engineering)

Abstract:
End-of-use medicines are a large waste stream that is almost never recovered. US households dispose of prescription medicines that are worth nearly $1 billion each year, and 63% of households discard unused medicines with household waste, where they are ultimately incinerated or landfilled. The Active Pharmaceutical Ingredient (API) in these products could be recovered and reused, yet whether doing so is environmentally worthwhile still remains unknown. Few life cycle assessments (LCAs) have examined API recovery from end-of-use medicines, and the relevant research needed to answer this question has developed independently, with little cross-citation. API manufacturing LCAs measure the burden of producing a drug but stop at the factory gate, leaving end-of-life unmodeled. Pharmaceutical waste and supply chain studies describe how medicines are collected and disposed of, and often call API recovery environmentally preferable without quantifying it. Recovery chemistry shows that APIs can be extracted from expired tablets and repurposed, but does not ask whether doing so outperforms disposal. Studies that focus on end-of-use medicines specifically remain scarce. Through a literature review, three recovery destinations for paracetamol API were identified: corrosion inhibitor, chemical synthesis feedstock and activated carbon precursor. This study compares the life cycle impact of recovering paracetamol API from unused paracetamol products for use as a corrosion inhibitor in the oil and gas industry, where it can protect steel well casing during acidizing, against the current practice (collection and incineration). The comparative LCA is built in openLCA and, to our knowledge, is the first to quantify whether recovering an API is environmentally better than incinerating it. The results will show hospitals, pharmacies and take-back programs whether this recovery route outperforms incineration, informing decisions on setting up such a recovery program.

Mentor(s):
Abheek Chatterjee (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7119
Presentation Time: STEW 218C at 2:00 PM-2:20 PM

Ejército Espía: Surveillance Technology and Attribution in Mexico's Grey-Zone Conflict

Social Science

Authors(s):
Sophie Salazar† (DSB|Liberal Arts); Andrea Njakara† (Liberal Arts)

Abstract:
This project examines whether the use of state surveillance technology constitutes a distinctive form of grey-zone conflict. Specifically, it looks at how Mexican government institutions both combat and collude with cartels. Ejército Espía, the case under study, examines how the Mexican military used state-grade Pegasus spyware to surveil journalists and human rights defenders. Therefore, the case investigates unlawful state surveillance and institutional corruption.

Using Hoffman's spectrum of unconventional warfare and a constructivist framework, we conduct a qualitative single case study analyzing forensic reports, investigative journalism, and scholarship on surveillance and regulation.

Preliminary analysis suggests that corruption, institutional fragmentation, and ties among government institutions, cartels, journalists, and civil society create attribution problems, especially when non-state actors may gain access to state-grade technology. These problems make it unclear whether surveillance reflects the interests of the state, individual state actors, cartels, or a combination, which makes this case a distinctive form of grey-zone conflict.

This research contributes to understanding how surveillance technology can obscure responsibility, with implications for press freedom and institutional accountability.

Mentor(s):
Chiara Cervini (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7120
Presentation Time: STEW 218C at 2:20 PM-2:40 PM

Atrocities as Military Doctrine in the Bosnian War - Unconventional Tactics and Grey Zone Operations

Social Science

Authors(s):
Timothy Brandon Irwin† (Liberal Arts|JMHC)

Abstract:
This study aims to determine the efficacy of Serbian utilization of unconventional tactics and methods, carried out by proxy groups operating in Bosnia. I assess the Srebrenica Genocide, Siege of Sarajevo and systematic sexual violence. I will examine the degree to which these strategies aided in accomplishing political and territorial goals through coercing civilian populations.

This project examines state behavior through a Constructivist lens, operating under the assumption that states are driven by constructed identities, historical context, and reciprocal interactions within an anarchic system. My study evaluates these tactics at two levels of analysis, Second Image; which explains conflict as based on the internal factors of a state such as ethnic breakdown, regime type, and political ideology as well as Third Image; which explains conflict as being the fault of the international system due to the absence of a world government. The combination of these two levels of analysis will enable better explanation by recognizing that conflict is messy and often has more than one contributing cause.

My results show that unconventional tactics carried out by Serbian proxy groups were a viable strategy of population control during the Bosnian War; strategies of ethnic cleansing such as the Srebrenica Genocide and systematic sexual violence were successful in shattering communities through eroding identities and causing long term demographic displacement. The Siege of Sarajevo, where access to food, water, and power was restricted diminished the legitimacy of the Bosnian government.

My findings are that Belgrade retained some degree of deniability while continuing to project power in the region, exaggerated by the failures of the international community, particularly the UN and NATO, to get involved in the early stages of the conflict. While Serbian success came

short of forming Greater Serbia, the Republic of Srpska functions in many ways as an independent country.

Mentor(s):
Chiara Cervini (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7121
Presentation Time: STEW 218D at 2:00 PM-2:20 PM

Protecting Women Before the Deepfake: A Consent-Aware Approach to Preventing Non-Consensual Sexual Deepfakes

STEM

Authors(s):
Ananya Shaurya† (Polytechnic|JMHC)

Abstract:
Non-consensual deepfakes affect women disproportionately and raise privacy, safety, and ethical concerns. Current defenses mainly focus on deepfake detection after the media has already been created. This paper explores a consent-aware adversarial protection approach that prevents facial identities from being represented, hindering future use in creating non-consensual deepfakes. Adversarial attacks that add perturbations crafted using the Fast Gradient Sign Method were applied to facial images, and the paper analyzed how protected images affect facial embeddings created by a FaceNet neural network. The study used 200 FairFace images: 100 Black Female faces and 100 White Female faces. The study tested three protection levels using $\varepsilon = 0.01$, 0.02, and 0.03. As the perturbation strength increased, the mean cosine similarity between original and protected facial embeddings decreased for both races. The similarity dropped from 0.019 to 0.050 at $\varepsilon = 0.02$ and to 0.082 at $\varepsilon = 0.03$. Group differences were significant at $\varepsilon = 0.02$ and $\varepsilon = 0.03$. These findings highlight the importance of fairness when implementing adaptive adversarial protection. A fairness-aware adaptive methodology is introduced, which seeks to maximize protection while balancing the strength of the perturbation and demographic differences.

Mentor(s):
Jennifer Bay (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7122
Presentation Time: STEW 218D at 2:20 PM-2:40 PM

Water Supply in the Dominican Republic- An Interdisciplinary and Holistic Approach to Safe Water in Developing Countries

STEM

Authors(s):
Karina Jones Peate† (Liberal Arts|JMHC)

Abstract:
The purpose of this project is to ensure the availability and sustainable management of clean drinking water systems, while addressing the broader water and sanitation needs of peri-urban schools and communities in the Dominican Republic. As part of the interdisciplinary service-learning course, "Water Supply in Developing Countries", undergraduate and graduate students collaborated to evaluate and maintain previously installed water treatment systems. During visits to a school in El Desecho in 2024 and 2025, the team assessed water quality in previously installed systems from the class. Testing was conducted using compartment bag tests and laboratory analysis in partnership with the Instituto Superior de Agricultura (ISA). Maintenance activities included replacing filtration components and batteries supporting the solar-powered system. Observations of the treatment systems were made during visits to the community in 2024 and 2025, and demonstrated the systems are being used and maintained without assistance from the service-learning group. In 2025, water samples were collected from an existing treatment system, an untreated handwashing station, and an untreated well. Results showed that all three locations exhibited Most Probable Number (MPN) values exceeding 100, confirming that the water should be used for non-potable practices. Additional laboratory testing detected elevated concentrations of mesophilic aerobes, Pseudomonas aeruginosa, and total coliforms, further indicating microbial contamination. Although the system is not currently used for drinking water, it supports daily activities such as cooking, cleaning, and sanitation. By reducing reliance on purchased water, the system has allowed the school to redirect funds toward providing student lunches. These findings highlight the socioeconomic benefits of sustainable, community-managed water infrastructure while emphasizing the need for further treatment improvements to achieve safe drinking water access.

Mentor(s):
Rebecca Johnson (HHS); Ernest R Blatchley (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7123
Presentation Time: STEW 218D at 2:40 PM-3:00 PM

Seeing the Economy from Space

Social Science

Authors(s):
Siyuan Zuo Guan† (DSB)

Abstract:
Nighttime satellite imagery has become a common proxy for GDP in countries where official statistics are thin and hard to come across, but how much it actually measures is rarely tested against ground truth. I put that question to U.S. counties, where reliable GDP already exists. Using real Bureau of Economic Analysis county GDP, Census population, and NASA Black Marble VIIRS radiance for roughly 3,000 counties from 2016 to 2022, I estimated the light-to-GDP relationship across a ladder of specifications and tested a light-based nowcast out of sample, while finding this method's limitations.

The main finding was collapse in elasticity figures. A naive regression puts the elasticity near 0.85, which would make light almost interchangeable with output. That figure is composition: bright counties are rich largely because they are populous and built up. Once county and year fixed effects remove those fixed differences between places, the within-county elasticity falls to 0.16. The raw data show the same thing, correlating at 0.84 in levels but only 0.13 in year-to-year changes. A light-based nowcast of GDP growth barely beats a no-change benchmark and misses the 2020 contraction, because lights fell less than output.

Then, I tried applying the method to a data poor country, in my example: Ghana. This exposed the deeper limit: its luminosity rose roughly 230 percent over the decade while real GDP rose about 40 percent (electrification and energy infrastructure seems to grow faster than real GDP).

The contribution is not that lights measure GDP, but a measured account of how much they do. Nighttime lights are a strong proxy for the level of economic activity, a biased proxy for its growth, and a weak short-run predictor, and fixed effects reduce but do not remove the bias. The full pipeline is built entirely from public data and is openly available on my github.

Mentor(s):
Victoria L Prowse (DSB)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7124
Presentation Time: STEW 214A at 3:00 PM-3:20 PM

The Spell of Disinformation: Weaponization of Illusion in Late Medieval and Early Modern Europe

Humanities

Authors(s):
Amanda Jean Laughery† (Liberal Arts); Kat Mccormick† (Liberal Arts)

Abstract:
In this paper, we apply a critical disinformation framework, focused on research forwarded by Rachel Kuo and Alice Marwick (2021), onto medieval studies to reframe early witchcraft and magic discourse as not simply superstition, but a system of disinformation that shaped social hierarchies and affirmed institutional power. Our argument will use three case studies to examine the dissemination of information as seen through book history and how illusion was deliberately weaponized to target marginalized communities. In Case Study 1, we examine Heinrich Kramer's Malleus Maleficarum as a foundational text that relies on institutional authority to validate a system designed for 'invisible harm,' where disinformation attacks are disguised under structural illusions of manipulated evidence against the accused witches. Case Study 2 focuses on how early modern literature interprets Kramer's work, analyzing Reginald Scot's The Discoverie of Witchcraft as a systematic attempt to expose illusions and reveal their reliance on fear, information poverty, and social vulnerability. In Case Study 3, these anxieties are also reflected in earlier medieval literature through Geoffrey Chaucer's Franklin's Tale, where a gendered discourse of courtly love allows for a group of men to use scholarly magic to marginalize the tale's heroine, Dorigen. By threading these texts together, this paper demonstrates that disinformation enables systems of institutional power to persist by transforming illusion into accepted reality and discrediting those who attempt to dismantle it.

Mentor(s):
Kristin Browning Leaman (Libraries)

Other Acknowledgment(s):
Maria Catherine Conners* (Liberal Arts|JMHC); Sarah Wu* (Liberal Arts|JMHC)

Talk Presentation Abstract Number: 7125
Presentation Time: STEW 214A at 3:20 PM-3:40 PM

Not Just a Kid: An Exploration of Childhood in the United States through Puppets

Humanities

Authors(s):
Angela Emily Clark† (HHS|Liberal Arts)

Abstract:
The hegemonic concept of childhood in the United States is that children are not whole persons as they are yet to become the idealized form of adult. Cultural notions of time dictate that children are yet to be considered “worthy” as they are expected to mold themselves into their culture’s expectations, while not being seen as a valid community member. This research critiques the damaging ideology that children are simply “human becomings” by exploring their unique relationship to hierarchical paradigms through multimodal research. Autoethnographic research and in-depth literature review were conducted to take an interdisciplinary look at how childhood exists in the United States. To explore these ideas and to publicly introduce conversations about childhood, I use puppets as an approachable and flexible art form. Children are often overlooked in conversations about systemic injustice, so an interdisciplinary lens was used to fully understand the connection between ideas of childhood and the understanding of culture. The exhibit of my puppets was held at The ALab in the Department of Anthropology at Purdue University between October 9-23, 2026, and this poster presentation serves to feature some of my exhibited works.

Mentor(s):
Dada Docot (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7126
Presentation Time: STEW 214A at 3:40 PM-4:00 PM

Assessing Functional Variation in Astragali for Dice Games Through Experimental Replication of Bone Preparation Techniques

STEM

Authors(s):
Kat Mccormick† (Liberal Arts); Nangba Hugh Konyak* (Science|JMHC)

Abstract:
Dice games were a popular form of gaming in ancient Greek and Roman societies, as seen by literary sources and archaeological assemblages. One of the most common gaming tools were astragali, “knucklebones”, derived from animals such as sheep, goats, and pigs. Although methods to prepare astragali are not documented in surviving ancient sources, archaeologists have noted thermal alteration on specimens recovered from sites, such as the Etruscan settlement of Cetamura del Chianti. This raises the possibility that heat-based processing techniques, including boiling, may have been used during preparation. As heating may alter lipid retention and distribution within the porous bone matrix, preparation methods may potentially affect dice rolling behavior. Using methods of experimental archaeology, this project investigates three techniques for cleaning astragali: boiling, maceration, and carrion insect activity. Differences in bone mass and residual lipid content is examined to determine whether varying preparation methods produce measurable changes in physical properties of the dice, affecting weight and balance. Standardized rolling trials and statistical analyses are used to compare the frequencies of dice rolling outcomes. These results demonstrate the relationship between bone preparation and functional performance, contributing to a better understanding of ancient gaming practices and assessing whether differences in cleaning methods may have influenced the results of astragali games.

Mentor(s):
Benjamin J Schoville (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7127
Presentation Time: STEW 214B at 3:00 PM-3:20 PM

Metals versus malignancy: How do essential metals mediate carcinogenesis?

STEM

Authors(s):
Cael Hinde† (Liberal Arts|Science)

Abstract:
The benefit of essential metals in the human diet is undeniable and well-studied. However, it is not common knowledge that a broad portion of humans with a Western diet experiences low levels of these nutrients, with nearly one half of Americans consuming too little magnesium and calcium. Essential metals are imperative in proper enzymatic function and formation, regulating many bodily processes such as metabolism, the circadian rhythm, and more. Proportions of these minerals have decreased largely with overprocessed food production and soil exhaustion; this inversely correlates with cancer rates across the country in the past century.

While there are an overwhelming number of factors involved in the complicated process of carcinogenesis (development of normal cells into cancerous cells), potential links to essential metal imbalances have been identified and studied. The purpose of this study is to serve as a meta-analysis combining findings from recent sources suggesting the benefits of magnesium and calcium mindfulness in the Western diet in the context of cancer prevention. Sources will identify correlations between levels of essential metals and rates of carcinogenesis and distinguish between type and degree of cancer, as different cancers are not equal nor completely similar. Additionally, this paper will examine other associated health consequences of low magnesium and calcium that may impact an individual's chance of cancer development or survivability. In conclusion, this compilation and analysis of work will seek to provide broad insight into potential links between essential metal deficiencies and the development and mortality of cancer.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7128
Presentation Time: STEW 214B at 3:20 PM-3:40 PM

TRACE (Transformer-based Reference-line Autonomy for Course Estimation)

STEM

Authors(s):
Connor Benjamin Coladonato† (Engineering); Liam Yates† (Science); Anand Krishnan† (Engineering)

Abstract:
Self-driving control systems like Model Predictive Control (MPC) are limited by their need for a pre-generated reference line. This restricts even autonomous vehicles to pre-mapped areas (geo-fencing) due to lack of reference line integration outside them. To make these systems fully autonomous and independent of location, removing this requirement is essential. The vision-based reference line generation through transformers team under the Autonomous Race Engineering Systems (ARES) VIP course is exploring transformers, a type of AI model that learns patterns from images, to generate a reference line in real time from visual input. This lets the vehicle navigate a road and its conditions and respond to obstacles, incomplete road markings, and adverse weather, reducing the need for a pre-generated reference line.

This work targets self-driving cars and the F1TENTH platform, equipped with a forward-facing camera and an onboard computer. Like most self-driving vehicles, it steers using MPC, a method that repeatedly predicts the vehicle's motion a moment ahead and chooses the steering and speed that keep it on a planned path. That path, called a reference line, is drawn in advance for each location, so the vehicle cannot drive in unmapped areas. The simulation is built to match this platform so results carry over to the real vehicle.

The team will create a simulation environment with optimal and suboptimal road situations, then develop transformers that generate a map highlighting the safest and most favorable paths (spatial heatmap) from camera input, without a preprogrammed reference line. Performance will be measured by comparing collision rate, route completion rate, and path efficiency on both the transformer-generated and pre-generated reference lines in simulation.

The end goal is a vehicle that can navigate a simulated track of optimal and suboptimal situations independent of a pre-generated reference line.

Mentor(s):
Andres Felipe Hoyos Moreno (Engineering); Reed Joseph Freer (Engineering); Richard Ajagu (Engineering); Samuel Labi (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7129

Presentation Time: STEW 214B at 3:40 PM-4:00 PM

Design and Optimization Through Experimental Validation of a Microgreen Growth Chamber for Lunar and Terrestrial Applications

STEM

Authors(s):

Mia Constance Schecter† (Agriculture|JMHC); Gregory Alfred Glenn† (Engineering); Sushma Katta† (Engineering|JMHC); Emilio Alejandro Meza Viera† (PWL); Suya Shen† (Agriculture); Muskaan Garg‡ (Engineering); Henry Ewald‡ (Engineering); Anishka Jain‡ (Scienc

Abstract:

The purpose of the Purdue University project is to design, build, test, and qualify a microgreen growth chamber for the NASA LEAF initiative to provide astronauts on long- term missions and homes on Earth with a quick, sufficient nutrient supply that uses minimal resources. Microgreens are ideal due to their rapid growth cycle, high nutrient density, and low resource requirements, making them well-suited for controlled-environment and space-based agriculture. Using a controlled growth chamber allows precise regulation of environmental variables for optimal plant production. Existing confined cultivation systems face limitations in scalability and closed-loop control, emphasizing the need for improved chamber designs that optimize growth efficiency. This project addresses this gap through research on minimizing the chamber size requirement, optimizing light formulas, and enhancing substrate designs. The project is split into five phases: baseline planning, prototype development, experimentation, optimization, and final validation. Currently, research is focused on experimenting with different substrate materials and optimal lighting formulas. Experiments use a layered substrate combination with agarose gel, ceramics, and porous growing mixture particles as well as LED red-blue lighting combinations to determine conditions necessary to cultivate healthy microgreen growth with high nutrient density. Through experimental design and application to support microgreen growth, this project seeks to expand the increasingly relevant field of plant research in space and further applications of microgreens in both terrestrial and extraterrestrial settings.

Mentor(s):
D. Marshall Porterfield (Agriculture|Engineering); Richard John Barker (Engineering)

Other Acknowledgment(s):
Adam W Gelman* (Agriculture|Engineering)

Talk Presentation Abstract Number: 7130
Presentation Time: STEW 214C at 3:00 PM-3:20 PM

Automated Detection of Right Coronary Artery Stenosis via Retrograde Flow Analysis

STEM

Authors(s):
Ngoc Anh T Nguyen† (PNW); Jayden Shah‡ (Lake Central High School (Merrillville, IN))

Abstract:
[Abstract Redacted]

Mentor(s):
Ernest Francis Talarico, Jr. (PNW); Loc Vu (Tan Tao University School of Medicine, Vietnam)

Other Acknowledgment(s):
Thach Nguyen* (Tan Tao University School of Medicine)

Talk Presentation Abstract Number: 7131
Presentation Time: STEW 214C at 3:20 PM-3:40 PM

Mindful Versus Non-Mindful HIIT Recovery: A Secondary Analysis of Physiological and Psychological Outcomes

Social Science

Authors(s):
Tithi Gohil† (HHS|JMHC)

Abstract:
Purpose: A secondary analysis of a completed study (Khatri et al., 2024) compared the effects of a treadmill-based high-intensity interval training (HIIT) session with and without mindfulness (MF) during recovery on within-session exercise performance, heart rate (HR) responses, perceived exertion (RPE), remembered feeling (FS), mental effort (ME), and recovery thought content and its relation to trait MF.

Methods: Forty young adults (mean age = 22.0 ± 3.4 years; females = 24) completed a crossover study involving mindful and non-mindful HIIT sessions on two counterbalanced days. Mindful recovery involved cues for breathing, bodily sensations, and a non-judgmental attitude, whereas non-mindful recovery involved cues for evaluation of exercise-induced responses. Analyses included repeated-measures ANOVAs, descriptive thought categorization, and generalized estimating equation (GEE) models.

Results: Across HIIT intervals, exercise RPE and recovery HR increased despite decreased exercise speed toward the final interval. Remembered FS did not differ between conditions, while ME was higher during non-mindful than during mindful recovery (5.15 vs. 2.90; $p<.001$). Sensory thoughts were more common during mindful recovery, whereas cognitive thoughts were more common during non-mindful recovery. An exploratory GEE model showed that higher trait MF scores ($p = .013$) were associated with lower odds of reporting cognitive thoughts during mindful recovery ($B = -3.373$, $p = .006$), but not during non-mindful recovery ($B = -0.086$, $p = .928$).

Implication: These findings suggest that mindful recovery may be particularly relevant to the sensory experience with lower ME, despite largely similar exercise performance, physiological responses, and remembered FS. Future studies could examine whether these acute effects depend on individual differences in trait MF and whether regular mindful HIIT engagement produces cumulative mental health benefits.

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Mentor(s):
Shih-chun Kao (HHS)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7132
Presentation Time: STEW 214C at 3:40 PM-4:00 PM

Retrofitting a UAV Landing Skid for In-House Design and Manufacturing using Carbon Fiber

STEM

Authors(s):
Nik Auclair† (Polytechnic); Caden Cole Cowles† (Polytechnic)

Abstract:
The purpose of this project is to redesign a skid plate for an existing fixed-wing unmanned aerial vehicle (UAV) using structural carbon fiber composite. The fixed wing UAV used for this project utilizes a plastic skid for landing and bungee-cord takeoff, which frequently breaks from takeoff and landing forces. This project's design goals are to develop a carbon fiber reinforced composite replacement skid with improved structural performance while maintaining compatibility with the existing UAV and the original component form factor. 3D scanning is used to accurately recreate geometry as a point cloud, and Computer Aided Design (CAD) technology is utilized for mesh reconstruction, composite part design, and tool design. Aluminum stock and Computer Numerical Control (CNC) machining will be used for tool manufacturing. With tool design underway, manufacturing is expected to begin by the end of this semester. Once completed, Finite Element and Geometric Deviation Analyses will be used to compare structural and dimensional properties between the composite assembly and the original plastic part. Thorough documentation of methods and troubleshooting are kept at all stages to aid future design efforts. The shipping time and scarcity of replacement components like this landing skid present an opportunity to utilize Purdue resources to design and build robust composite parts with in-house tooling and materials.

Mentor(s):
Damon Lercel (Polytechnic); Nathan Tyler Rose (Science); Garam Kim (Polytechnic)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7133
Presentation Time: STEW 214D at 3:00 PM-3:20 PM

How Rising Severe Convective Storms Expose Gaps in Insurance Risk Models

STEM

Authors(s):
Logan Labno† (Science)

Abstract:
Severe convective storms (SCS) bring destructive tornadoes, hail, and strong winds that cause major property damage across the U.S. Traditionally, insurance risk models focused mostly on major single events like hurricanes and earthquakes. However, the growing frequency and severity of these storms expose significant flaws in how insurance companies estimate risk. Because older models often treated SCS as secondary perils, they struggle to capture spikes in storm frequency, which can lead to underpriced insurance policies and unexpected financial losses for insurers. This research evaluates how changing storm patterns reveal these gaps in traditional modeling and examines how modern probability models can better measure these risks. Using industry loss data and insurance pricing structures, this project highlights the hidden financial risks found in older weather assumptions. Early findings show that relying only on past weather data can underestimate real-world financial risk, which can make insurance markets less stable for homeowners and businesses. Ultimately, updating these models can help ensure insurance prices remain accurate and financial protection stays reliable across storm-prone regions.

Keywords: Catastrophe Modeling, Severe Convective Storms, Risk Assessment, Property Insurance, Actuarial Science

Mentor(s):
Linda E Haynes (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7134
Presentation Time: STEW 214D at 3:20 PM-3:40 PM

3D Printing G-Quadruplex DNA: Making Handheld Tools for Molecular Visualization and Understanding

STEM

Authors(s):
Shawn Kongzhao Liu† (Science)

Abstract:
G-Quadruplexes (G4s) are non-canonical structures formed in guanosine-rich regions of DNA. They are formed by four continuous G-tracks connected by loops. They are commonly found in functionally important regions such as telomeres and oncogene promoters, indicating their regulatory roles. In the last few decades, additive manufacturing, also known as 3D printing, has emerged as a cost-effective method for structural biologists to produce physical models for complex biological structures like G4s. However, structural features of G4s, including overhangs and loops, make 3D printing G4s especially challenging with difficult to remove supporting material, snap-prone bases and backbones, and stringing. The current work aims to establish a method to reliably create accurate physical G4 models through 3D printing. We obtained G4 models from the Protein Data Bank and visualized them with PyMOL. Different visualization parameters including representation modes, cations, and base and backbone size were tested to establish an optimal model for 3D printing. Additionally, we adjusted G4 size, support structures, and splicing orientation in Ultimaker Cura to address the challenges mentioned above. Our results show that overall larger size, thicker bonds, and the presence of cations improve 3D printing quality. Specifically, we found that they result in clearer definition of individual bases, less breakage in bases and backbone, and greater ease of removing supporting material. We further found that bases aligned with the 3D printer build plate were less likely to snap than those perpendicular to the build plate. Our results highlight how proper splicing orientation of complex biological structures improves 3D printing quality while maintaining important structural features. Future endeavors include testing 3D printing with mixed filaments, multi-nozzle 3D printers, and modern 3D printing software to further improve printing quality and establish a reliable G4 3D printing method.

Mentor(s):
Jinho Jang (Pharmacy); Danzhou Yang (Pharmacy)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7135
Presentation Time: STEW 214D at 3:40 PM-4:00 PM

The Medical Applications of CRISPR

STEM

Authors(s):
Claire Hack† (Science)

Abstract:
What is CRISPR and how does it function in the medical field? A relatively new gene editing tool called clustered regularly interspaced short palindromic repeats (CRISPR) is being used by scientists alongside the Cas9 enzyme to more accurately locate, edit target genes, and solve medical problems. Different methods are being used with the abilities of CRISPR to make changes in the genome of many living organisms. CRISPR raises the opportunity to identify potential drug development opportunities in the case of many cancer treatments as well as numerous genetic disorders.

This research will investigate what the CRISPR and Cas9 system is and what it does where it is naturally found in bacteria cells. It will also find the current uses of CRISPR in the medical field such as treatments for biomedical illnesses and medical diagnosis. I hypothesize that CRISPR holds a great deal of potential in both medical diagnosis, research development, and treatment.

To investigate this hypothesis, research on current medical uses will be done to study the current medical applications of CRISPR. Peer reviewed articles of prior research done on the methods of CRISPR will provide insight into these questions about CRISPR.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7136
Presentation Time: STEW 218A at 3:00 PM-3:20 PM

Deep Learning for Dendritic Spines Resolution Restoration and Segmentation in Two-Photon Microscopy

STEM

Authors(s):
Leonor Antunes Sinogas† (Science)

Abstract:
Dendritic spines are small protrusions on neuronal dendrites that serve as major sites of excitatory synaptic transmission. Their morphology is closely associated with synaptic strength, plasticity, learning, and memory. However, their small size makes accurate measurement challenging in two-photon microscopy, where low signal-to-noise ratio, blur, motion artifacts, and poor axial resolution can obscure spine boundaries and thin neck structures.

This project develops AIBIO-7, a deep learning-based pipeline for restoring and segmenting 3D two-photon dendritic spine images. The workflow integrates Content-Aware Image Restoration (CARE) for denoising, Self-Net for axial restoration, and a custom nnU-Net for segmentation of dendrites, spine heads, and necks. Restoration was evaluated using intensity profiles and axial full width at half maximum (FWHM), with fluorescent beads providing a corrected axial reference of 1.35 μm. Twenty image frames were manually labeled to train nnU-Net.

CARE preserved dendritic structures and produced smoother images, but original and restored intensity profiles remained nearly identical, indicating limited quantitative improvement. Self-Net produced smoother, more isotropic-looking volumes but did not improve measured axial resolution. Pooled spine-head axial FWHM increased from 2.69 μm to 2.91 μm rather than approaching the 1.35 μm reference. In contrast, nnU-Net achieved F1 scores of 0.942 for dendrites, 0.865 for necks, and 0.925 for heads, averaging 0.910. Head precision and recall were 0.9266 and 0.9234, while neck precision and recall were 0.8715 and 0.8578.

These results identify automated segmentation as the strongest component of AIBIO-7 while highlighting the need for larger, more diverse datasets to improve restoration. Future work will use segmentation masks to quantify spine morphology and track structural changes over time, supporting studies of synaptic plasticity, learning, and memory.

Mentor(s):
Shulan Xiao (Engineering); Linlin Li (Engineering)

Other Acknowledgment(s):
Scotty Secrist* (PWL)

Talk Presentation Abstract Number: 7137
Presentation Time: STEW 218A at 3:20 PM-3:40 PM

Temperature-Dependent Weak Localization In Ultrathin Gallium-doped Zinc Oxide Films

STEM

Authors(s):
Muhammad Mahdi Marzan† (Engineering); Saishri Bagde‡ (Engineering)

Abstract:
Gallium-doped zinc oxide (GZO) is a transparent conducting oxide which has attracted growing interest for plasmonic, optoelectronic, and quantum devices, some of which operate under cryogenic conditions and rely on films that are under 100 nanometers thick. At these thicknesses, electron transport becomes very sensitive to disorder and to the film-substrate interface, yet low-temperature transport in ultrathin GZO has not been studied in depth across different substrates. In this research, we study GZO films with a thickness of 8-100 nm, grown by pulsed laser deposition on fused silica, sapphire, and silicon substrates to provide a range of microstructural disorder. We measured longitudinal and Hall resistance in the van der Pauw geometry from 5 K to 100 K in magnetic fields up to 9 T and extracted the carrier density, mobility, and phase coherence length as functions of temperature. At low temperatures the films exhibit negative magnetoresistance, a signature of weak localization, and the thinnest film shows evidence of variable-range hopping. We fit the low temperature magnetoresistance to the Hikami-Larkin-Nagaoka (HLN) model for 2D weak localization to get the phase coherence length at each temperature. Preliminary results imply that Nyquist electron-electron scattering is the dominant dephasing mechanism in the 2D weak-localization regime. It is also interesting to note that the weak localization data suggests a crossover from two- to three-dimensional behavior as temperature increases. In the latter regime, we apply the Kawabata formula for negative magnetoresistance with a correction for electron-electron interactions. The results of our study show how thickness and disorder control the electronic behavior of ultrathin GZO and can guide its use in nanophotonic and quantum devices.

Mentor(s):
Alexandra Boltasseva (Engineering); Miroslava Marinova Marinova (Engineering); Kyu Ri Choi (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Talk Presentation Abstract Number: 7138
Presentation Time: STEW 218A at 3:40 PM-4:00 PM

The Impact of Degrees of Freedom and Weight Distribution on Quadrupedal Robot Power Consumption and Locomotion

STEM

Authors(s):
Matthew Manuel† (Engineering); Aiden James Carr* (Engineering|JMHC); Megan Zuran Grolemund* (Engineering)

Abstract:
The Purdue Humanoid Robot Club aims to create dexterous humanoid robots and rovers to perform certain tasks in space to which a human could, without the risk to human life. These robots would be able to use object detection paired with sensors and motors to both navigate and manipulate their environment. My team aims to develop and test these various mechanisms in a smaller and simpler quadrupedal robot to maximize time and cost efficiency. As the only member in my team in VIP, my goal is to develop a working leg mechanism that distributes weight in a way that maximizes power efficiency, with the least amount of motors to minimize cost while still allowing for the minimum required movement capabilities as set by the club goals. What I've found so far is that distributing weight towards the chassis of the robot decreases the amount of torque required to move the leg, thereby decreasing power consumption. Additionally, while a single motor per leg can mimic natural movement using gear reductions and overdrives, it cannot truly provide enough degrees of freedom for the quadruped to perform complex tasks such as jumping and lateral movement. Ultimately, I will continue to design various types of leg mechanisms to meet these club goals, test the most promising ones out by 3D-printing them, and finally choose to present the design that best reaches the project's minimum goals while maximizing power efficiency and minimizing manufacturing costs.

Mentor(s):
Rohan Rahul Pradhan (Engineering); Jaeeun Kim (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7139
Presentation Time: STEW 218B at 3:00 PM-3:20 PM

Mechanical Testing Chamber for Cells

STEM

Authors(s):
Miram Elag† (Engineering|JMHC); Grace Lincoln† (Engineering)

Abstract:
Commercial cell-testing systems can cost thousands of dollars and may be difficult to maintain or repair, creating a need for more affordable and reliable alternatives. This project aims to develop a cost-effective, reusable cell chamber that accommodates microscope slides, replicates in vivo shear and tensile stresses, and enables microscopic observation of cells. Building on previous prototypes, the current design features a circular geometry to reduce corner-related shear stress and prevent membrane folding, along with a separate water line to improve control of the fluid gradient across the membrane. The prototype will undergo stress testing, including evaluation using fluid flow to assess its performance and reliability and identify areas for improvement. The findings will guide subsequent design iterations and help determine whether the chamber offers a practical, repairable alternative to existing systems while advancing its development toward a commercially viable prototype.

Mentor(s):
Julie Ying Hui Ji (PWL); Sungsoo Na (PWL)

Other Acknowledgment(s):
Natasha Rajendrara Gundapaneni* (Engineering)

Talk Presentation Abstract Number: 7140
Presentation Time: STEW 218B at 3:20 PM-3:40 PM

Copper Electroplating Optimization for High Aspect Ration Through-Silicon Via Fabrication

STEM

Authors(s):
Tim Jacques van Antwerpen† (Engineering); Annabelle Nakamura Defosse† (Engineering|JMHC); Ekagra Agarwal† (Engineering); Sophia Yixuan Lu† (Engineering); Logan Scott Fergusson† (Engineering); Qiming Chai† (Engineering)

Abstract:
Semiconductor technology is foundational to the computers and hardware that drive the world we live in today. Traditionally, technological advances were fueled by shrinking transistors, transistor scaling is approaching the limits of physics, motivating new approaches for further advances. One key technology pathway identified is 3D integration, where multiple chips are stacked vertically for greater performance. This project develops a 3D integration workflow centered on Through-Silicon Via (TSV) fabrication for advanced microelectronic packaging. TSVs provide vertical electrical interconnections between stacked chips, enabling reduced interconnect length and improved power efficiency in integrated systems.

The primary focus of our work this semester is optimizing one step in the TSV fabrication process: electroplating. The purpose of electroplating is to fill etched TSVs with copper following the deposition of thin films that serve as dielectric, adhesion, diffusion barrier, and seed layers. Key challenges include poor adhesion between thin films, low Faradaic efficiency, and nonuniform copper deposition that can lead to void formation in high-aspect-ratio TSVs. Our experiments have identified cases where copper films delaminate upon immersion in the plating solution without applied current, highlighting the importance of understanding interfacial stability and electrochemical conditions. To address these challenges, we systematically investigated process improvements such as plating temperature, solution agitation, process sequencing, sample pre-wetting, and anode-to-cathode area ratios to improve Cu-Ta and Cu-Ti interface adhesion, increase Faradaic efficiency, and promote void-free filling of high-aspect-ratio TSVs. Successfully developing a reliable and reproducible electroplating process would enable the fabrication of functional TSVs and contribute to

more scalable, cost-effective 3D integration technologies for next-generation semiconductor devices.

Mentor(s):
Peter Bermel (Engineering); Saeed Mohammadi (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7141
Presentation Time: STEW 218B at 3:40 PM-4:00 PM

Accelerating Data Movement on the AFT RISC-V Microcontroller with a Peripheral-Triggered Multi-Channel DMA Controller

STEM

Authors(s):
Yujia Alina Li† (Engineering); Ronald Oum† (Engineering); Drew Babel† (Engineering)

Abstract:
In embedded systems-on-chip (SoCs), copying data between memory and peripherals in software consumes processor cycles otherwise available to application code. Because of this, direct memory access (DMA) systems are often utilized to offload said cycles to dedicated hardware to increase throughput. For AFT, Purdue SoCET's RISC-V microcontroller SoC, a prior team built DMA-zing, an 8-channel DMA controller. DMA-zing, however, was never integrated into the chip. The controller had no connection to AFT's bus, no way for a peripheral to pace a channel, and ring-buffer, one-shot, burst, and error-handling defects the original tests missed. To integrate DMA-zing into AFT, we correct the defects and rebuild the test suite to cover every mode, size, and bus fault, attach the controller's read and write ports to AFT's shared bus as two managers alongside the RISC-V core, and add a 32-input trigger controller in which each peripheral interrupt grants a channel credit for a set number of items without processor involvement. In full-chip simulation, a copy sustains one word every 2 cycles, 10x the throughput of a software copy loop and 100% of bus bandwidth, as the bus accepts one transfer per cycle and each word needs one read and one write. With a fixed overhead near 550 cycles for driver setup and the completion interrupt, the end-to-end speedup rises from parity near 30 words to 7.9x at 1,024 words, while a paced channel is configured once per stream. This same overhead defines the first of two limitations, as transfers under 30 words run slower than software. Each channel further moves a single contiguous region, which excludes scatter-gather. Before AFT's next tapeout, we will formally verify the design and compare the controller's area with the RISC-V core to select the final channel count. On silicon, the DMA allows AFT to stream sensor samples into a memory ring on each timer tick and feed a future network interface while the processor runs application code.

Mentor(s):
Cole Aaron Nelson (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7142
Presentation Time: STEW 218C at 3:00 PM-3:20 PM

Shader Core: Replacing Fixed-Function GPU Hardware with Flexible Execution

STEM

Authors(s):
Raghuv Potdar† (Engineering); Nikolai Viswanath† (Engineering|JMHC); Khoi Anh Nguyen† (Engineering); Andy Hanjun Hu† (Engineering); Caleb Enos Zhang† (Engineering|JMHC); Dongliang Luo† (Engineering)

Abstract:
Graphics processing units (GPUs) previously relied on fixed-function pipelines where each functionality was supported through dedicated hardware. Given the diversity of graphics algorithms, architects could continue expanding with costly fixed-function hardware with declining utilization or ignore certain functionalities and accept the performance loss.

To address this problem, we propose the design and implementation of a programmable shader core, capable of supporting a diverse range of graphics algorithms without requiring dedicated hardware. Our shader core replaces the vertex and fragment shader stages within a fixed-function pipeline, as those are the stages with the greatest variability in utilization between graphics algorithms. Drawing from previous simulator work, we support packetization–a compiler technique to separate dependent instructions–to maintain correctness instead of a scoreboard which saves power and area.

In comparison with dedicated hardware, our shader core is expected to slightly underperform for the same workload. However, we will show that our shader core can perform complex workloads that a fixed-function cannot do under the pretense that it doesn't have hardware capability to do so.

Our intended outcome is a fully implemented and verified shader core on a PolarFire® SoC Video Kit FPGA to demonstrate hardware viability and approximate area. With this, our design will serve as a hardware basis for future teams to expand upon, exploring designs for other parallel workloads such as machine learning. Accordingly, the ISA and hardware implementations have explicit room for future expansion and optimizations.

Mentor(s):
Zach Anthony Barna (Engineering); Charles Spencer Bowles (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7143
Presentation Time: STEW 218C at 3:20 PM-3:40 PM

Rooftop Photovoltaic Generation for Refrigerated Heavy-Duty Truck Trailers

STEM

Authors(s):
Yash Dalal† (Engineering); Daniel Jungil Lee† (Engineering); Andre Penna Fontana† (Engineering)

Abstract:
Battery-electric heavy-duty trucks such as the Tesla Semi offer a path to cleaner freight, but refrigerated trailers and energy-draining motors deplete the battery and cut range. Rooftop solar could offset that demand. Fraunhofer IVI's IVImon model, applied to an 18-ton, 44-foot electric truck with a 3.2-kWp PV system, estimated that vehicle-mounted solar could cover up to 25% of energy needs on summer days and about 13% annually. Private companies have conducted limited demonstrations of solar-equipped refrigerated trailers in the United States, but publicly available validation remains independent limited.

This project investigates whether roof-mounted flexible, high-efficiency monocrystalline panels (back-contact or heterojunction) can reduce net energy use after accounting for added weight, climates, and conditions maximize the benefit. The current model uses station-specific hourly PVWatts AC-output profiles, scaled to a 7.04-kW DC array with 20.6% system losses, to estimate solar generation on I-10 (Los Angeles, CA to Houston, TX) and I-40/I-35 (Barstow, CA to Dallas–Fort Worth, TX) using 20 station-specific solar profiles per route. Subsequent work will integrate refrigeration and auxiliary loads and validate predictions with a scaled truck testbed.

At 80% roof coverage (344.4 ft²) and a 7.04-kW PV array, theoretical calculations show a mean annual daily output of 27.2 kWh/day on I-10 and 26.9 kWh/day on I-40/I-35 averaged across the 20 station profiles. In the modeled June 15 trip, generation totals 71.9 kWh on I-10 and 71.5 kWh on I-40/I-35. At 1.7 kWh/mi, these totals equal approximately 42.3 and 42.1 mi of energy-equivalent driving range, respectively, before accounting for PV-system mass. Refrigeration offset, auxiliary-load coverage, weight-related energy penalties, and avoided emissions remain to be quantified. This work will help inform research on effective integration strategies for photovoltaics in refrigerated trucks.

Mentor(s):
Peter Bermel (Engineering); Muhammad A Alam (Engineering)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7144
Presentation Time: STEW 218C at 3:40 PM-4:00 PM

Sex-specific Proteomic Signatures of Cognitive Resilience in Asymptomatic Alzheimer's Disease

STEM

Authors(s):
Navya Dewan† (Science|JMHC)

Abstract:
Alzheimer's disease (AD) shows a marked sex disparity, with females disproportionately affected and experiencing faster cognitive decline. Some individuals harbor substantial amyloid-β and tau pathology yet remain cognitively normal. These individuals are termed asymptomatic AD (AsymAD), suggesting the presence of endogenous neuroprotective mechanisms. Whether these resilience pathways are driven by sex-specific protein alterations remains poorly understood. We analyzed postmortem brain proteomic profiles (8,603 proteins) from AD and AsymAD cases in the ROSMAP, Banner, and Mount Sinai cohorts. Differential expression was assessed using linear models with empirical Bayes moderation (adjusted $P < 0.05$). Females showed nearly twice as many altered proteins (1,318: 826 up, 492 down) as males (672: 464 up, 208 down). Reactome and GO Biological Process enrichment revealed shared and sex-divergent adaptations. Resilient individuals of both sexes upregulated mitochondrial bioenergetics, including oxidative phosphorylation, ATP synthesis, and complex I biogenesis. Resilient females also upregulated mitochondrial gene expression and translation. They downregulated carbohydrate catabolism (pentose-phosphate shunt, NADPH regeneration) and innate immune cascades (neutrophil degranulation, interleukin signaling). Resilient males instead upregulated the TCA cycle and nonsense-mediated decay. They downregulated spliceosomal splicing, nuclear RNA transport, and apoptotic signaling. Thus, cognitive resilience in AsymAD involves shared bioenergetic preservation alongside sex-divergent proteomic programs. Females showed translational and immune remodeling, while males showed modulation of RNA processing and apoptosis. These signatures provide feature sets for machine learning models to distinguish resilient from progressive AD and may inform potential sex-specific therapeutic strategies.

Mentor(s):
Priyanka Baloni (HHS); Purba Mandal (HHS)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7145
Presentation Time: STEW 218D at 3:00 PM-3:20 PM

Frequency and Duration Mismatch Negativity as a Neurophysiological Correlate of Psychosis-Proneness in a Non-Clinical Sample

STEM

Authors(s):
Alexander Jamison Merchant† (HHS)

Abstract:
The mismatch negativity (MMN) is an auditory event-related potential elicited by deviant stimuli within a stream of standard stimuli. It is among the most consistently replicated neurophysiological markers of auditory processing deficits in neurodegenerative diseases and has been proposed as an endophenotype for psychosis risk. Although MMN reductions are well documented in clinical high-risk (CHR) populations, less is known about how the MMN relates to sub-clinical psychotic experiences in the general population. Further, it is unclear how specific MMN subtypes (frequency-deviant, fMMN; duration-deviant, dMMN) relate differently to symptom dimensions. This study examines associations between psychosis-proneness, measured by the Community Assessment of Psychic Experiences (CAPE-42) and both fMMN and dMMN in a non-clinical adult sample. CAPE-42 frequency and distress scores were computed for positive and negative dimensions. Comparisons against published norms indicated that frequency scores fell significantly above healthy norms and significantly below psychotic disorder norms, consistent with an intermediate, subclinical risk profile. EEG data was collected using a passive oddball paradigm presenting both frequency and duration deviants, with MMN quantified as mean amplitude and peak latency at frontocentral sites within deviant-specific time windows, informed by prior schizotypy and CHR literature. For our planned analyses, we hypothesize that negative-dimension CAPE scores, reflecting behavioral precursors to psychosis, will show a stronger association with dMMN, while positive-dimension scores, reflecting psychotic-like experiences, will show a stronger association with fMMN. Multiple regression, controlling for age and other demographic variables, will test these associations for each dimension and deviant type. Findings may clarify whether fMMN and dMMN distinguish dimensions of psychosis-proneness before clinical risk emerges, advising earlier intervention.

Mentor(s):
Daniel J Foti (HHS)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7146
Presentation Time: STEW 218D at 3:20 PM-3:40 PM

Maraviroc and Recovery After Traumatic Brain Injury in Mice

STEM

Authors(s):
Ashley Fontana† (HHS)

Abstract:
Traumatic brain injury (TBI) can cause lasting changes in brain function, behavior, and cognition. Following TBI, inflammation and activation of immune cells in the brain can contribute to neurological dysfunction and may interfere with recovery. Maraviroc is a drug that blocks the chemokine receptor CCR5, a receptor involved in inflammatory signaling. Previous research has shown that blocking CCR5 with maraviroc may reduce neuroinflammation and improve cognitive and behavioral outcomes in animal models of neurological injury and disease. However, the effects of maraviroc following TBI, particularly on behavioral and cognitive recovery, require further investigation. This study will examine whether maraviroc can improve recovery following TBI in mice.

Mice will undergo a controlled cortical impact (CCI) procedure to model TBI and will subsequently receive maraviroc treatment. Behavioral testing will be used to evaluate changes associated with TBI and determine whether maraviroc improves recovery. Tests will assess measures such as movement, anxiety-related behavior, and memory recognition. Behavioral performance will be compared between injured mice receiving maraviroc and appropriate control groups to determine whether treatment produces meaningful improvements. This study will also consider whether behavioral changes associated with maraviroc are consistent with reduced effects of TBI. Understanding how maraviroc influences behavioral and cognitive recovery may provide insight into the potential of CCR5-targeted treatments for neurological injury and other conditions involving neuroinflammation.

Keywords: maraviroc, CCR5, traumatic brain injury, TBI, mice, neuroinflammation, behavior, memory

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Talk Presentation Abstract Number: 7147
Presentation Time: STEW 218D at 3:40 PM-4:00 PM

Tuning Out the Noise: Auditory Filtering and Classroom Attention in Autistic College Students

Social Science

Authors(s):
Grace Lauren Scott† (HHS)

Abstract:
Autistic individuals often have difficulty filtering auditory input, but the real-world impact is unclear. We examined auditory filtering during visual search, a task in which autistic individuals often excel, and the relation between filtering abilities and classroom attention.

Thirty-eight Purdue University students (14 autistic, 24 neurotypical [NT]) completed a visual search task (target present/absent; three set sizes) in quiet, social-noise, and non-social-noise conditions. Filtering was indexed by difference scores (noise − quiet) in median response time (RT). A subsample (n = 28) was observed in class, and attention was coded using the Multi-Option Observation System for Experimental Studies (MOOSES), yielding percent time on-task and rate of attention shifts off-task.

Both groups showed typical search effects (i.e., slower in target absent, larger set size condition; all $p < .001$); however, noise did not alter search efficiency. On target-present trials, NT participants responded faster in noise than in quiet, whereas autistic participants slowed ($p = .04$). Across all participants, greater noise-related slowing during search was associated with more frequent in-class attention shifts off-task ($\rho = .44$, $p = .02$) and less time on-task ($\rho = -.43$, $p = .02$).

Preliminary findings suggest autistic college students may be more slowed by background noise, and that noise-related slowing is related to increased off-task attention in classroom settings. Results warrant replication and may support evaluating noise reduction as a classroom accommodation.

Mentor(s):
Brandon Keehn (HHS)

Other Acknowledgment(s):

VIRTUAL PRESENTATIONS

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Virtual Presentation Abstract Number: 9000

Virtual presentations available on the Fall Expo website from Nov. 16-20.

ANTIOXIDANT ACTIVITY AND MOLECULAR RESPONSES TO THERMAL STRESS IN THE SEA URCHIN, Lytenchinus variegatus

STEM

Authors(s):
Noshin Atiya Rahman† (PFW)

Abstract:
Sea urchins play essential roles in marine ecosystems by regulating ecological communities and contributing to nutrient cycling. As early diverging deuterostomes, they possess evolutionarily conserved molecular pathways that make them valuable models for investigating biological responses to environmental stress. This study investigated the antioxidant and molecular responses of the green sea urchin, Lytechinus variegatus, to gradual thermal stress, with particular emphasis on antioxidant capacity and the expression of stress- and immune-related genes.

Sea urchins were assigned to control and thermal-stress groups. Animals in the thermal-stress group were subjected to a progressive temperature increase of 1°C per day, whereas the control group was maintained at the optimal temperature. Following five days of exposure, coelomic fluid, body wall tissue, and spines were collected to assess antioxidant capacity using the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical-scavenging assay. Ascorbic acid showed concentration-dependent radical-scavenging activity, while control and thermal-stress samples exhibited negligible antioxidant activity. These findings suggest that the experimental temperature increase may not have been sufficient to stimulate a detectable antioxidant response in L. variegatus, a tropical species adapted to relatively warm environmental conditions. Alternatively, the observed results may reflect limitations in detecting antioxidant activity under the experimental conditions.

Quantitative PCR (qPCR) analysis is currently underway to evaluate the expression of NF-κB and FoxO, two transcription factors involved in immune regulation, cellular stress responses, and the maintenance of physiological homeostasis. Comparison of gene expression between control and thermally stressed animals may reveal underlying molecular responses that were not apparent from the antioxidant assay. These findings will clarify how L. variegatus responds to rising temperatures.

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Mentor(s):
Ahmed Mustafa (PFW); Rebecca Palu (PFW)

Other Acknowledgment(s):
Sayed Abdullah Al Mamun* (PFW)

Virtual Presentation Abstract Number: 9001

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Building Material Health and Safety After 9/11: What Changed, and What Gaps Remain?

Business Case Study

Authors(s):

Ainsley Elizabeth Benson-Catellier† (Liberal Arts); Sonia Vipul Bhagat† (Liberal Arts); Madison Rose Compher† (Agriculture); Brianna Rachelle Pastran-Pacheco† (Liberal Arts)

Abstract:

When a building is unexpectedly destroyed, the aftermath can be devastating. Its materials do not simply disappear; the ensuing chaos of collapse, pulverization, and fire can create long-term health risks. These health concerns motivate our research question: How do contemporary approaches to sustainable material selection account for human and ecological health risks when interacting with building materials that are burned, pulverized, or released during catastrophic events? Using the World Trade Center as a case study, we aim to investigate changes in building legislation, post-9/11, relevant to human and environmental health, and determine what gaps remain. We are conducting a literature review, emphasizing research surrounding the issues' progression over time, both in human, ecological, and environmental consequences and building material standard frameworks. We focus on hazardous materials, specifically the resulting dust clouds and combustion byproducts, as a metric to analyze progression. To do this, we explore building standards set prior to 9/11 and after, to see if they addressed the unique circumstances surrounding the event, and compare this evolution to current adopted frameworks. Following this exploration, we discuss where improvements can be made in current material health and safety standards. This study compares post 9/11 building material standards across three widely used sustainability rating systems: Leadership in Energy and Environmental Design (LEED), the WELL Building Standard, and the Living Building Challenge (LBC). Our findings may help inform safer material selection and reduce human and environmental health risks during catastrophic events.

Mentor(s):

Genell Wells Ebbini (Liberal Arts)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Virtual Presentation Abstract Number: 9002

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Design of a Hardware-Accelerated Edge Detection and Feature Extraction Pipeline Using Sobel and Hough Transform

STEM

Authors(s):
Michael Borokhov† (Engineering); Kieran Ray Neill† (Engineering); Nathan Leong† (Engineering); Aaron Guo† (Engineering)

Abstract:
Real-time computer vision algorithms are characterized by the need for an image processing architecture that can extract meaningful visual information based on certain constraints in computational throughput, hardware resources, and energy consumption. This presentation covers the design and implementation of a hardware accelerated image processing pipeline featuring edge detection via Sobel operator followed by geometric feature extraction based on Hough transform.

The architecture uses the Sobel operator for computation of the horizontal and vertical image gradients using 3 x 3 convolution kernels, and a column-major line buffer for storage of the local image neighborhood used for gradient calculation, exploiting spatial data reusability and saving the access to the image memory. Then the edge information is passed through the Hough transform for the extraction of geometric information from edges. Through the use of specialized hardware for computationally complex processing steps the design is expected to improve throughput and reduce computational overhead related to the execution of software-based vision processing.

Development includes RTL design, functional verification and FPGA prototyping of the proposed architecture to validate the functionality of the processing pipeline before ASIC tape-out. This work establishes a hardware-oriented approach to integrating low-level edge detection and higher-level geometric feature extraction, providing a foundation for efficient and scalable vision-processing accelerators in embedded systems.

Mentor(s):
Jayaditya Borah (Engineering)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Virtual Presentation Abstract Number: 9003

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Wrong-Drug Administration Incidents Following EPMA Implementation: A Retrospective Analysis at St Bartholomew's Hospital

STEM

Authors(s):
Peyton Rose Collier† (Pharmacy)

Abstract:
Introduction: Wrong-drug administration remains a source of preventable patient harm despite the implementation of Electronic Prescribing and Medicine Administration (EPMA) systems at National Health Service (NHS) sites, including St Bartholomew's Hospital (SBH), in 2023.

Objective: To identify patterns and contributing factors associated with wrong-drug administration incidents across NHS sites, with a focus on SBH following EPMA implementation.

Methods: A retrospective observational analysis was conducted using data extracted from NHS incident reports in Microsoft Excel®. The dataset included incidents reported across 13 NHS sites from July 2012 through July 2026. A total of 1,717 incidents were analyzed to characterize patterns before and after EPMA implementation. Post-implementation incidents at SBH were examined by location, medication category, type of error, and contributing factors.

Results: Among post-EPMA incidents at SBH, 64 wrong-drug administration incidents were identified across 22 locations or wards. The most common incident types involved administration of a completely different medication than prescribed (42%), incorrect intravenous or transducer fluid (17%), and incorrect formulation (16%). Frequently implicated medication categories included insulin, opioids, intravenous fluids, and cardiovascular medications. Reported contributing factors included medication storage and selection errors, failure to review prescriptions before administration, changes involving self-administered medications, look-alike/sound-alike medications and packaging, and bypassing independent double-check procedures.

Conclusions: Wrong-drug administration incidents persisted following EPMA implementation, with reported errors highlighted during medication selection and administration. Barcode medication

administration (BCMA) may provide an additional safety barrier by helping detect medication errors before administration.

Mentor(s):
Ellen M Schellhase (Pharmacy); Monica Miller (Pharmacy)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9004

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Nature's Blueprint for Sustainable Construction

STEM

Authors(s):

Sophia Cunningham† (Engineering); Kara Wang† (Engineering|JMHC); Lillian McFall‡ (Engineering|JMHC)

Abstract:

Inspired by the remarkable structural architectures found in nature, this research project investigates how biological models can shape the design of eco-friendly building materials. Specifically, the project examines the natural mechanisms used by caddisfly larvae and polychaete worms to select, sort, pack, and glue sand and shell particles into cohesive assemblies. To connect biological principles with engineering applications, the research integrates advanced imaging, rigorous mechanical testing, and additive manufacturing. High-resolution three-dimensional visualization is performed using Scanning Electron Microscopy (SEM) and micro-Computed Tomography to uncover precise particle arrangement and adhesive strategies. Subsequently, mechanical evaluations, including compression, shear, and fracture experiments, explain how these natural architectures distribute stress, resist crack propagation, and absorb energy under load. These structural findings are then translated into computer-aided design (CAD) models, enabling the fabrication of physical prototypes via advanced 3D printing techniques, alongside computational models that simulate load transfer and stress concentrations. By connecting material organization to structural performance, this research establishes innovative, practical concepts for developing sustainable and resilient construction materials.

Mentor(s):

Pablo D Zavattieri (Engineering); Dylan Kenji Wainwright (Agriculture|Science)

Other Acknowledgment(s):

Mariana Arias Loaiza* (Engineering); Juan Fernando Cucuyame Morales* (Engineering)

Virtual Presentation Abstract Number: 9005

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Implementation of a Pressure-Mapping Sensor Matrix for Real-Time Bucket Elevator Force Analysis

STEM

Authors(s):
Noah Alston Dyer† (Engineering)

Abstract:
Within lunar excavation research by the Purdue Lunabotics team, quantifying localized forces on the bucket elevator system is critical for optimizing excavation efficiency. Traditional single-point devices like S-load cells offer limited dynamic feedback, prompting the evaluation of an ultra-thin, piezoresistive pressure-mapping sensor array placed between the bucket and belt. The sensor utilizes a grid of intersecting conductive rows and columns where pressure drops electrical resistance at discrete sensing elements (taxels). To read this multi-point matrix without excessive cabling, an Arduino-based data acquisition system employs multiplexed matrix scanning—using chips like the CD74HC4067 to expand pin capacity—and digital signal conditioning to process data at high sample rates. Engineering challenges such as crosstalk ("ghosting") are resolved by setting inactive row pins to a high-impedance state, while geometry-induced rotation forces are calibrated against reference loads. Despite a minor trade-off in raw precision (~2% to 5% deviation), the tactile sheet's ultra-thin form factor and continuous spatial-temporal force mapping make it an optimal instrumentation solution for bucket elevator analysis.

Mentor(s):
Curtis Earl Marshall (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9006

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Stadium Lights and Their Surroundings: Examining Light Pollution at Ross-Ade

Business Case Study

Authors(s):
Miranda J Freeman† (Liberal Arts); Lila Renee James† (Liberal Arts); Sonja E Glover† (Liberal Arts); Anneka Christine Zylstra† (Liberal Arts)

Abstract:
Our project addresses the nighttime lighting procedures and the effects on the surrounding environment of Ross-Ade Stadium. Lighting is necessary for security; however, light that spills beyond the stadium boundaries can contribute to light trespass and skyglow. The stadium lighting affects the surrounding area, which includes local ecosystems, species, and residents. Our research explores nighttime lighting practices at Ross-Ade and how they contribute to light trespass. Based on our research, we are determining what potential effects these conditions might have on nearby residents and nocturnal wildlife, particularly migratory birds, whose migration patterns can be disrupted by illuminated structures.

We used a light meter to measure light levels inside the stadium and at various points along its property line, comparing readings with the stadium lights on and off. These readings indicate excessive light emissions from the fixtures. We are evaluating these levels against Illuminating Engineering Society (IES) DarkSky thresholds and the Light Pollution Deduction credits in the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) v4 and Sustainable Sites Initiative (SITES) v2. Our investigation aims to understand the benefits of the stadium's current nighttime lighting schedule, as provided by Purdue facilities. The lights are turned on for major sporting and donor events and remain off the rest of the time. While this schedule limits unnecessary nighttime lighting, the fixtures follow NCAA-recommended light levels for televised broadcasts.

Based on our research, we are exploring strategies that include dimming lights during periods of low activity, using timers or automated controls, directing and shielding light, and using warmer color temperatures. Our goal is to identify approaches that reduce the social, ecological, and economic impacts of nighttime lighting at Ross-Ade, without compromising its necessary functions.

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Mentor(s):
Genell Wells Ebbini (Liberal Arts)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9007

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Great Automated Coffee (GAC)

Creative

Authors(s):
Ryan Gelston† (Engineering); Cole Anthony Massie‡ (Engineering); Carman Stanton‡ (Engineering|JMHC); Isabella M Mazion‡ (Engineering|Liberal Arts); Astha Jayesh Patel‡ (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Carla Zoltowski (Engineering); James Corbett Beasley (PWL); Beth J Hess (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9008

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Storm-Surge-Resilient Interior Materials and Assemblies in Coastal Multifamily Housing

Business Case Study

Authors(s):
Lauren Danielle Gogna† (Liberal Arts); Lucy Marie Courtney† (Liberal Arts); Alaina Caitlin Koch† (Liberal Arts|JMHC); Emily Elizabeth Breit† (Liberal Arts)

Abstract:
[Abstract Redacted]

Mentor(s):
Genell Wells Ebbini (Liberal Arts)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9009

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Living Walls at Purdue: How Can We Effectively Balance Biodiversity Benefits with Water and Maintenance Demands?

Business Case Study

Authors(s):

Mikayla Elizabeth Haak† (Liberal Arts); Raina Sanders† (Liberal Arts)

Abstract:

Living walls are becoming more and more common in the built environment because they are seen as a sustainable way to include vegetation into buildings while improving aesthetics and environmental performance. However, it is not always clear whether living walls provide meaningful ecological benefits or if those benefits outweigh the resources required to install, maintain, and operate them over time. This project looks into the conditions under which living walls can successfully support pollinators and other beneficial insects at Purdue while considering important factors such as water use, maintenance requirements, plant survival, and the local climate. Biodiversity value is measured through pollinator visits, native species richness, and the availability of floral resources throughout the growing season. The research includes a review of existing literature as well as an analysis of case studies, including the UC Berkeley living wall and Purdue's INhome Biowall. These examples are evaluated to compare their ecological benefits with the resources and long-term maintenance needed to sustain them. The study also examines how Purdue's climate, seasonal weather patterns, cost, and environmental conditions could possibly influence the performance and effectiveness of living walls throughout the year. By analyzing both the environmental advantages and practical limitations of these systems, this research works towards determining when living walls can function as effective ecological infrastructure rather than simply decorative features. The findings provide practical recommendations to help designers, campus planners, architects, and other professionals make informed decisions about when and where living walls are an appropriate and sustainable solution for buildings on Purdue's campus.

Mentor(s):

Genell Wells Ebbini (Liberal Arts)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Virtual Presentation Abstract Number: 9010

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Building for Well-Being: LEED Strategies and Occupant Health

Business Case Study

Authors(s):

Liana Havanjian† (Liberal Arts); Natalie Grace Dunn† (Liberal Arts); Maggie Lynn Pettyjohn† (Liberal Arts); Kaitlynn Stricklin† (Liberal Arts)

Abstract:

Sustainable buildings are often evaluated on how well they reduce environmental impacts, but the relationship between sustainability strategies and occupant health and well-being is equally important. This research investigates the extent to which strategies recognized by the Leadership in Energy and Environmental Design (LEED) rating system also address conditions associated with occupant health and well-being. The study compares two Purdue University buildings with comparable student-centered functions: the Krach Leadership Center, certified LEED Gold under LEED 2009 (LEED v3), and the Wilmeth Active Learning Center (WALC), which is not LEED certified. The research team will observe occupant activities, length of stay, and seating choices to describe use patterns, and will document building characteristics such as daylighting, views to nature, acoustics, ventilation, and thermal comfort strategies. Observational findings, documented characteristics, and relevant literature will be used to identify similarities and differences between the two indoor environments. These findings will then be evaluated against relevant LEED credits and features of the WELL Building Standard v2, a health-focused complement to LEED. The study also considers the ecological and economic implications of these strategies, including resource efficiency and long-term operating costs. By identifying areas of alignment and potential gaps between sustainable building practice and human-centered design, this research aims to inform future design decisions that balance environmental responsibility, occupant needs, and long-term building performance.

Mentor(s):

Genell Wells Ebbini (Liberal Arts)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9011

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Design of a Continuous-Time Delta-Sigma Analog-to-Digital Converter in 65 nm CMOS

STEM

Authors(s):

Safa Islam† (Engineering)

Abstract:

Analog-to-digital converters (ADCs) translate real-world signals such as sound, radio waves, and sensor readings into precise digital codes for computers. Delta-sigma ADCs achieve high precision by sampling far faster than the signal changes and pushing quantization error outside the band of interest, and continuous-time implementations add built-in anti-aliasing filtering. This project, conducted through Purdue's SoCET program, designs a second-order continuous-time delta-sigma modulator in 65 nm CMOS with a 3 MHz signal bandwidth at a 320 MS/s sampling rate, an oversampling ratio of about 53. The architecture uses a cascade-of-integrators-feedback (CIFB) loop built from active-RC integrators, a 1-bit quantizer, and a non-return-to-zero feedback DAC. A Python behavioral model captures how circuit imperfections degrade performance, including finite op-amp gain and bandwidth, excess loop delay, clock jitter, and component variation. These simulations translate the system-level target into block-level specifications, such as a moderate-gain (~50 dB), bandwidth-prioritized op amp, and guide loop coefficient selection to compensate for excess loop delay. Each block will then be designed at the transistor level in Cadence Virtuoso, simulated against its specifications, and assembled into a complete modulator for full-system verification. The resulting converter targets wireless receivers, audio, and sensor and biomedical interfaces.

Mentor(s):

Seyedehmarzieh Rouhani (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9012

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Sustainable for Whom? Silica, Worker Health, and the Limits of the Sustainable Tile Label.

Social Science

Authors(s):

Megan Elsa Jerrell† (Liberal Arts); Hannah Hj Shin† (Liberal Arts|JMHC); Jennifer Castro-Espiritu† (Liberal Arts); Melissa June Nelson† (Liberal Arts)

Abstract:

Tile usually contains silica, a naturally occurring mineral used to strengthen and increase the durability of tile. Respirable crystalline silica (RCS) dust poses a significant health risk to workers when inhaled during fabrication and installation when exposure is not controlled. Despite these potential exposures, tile is touted as a sustainable flooring option throughout the design and construction industry. In addition to the material being low VOC, it is nonporous and does not harbor external particulates or harmful bacteria. Additionally, ceramic tiles are highly recyclable during manufacturing. Factory waste can be recovered and reused to manufacture new tile. These properties greatly benefit users, but exposure to silica may harm the people that work to fabricate and install this material. This research examines what the label of sustainable material actually encompasses, who these standards benefit, and who may not be considered or thoroughly protected. We are investigating these connections using data collected from ceramic tile companies, peer-reviewed scientific articles, and health and labor organizations. We are also identifying guidance and regulations on workers' health from LEED, WELL, and other sustainability certifications. The comparisons we generate will demonstrate who or what may be left out of consideration under sustainability labels and may expose any areas for development to continue striving for equitability and sustainability.

Mentor(s):

Genell Wells Ebbini (Liberal Arts)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9013

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Robotics Development Through the RoboMaster VIP Project

STEM

Authors(s):
Soham Jindal† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Andrew Li Niu (Science)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9014

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Pulley-Operated Robotic Hand

STEM

Authors(s):
Harshil Bijal Joshi† (Engineering); Isaac En Kai Then† (Engineering)

Abstract:
Our research project is about a robotic hand that will employ a string-pulley mechanism to control the movement of its fingers. The research purpose is to see how much force the hand will be able to support using this proposed mechanism, and whether this is a viable alternative method to dexterous hand models that already exist. Our work is significant because research on dexterity is relatively underdeveloped and is very relevant to our club's purpose of building a humanoid robot. The implications we plan for the mechanism in order for it to work is by having a servo at the base of each finger, which pulls a string that runs up the front of the finger and loops at the top of each finger to run down the back of the finger. Pulling the string from the front contracts, while pulling the string from the back extends the finger. Our plan is to first prototype our hand without electrical components, 3-D model segments for each finger, and then finally wire the servos and electrical parts. The implications of this project could advance methods to create dexterous, robotic hands.

Mentor(s):
Jaeeun Kim (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9015

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Design & Implementation of Peripheral Systems with FPGA Based Simulations on a RISC-V-Based Microcontroller

STEM

Authors(s):

Arnav Juneja† (Engineering); Drew Forrest Sullivan† (Engineering); Matthew Du† (Engineering|JMHC); Lucas Michael Mallen† (Engineering); Rohan Mihir Gandhi† (Engineering)

Abstract:

The AFT processor developed by System-on-Chip Extension Technologies (SoCET) has opportunities to modernize its existing peripheral implementations and expand their functionality. This project evaluates AFT's peripherals to identify missing features and areas for improvements, then updates or rewrites selected modules to address these limitations. One target is the timer, which is being extended with shadow registers, input synchronization, and up-down counting while maintaining backward compatibility with the existing processor's functionalities. In parallel, this project also ports AFT to the RealDigital Urbana board, which uses an AMD Xilinx Spartan-7 FPGA, to enable hardware testing and software development before tapeout. Updated peripherals will be evaluated through RTL testbenches to verify new functionality and to confirm that existing behavior is preserved where backward compatibility is required. The FPGA port will be validated by synthesizing, programming, and running AFT on the board, allowing testing of the processor and the peripherals on physical hardware before custom silicon is available. Project deliverables include verified peripheral updates and a working FPGA implementation of AFT on the Urbana board. By expanding peripheral capabilities while enabling earlier hardware and software testing, this project will help establish a stronger foundation for future developers. Its scope is limited to selected peripheral improvements and FPGA porting, rather than a complete processor redesign or comprehensive optimization.

Mentor(s):

Cole Aaron Nelson (Engineering); Mark Johnson (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9016
Virtual presentations available on the Fall Expo website from Nov. 16-20.

Screen-Aware AI Agents for Desktop Task Automation: Design and Prototyping of Tool-Using Assistants

STEM

Authors(s):
Jay Amit Katariya† (DSB)

Abstract:
AI agents, systems in which a large language model perceives its environment, calls tools, and takes actions on a user's behalf, are moving from chat windows into everyday desktop software. Designing them well raises practical questions: how much screen context to provide, which actions should run without confirmation, and how a user stays in control of an agent that clicks and types. This project explores these questions by designing and building three open-source agent prototypes. The first is a screen-aware agent, summoned with a keyboard or cursor gesture, that observes the display and performs clicks and keystrokes. The second is a vision-based tool that answers questions about whatever is currently on screen. The third is a locally run, bring-your-own-key assistant that combines live web search, file attachments, and local tools. Across the prototypes, we focus on the interface between model and computer: how screen state is captured and passed to the model, how tool calls are exposed and logged, and where human confirmation is required before an action is taken. We also outline a planned evaluation comparing task completion, the number of user interventions, and user trust across these designs on common desktop tasks. These findings are intended to inform design guidelines for agents that are useful, transparent, and controllable by the people who use them.

Mentor(s):
Curtis Earl Marshall (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9017

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Can a microcontroller-based adaptive system maximize composting kinetics using variable, passive photovoltaic energy inputs?

STEM

Authors(s):

Ian James Knight† (Engineering); Anushka Erra† (Engineering)

Abstract:

Urban organic waste management frequently depends on centralized collection and processing systems, resulting in substantial transportation costs, energy consumption, and operational inefficiencies. These challenges create a growing demand for decentralized composting technologies capable of processing organic waste locally, particularly in space-constrained urban agricultural environments. Existing solutions, including electric in-vessel composters, commercial aerated static piles, and solar-powered ventilation systems, offer alternatives to conventional waste disposal but remain limited by high energy requirements, fixed aeration schedules, or insufficient responsiveness to changing biological conditions. Previous research on aerobic composting has demonstrated the importance of temperature regulation, oxygen availability, and moisture retention in sustaining microbial activity and efficient organic decomposition. In particular, excessive aeration can accelerate moisture and heat loss, while inadequate aeration can restrict oxygen availability and inhibit decomposition. Thus, to create a cost-effective solution that can avoid the shortcomings of deterministic control systems, this research project asks, “can a microcontroller-based adaptive system maximize composting kinetics (k) using, variable, passive photovoltaic energy inputs.” We assume that there will be no significant difference between a microcontroller-based adaptive system and continuous blowing. If successful, this project will help enable more widespread deployment of automated composting systems.

Mentor(s):

Peter Bermel (Engineering); Muhammad A Alam (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9018
Virtual presentations available on the Fall Expo website from Nov. 16-20.

Enabling Symmetric Multi-Core FreeRTOS on SoCET's Custom RISC-V AFT SoC

STEM

Authors(s):
Jacob Lawrence† (Engineering)

Abstract:
Purdue SoCET's AFT is a custom dual-core RISC-V system-on-chip with shared memory. While a basic FreeRTOS port currently runs real-time tasks on a single hart, the boot process leaves the second hart idle with interrupts disabled. This project enables symmetric multiprocessing (SMP), allowing a single kernel to schedule work across both harts to fully utilize the new hardware capabilities.

Bringing the second hart into the scheduling fold leverages specific chip features. After shared memory is initialized, hart 1 receives its own stack and interrupt setup. The harts then coordinate via the core-local interrupt controller's (CLINT) software interrupts: an initial interrupt starts the scheduler on hart 1, while subsequent interrupts trigger context switches. With the system timer tick isolated to hart 0, shared scheduler data is protected using atomic load-reserved (LR) and store-conditional (SC) instructions, ensuring neither hart corrupts the task list during updates.

Because embedded developers rely on an RTOS to manage complex, multi-tasking environments without writing custom schedulers, the final deliverables include the SMP port, tests, and a baseline demo for future developers. The tests verify concurrent execution, cross-hart task migration, and task pinning, while the demo confirms time-critical tasks meet their deadlines under load. As a machine-mode layer for AFT's interrupt controller, this port does not implement virtual memory or per-task memory protection. Integrating the finalized image into the software team's broader build flow and validating it on the FPGA remain as subsequent work.

Mentor(s):
Cole Aaron Nelson (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9019

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Beyond Looking Green: Comparing Native Flowering and Sedum Green Roofs for Pollinator Habitat and Building Performance

Business Case Study

Authors(s):

Leslie Lim† (Liberal Arts); Reem Hussam Al Zubi† (Liberal Arts); Natalie Margaret Hallaert† (Liberal Arts); Sam Raveesh† (Liberal Arts)

Abstract:

Green roofs are widely promoted as a sustainable building strategy and are often assumed to benefit nature simply because they are green. However, most green roofs are planted with sedum, a hardy, low-maintenance succulent chosen for its ability to survive in shallow soil with little water. While sedum performs well for the building, it may provide limited food and habitat for pollinators. This research studies the green roof as a nature-based strategy and focuses on biodiversity, not on biophilic experience for people. It asks how native flowering plants and sedum compare in supporting bees and butterflies on Midwest green roofs, and what trade-offs each planting strategy creates in substrate depth, structural load, water use, maintenance, plant survival, stormwater performance, and cost. Through a review of peer-reviewed studies, Purdue Extension resources, and professional green roof guidance, we compare the two strategies using five biodiversity measures: pollinator abundance, species richness, native bee presence, floral resources, and bloom period. Bees and butterflies are evaluated separately because of their different habitat needs. Preliminary research suggests that results vary across studies, and that the amount and timing of flowering may matter as much as whether plants are native. The findings are organized into an evidence-based comparison showing where ecological goals and building performance align or conflict. This research aims to help designers, building owners, and facility managers choose green roofs that perform well for both buildings and urban biodiversity, and to clarify whether a roof can succeed as green infrastructure without succeeding as habitat.

Mentor(s):

Genell Wells Ebbini (Liberal Arts)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Virtual Presentation Abstract Number: 9020

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Robotic Glockenspiel with Raspberry Pi-Controlled Solenoids

STEM

Authors(s):
Claire Liu† (Engineering); Jiya Kaur Dhiman† (Science); Zijie Lou† (Engineering); Saif Nasser Zagha† (Science); Jiashu Liu‡ (Engineering); Rohan Rahul Pradhan‡ (Engineering); Sruthika Shivakumar‡ (Engineering|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Yung-Hsiang Lu (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9021

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Experimental Characterization of Radiation-Induced Failures in FinFET and GAA-Based Microcontrollers

STEM

Authors(s):

Felix Ramazov Marikashvili† (Engineering)

Abstract:

Semiconductor manufacturing is slowly entering using Angstrom technology in order to combat traditional scaling challenges like power leakage, electrostatic control and power density that come with Fin Field-Effect Transistor (FinFETs) and Gate-All-Around (GAA) designs. This research experiment observed how radiation failures will evolve as the transition occurs.

Moving forward from using Geant4 and Sentaurus, we administered physical testing in Purdue's Subcritical Pile on various microprocessors, like the Arduino Uno (FinFET), Nano ESP32 (GAA), and Raspberry Pi. Utilizing an innovative original UI specifically to analyze radiation damage on microcontrollers, we examined drain-current disturbances, SEUs (Single Event Upsets), Multi-Bit Upsets, and logic or timing faults.

The experimental setup used dual-tier architecture with DUTs performing logic, memory and system stress tests, controlled by an Arduino Nano ESP32 bridge with UART commands and HTTP remote monitoring. In order to validate the microcontrollers before testing, we performed baseline validation tests to ensure that hardware that was used for this experiment was functional and hasn't sustained prior system damage before being exposed to the radiation environment.

Mentor(s):

Andrew Owen Fewell (Engineering); Peter Bermel (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9022

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Adaptive Lagrangian DPO for Multi-Objective Code Optimization Under Conflicting Hardware Constraints

STEM

Authors(s):
; Andre Lee‡ (Science); Srreyansh Sethi‡ (Science); Manas Anantha Maligi‡ (Engineering); Amr El Sayed Rageh‡ (Engineering)

Abstract:
Fixed scalarization DPO optimization works for a small number of compatible, non-conflicting hardware objectives, but can struggle with Pareto-optimal trade-offs because of the opposing gradients. This paper explores adaptive Lagrangian optimization methods that treat multi-objective code optimization as a dynamically constrained Pareto problem. The efficacy of the optimization is determined by the learned Pareto frontier and not by one aggregate reward. We used hypervolumes to measure how much objective space the different Pareto solutions dominate, while the Pareto coverage estimation gives the size of the multi-tradeoff range the model can generate. The proposed Lagrangian constrained multi-objective optimization uses runtime as the main target, while energy, memory, and CPU cycles are the constraints. The adaptive nature of the optimization is enabled by the dynamic adjustment of the Lagrangian coefficients during training. The algorithm automatically resolves a surplus/deficit in some metric, like memory, by raising/lowering its corresponding coefficient, thereby further constricting it in the desired direction. Experiments were performed on the CodeNet dataset with 120K code snippets, using FP4-quantized QLoRA to fine-tune Code-Llama 7B/13B/34B LLM models. Comparisons have been made with single-, dual-, triple-, and quadruple-objective fixed-weight DPO. When using Lagrangian DPO with only two generally aligned objectives (e.g., energy and CPU cycles), the Pareto hypervolume improves by 2-3% over the fixed-weight method. However, a clear split in performance between the two methods starts when at least two or more conflicting objectives exist, and the code options are Pareto-incompatible. For three and four objectives with conflict, Lagrangian DPO results in improvements of 10-15%, with the constraint violation rate significantly reduced.

Mentor(s):
James C Davis (Engineering); Huiyun Peng (Engineering)

Other Acknowledgment(s):
Stefan Teodor Maxim* (Engineering); Arjun Sandeep Gupte* (Engineering)

Virtual Presentation Abstract Number: 9023
Virtual presentations available on the Fall Expo website from Nov. 16-20.

Wind Tunnel Testing

STEM

Authors(s):
Ajay Ramesh† (Engineering); Elijah David Gallup† (Engineering); Vani Tiwari† (Engineering); Satyanandana Sivani Thallam† (Engineering); Derek Purka† (Engineering); Julian Foley† (Engineering); Aditya Satish Musale† (Polytechnic)

Abstract:
Current SysID models rely on ungrounded physics assumptions during complex UAV

maneuvers due to a lack of empirical high-alpha aerodynamic data. This research investigates

how recording angle of attack (-5° to 20°) and thrust activation in a low-speed wind tunnel can

eliminate these assumptions and improve predictive flight modeling. We plan to mount a UAV

test rig in the Purdue wind tunnel to execute throttle and dynamic pitch sweeps, using a custom

Python reduction pipeline to isolate net aerodynamic forces and non-dimensional coefficients

(???????? , ????????). Success will be measured by the error reduction between our empirical ???????? vs. AoA

curves and theoretical baselines, along with the delivery of a clean, validated dataset for SysID

integration.

Mentor(s):
Curtis Earl Marshall (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9024

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Building for Generations: Sustainability and Adaptability in Transitional Housing

Business Case Study

Authors(s):

Ellen Grace Rath† (Liberal Arts); Hailey Lyn Ford† (Liberal Arts); Ashlyn Kristine Welte† (Liberal Arts); Rachael Sheridan Wilson† (Polytechnic)

Abstract:

The goal of this research is to answer, “How can transitional housing be designed as a long-term community asset while supporting resident health and dignity, durability, adaptability, and sustainable building performance?” We analyze existing examples of both local and national transitional housing by looking at the material durability and replacement cycles, life-cycle costs, maintenance and operations, indoor environmental quality, adaptability, accessibility, and energy performance. This informs us about the quality, efficiency, and physical safety of current projects. We are specifically interested in how the physical environment of transitional housing projects supports occupant health and safety, as well as the reality of environmental impacts from construction. It also allows us to identify where there may be gaps in the function of these designs and gives us insight into where improvements need to be made. Then, we focus on future use, researching sustainable projects that emphasize adaptability and allow for reuse. We explore the same physical criteria of these projects like material choices, maintenance, accessibility, convertible spaces, and energy use among others. The goal of this phase of research is to identify what makes a project capable of being functional long-term, even as the role of the building changes. These findings are also applied in the context of transitional housing, with an emphasis on providing dignity and support for those who occupy these spaces. By comparing our findings on these two subjects, we can recognize case studies that were built to last and adapt, where current standards fall short, and what the trade-offs cost.

Mentor(s):

Genell Wells Ebbini (Liberal Arts)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9025

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Upgrading Manual Heavy Construction Equipment for Remote and Automated Operation Using Isaac Sim and MQTT

STEM

Authors(s):
Shreraj Singh Sanjay Sainani† (Engineering); Carolina Sun† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Jiansong Zhang (Polytechnic); Meta Soy (Polytechnic); Jingyi Lai (Polytechnic)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9026

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Continuous Integration, Testing, and FPGA Demo Framework for a Custom RISC-V Microcontroller

STEM

Authors(s):
Hirthik Gopal Shanmugam† (Engineering); Nicholas Zhang† (Engineering)

Abstract:
Purdue System-on-Chip Extension Technologies (SoCET) is currently making a custom RISC-V-based system-on-chip (SoC) called AFT. As more people contribute, keeping the hardware and software working together has become harder. Previously, tests were spread across the repository and often had to be run manually. This took extra time and made it easier for developers and reviewers to miss problems.

Our goal is to make testing easier by building a continuous integration (CI) system for AFT. Using GitHub Actions, the system should automatically compile RTL, build software, and run tests whenever a pull request is opened or updated. This helps catch problems before changes are merged. We're also moving existing tests into a shared setup so new tests can be added more easily. In addition to this, we want to develop FPGA demos to test selected applications on physical hardware. However, our main focus is on automatic testing. We can measure progress by tracking the number of tests, their pass rates, and problems caught before merging. Over time, we could also track whether fewer bugs reach the main codebase and whether pull requests are reviewed faster.

Currently, CI only runs tests in simulation, so it cannot confirm that the design works after synthesis or on an FPGA. Future work could add post-synthesis checks, more tests, and automated FPGA testing. Overall, we want to make testing easier to maintain as AFT grows, allowing future contributors to add new features without rebuilding the testing process.

Mentor(s):
Cole Aaron Nelson (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9027

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Integrating Lean Construction Methods into Sustainability Learning in Construction Management Education

STEM

Authors(s):

Kulpreet Singh† (Polytechnic)

Abstract:

Sustainability education in construction management often addresses waste reduction, safety, materials, scheduling, and project impacts as separate topics. Students may therefore have limited opportunities to understand how these concepts interact in construction project decisions. This undergraduate research project explores how Lean Construction methods can connect these topics and support practical, industry-relevant sustainability learning.

The project examines value stream mapping, pull planning, Last Planner System concepts, and A3 problem solving as potential teaching tools for exploring waste reduction, rework prevention, workflow reliability, safety, and responsible resource use. The planned approach combines a review of relevant literature and industry examples with an examination of selected construction management course materials. This review will identify how sustainability is currently addressed and where Lean-based learning activities could strengthen connections between classroom concepts and industry practice.

The anticipated outcome is a pilot learning module or instructional toolkit that links selected Lean methods to sustainability learning objectives through construction scenarios and structured problem-solving activities. These materials will be designed for future classroom implementation and evaluation. As research in progress, the project aims to establish a foundation for studying how Lean-based instruction can help students recognize tradeoffs, connect operational decisions with sustainability outcomes, and develop a more integrated understanding of construction project performance.

Mentor(s):

Esra Tepeli (Polytechnic)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9028

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Automating Steel Construction Through Sensor Integration, LLM-Driven Reasoning, and Robotic Simulation

STEM

Authors(s):

Adam Song† (Science); Cade Stogsdill† (Engineering); Adhitya Shantharam† (Science)

Abstract:

Automation in steel construction has the potential to significantly improve productivity, cost efficiency, and safety. This project aims to develop tools for autonomous assistance in steel construction, focusing on robotic simulations and autonomous crane operations. Before deploying machinery, we built a virtual construction environment to test robot movement and situations to ensure safety. Within this simulation, we implemented a robotic tracking algorithm equipped with a custom end-effector that accurately tracks bolt holes in I-beam connections to move towards automated structural fastening. In the physical lab, we address the complex challenge of heavy material handling by applying various sensors to the crane. We combine data from a 9-axis Bluetooth IMU with an accelerometer and inclinometer, that gives us motion and orientation data wirelessly, with specialized object detection and a depth sensing camera system. Together, these sensors generate an exact 3D map of the crane's load and its surroundings. We feed this real time data, including swing angle, speeds, and spatial coordinates, into a Large Language Model (LLM). Acting as the system's reasoning engine, the LLM analyzes the workspace to anticipate human movement, allowing the crane to autonomously adjust its path and prevent accidents. By bridging simulated robotic testing with smart, sensor guided crane operations, our system creates a safer work environment between heavy machinery, automated robots, and human workers. This approach reduces workplace hazards by actively preventing collisions and offloading dangerous, repetitive labor from people to machines. By letting robots handle these demanding tasks, we bring reliable, real-time coordination and improved safety to the job site.

Mentor(s):

Jiansong Zhang (Polytechnic); Meta Soy (Polytechnic); Jingyi Lai (Polytechnic)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Virtual Presentation Abstract Number: 9029
Virtual presentations available on the Fall Expo website from Nov. 16-20.

Design and Prototyping of a Lightweight 3D-Printed Gripper for a Humanoid Robot

STEM

Authors(s):
Rohan Sunil† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Jaeeun Kim (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9030

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Real-Time Beehive Monitoring Using Grafana and TimescaleDB

Social Science

Authors(s):

Said Taghiyev† (Engineering|JMHC); Talon Matthew Hooten† (Engineering)

Abstract:

Monitoring beehive conditions is important for understanding bee activity and maintaining healthy colonies. Traditional monitoring often requires physically inspecting beehives, which can disturb the bees and make it difficult to continuously observe environmental changes. This project explores how technology can make beehive monitoring easier and more efficient through live data collection and visualization.

The project focuses on developing a monitoring system that uses sensors to collect information about conditions inside and around beehives. The collected data is intended to be stored in TimescaleDB, a database designed to manage time-series information. Grafana is used to organize and visualize this information through dashboards containing graphs and other visual displays. These dashboards are designed to help researchers spot patterns and changes in hive conditions over time.

The initial phase of the project involves learning how Grafana works, exploring different visualization panels, and understanding how sensor data can be connected to a database and displayed. Future development will focus on creating an accessible dashboard that allows users to monitor beehive conditions without repeatedly opening the hives.

The overall goal is to create a useful and efficient system that makes beehive data easier to understand. By combining sensor technology, TimescaleDB, and Grafana, this project aims to enable more effective monitoring and provide useful information for beekeeping research.

Mentor(s):

Gregory David Sturm (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9031

Virtual presentations available on the Fall Expo website from Nov. 16-20.

LiDAR and Polycam Lunabotics Competition Measurement Accuracy

STEM

Authors(s):

Josh Truman† (Engineering); Isabelle Jacqueline LeBlanc† (Engineering); Max Mayer† (Engineering); Divya Anantkumar Patel† (Engineering); Marcus Abraham Zee† (Engineering); Liang-Hua Chao† (Engineering)

Abstract:

The purpose of this research group is to determine the most accurate and feasible method to measure the volume of a regolith (moondust) berm created by a robot for the Lunabotics competition. The system must measure a defined area before and after the run without perturbing the environment or inhibiting the robot. Previously, this was achieved with an overly precise and expensive LiDAR system paired with inaccurate processing software. To fix this, we are looking into various cheaper, less accurate sensors as well as alternative volume calculation methods.

We are looking for a solution to have an accuracy of around five percent. This may be impossible at the price point of solutions we are considering or due to the constraints and conditions of the competition setting. Ultimately, we need to find an acceptable solution to allow the competition to confidently assess robot performances.

Mentor(s):

Curtis Earl Marshall (Engineering); Alexander Repikov (Engineering|JMHC)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9033

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Design and Modeling of a Bias Voltage DAC for Cryogenic Qubit Control

STEM

Authors(s):

Henan Wang† (Engineering)

Abstract:

This project investigates a charge-redistribution digital-to-analog converter (DAC) for programmable bias generation in cryogenic solid-state qubit systems. The goal is to support accurate, low-power bias control through a shared DAC and multiple sample-and-hold outputs. Behavioral modeling has explored capacitor mismatch, parasitic capacitance, and leakage-driven refresh requirements, identifying tradeoffs among output coverage, linearity, and power. Initial circuit development in TSMC 65 nm CMOS has established a room-temperature simulation baseline in Cadence Virtuoso and Spectre. A 3-bit capacitor DAC using process-specific metal-insulator-metal capacitors and ideal switches produces 499.996 mV for code 100 with 0 V and 1 V references. Separate CMOS transmission-gate simulations verify signal tracking and reveal a turn-off voltage step on a held capacitor, motivating further switch and timing optimization. Planned work includes integrating transistor-level switches into the DAC, evaluating all input codes, and characterizing linearity, settling, charge injection, and voltage retention. Subsequent development will investigate higher-resolution architectures, multichannel storage and refresh, and layout parasitics. Cryogenic performance evaluation will depend on validated low-temperature device models; sensitivity studies will guide design choices where such models are unavailable. This work establishes a path from behavioral analysis and initial circuit validation toward an integrated bias-control system for quantum applications.

Mentor(s):

Seyedehmarzieh Rouhani (Engineering)

Other Acknowledgment(s):

Mark Johnson* (Engineering)

Virtual Presentation Abstract Number: 9034

Virtual presentations available on the Fall Expo website from Nov. 16-20.

The Disproportionate Impacts and Implications of Polyurethane Interiors on Human Health in the USA

Social Science

Authors(s):

Kallie Jane Watson† (Liberal Arts); Hannah Faith Haskins† (Liberal Arts); Caroline Gillig Close† (Liberal Arts); Sophia Caroline Fox† (Agriculture)

Abstract:

Polyurethane (PU) is widely used in building interiors, including floor finishes, coatings, sealants, and adhesives. However, its effects on human health, the environment, and buildings are rarely considered in architectural decisions. This project asks: How do polyurethane-based interior materials affect indoor air quality, and how do housing conditions and socioeconomic inequalities influence exposure to these materials? Drawing on Cradle to Cradle, we examine whether PU can participate in healthy, regenerative material cycles rather than simply being made “less bad.” Our research synthesizes scientific literature, government publications, nonprofit reports, industry perspectives, and published accounts of communities living near plastic production facilities. Preliminary findings raise concerns about microplastic exposure, chemical-related health effects, toxic emissions, and fire safety. We focus on common PU products, including floor coatings, adhesives, sealants, and foam, comparing available evidence on their potential health risks. We also examine how these risks intersect with socioeconomic inequality, particularly for communities near production facilities and residents of lower-income housing. By considering perspectives from researchers, affected communities, advocacy organizations, and industry stakeholders, we explore strategies to reduce health risks while accounting for financial, infrastructural, and practical constraints. Ultimately, this project aims to develop evidence-based recommendations for healthier material selection and advance environmental health and justice in the built environment.

Mentor(s):

Genell Wells Ebbini (Liberal Arts)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9035
Virtual presentations available on the Fall Expo website from Nov. 16-20.

Semiconductor Unit Process

STEM

Authors(s):
David Changhong Yang† (Engineering)

Abstract:
[Abstract Redacted]

Mentor(s):
Jozue Kim (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9036

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Designing Bare-Metal Geometry Dash SOC

STEM

Authors(s):
Aaron Yin† (Engineering); Julian Arun Creel† (Engineering); Saket Manoj Kanagal† (Engineering)

Abstract:
The goal of this study was to make an implementation of the popular game, Geometry Dash, purely in hardware. The chip would receive controller inputs and handle game logic, speaker output, and a VGA display. The chip design would be brought to tape-out, verifying its functionality on a real SOC. This study included the full design flow for a chip, including the project specification where the top-level functionalities were established, RTL design and diagramming where the dataflow and system logic were fleshed out, SystemVerilog implementation, verification, synthesis, physical design, and tape-out. The project was implemented from the bottom up, designing and verifying the lowest-level modules first and then implementing them into a higher-order system.

Mentor(s):
Luke J Ferrer (Engineering|JMHC)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9037
Virtual presentations available on the Fall Expo website from Nov. 16-20.

How Quantization Impacts Image Quality When Using AI Image Generation Models

STEM

Authors(s):
Mingze Zhang† (Polytechnic)

Abstract:
Due to how big AI image generation models have become, many of them cannot run on an average GPU. By using quantization, we can make these larger models smaller, so we can run them on our normal computers. Many people are running quantized models, but I feel that they do not know how much quality they are losing.

This will be an exploration into the topic. First I will go over papers on how people have quantized diffusion models. After that I will be testing various quantization techniques on an open-source image model, such as Qwen-Image. I will be testing various settings for each technique, including bit width, what is being quantized, and other settings they allow. I will be generating images with the same prompt and seed, and then measure how much VRAM is being used, how long it takes to generate, and how far off the image is from the non-quantized model. I will also be looking at PSNR, LPIPS, FID, and cosine similarity between the models' outputs to catch changes we cannot see with the naked eye.

After reading one paper on the subject (Li et al., 2025), I think that for two models of the same size, some methods can give better image quality than others. I hope to show the general public what they are getting when using different quantization methods, so they can run these big models at home.

Mentor(s):
Harris J Bras (Liberal Arts)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9038

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Aerodynamic Response and Flow-Induced Deformation of Flexible Polymer Films in Wind Tunnel Testing

STEM

Authors(s):
William Hongyi Zhong† (Science|JMHC)

Abstract:
[Abstract Redacted]

Mentor(s):
Joseph Jeong (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9039

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Design and Experimental Validation of an Integrated Robotic End-Effector for Automated Steel-Frame Assembly

STEM

Authors(s):

Caleb Zachary Chong† (Engineering); Aanya Mangla† (Engineering)

Abstract:

Despite technological advancements, the construction industry has been slow to adopt automation, limiting productivity, safety, and efficiency. This research focuses on the design, development, and physical validation of a robotic end effector for automated steel-frame assembly, specifically addressing challenges in bolt handling, positioning, and alignment. The major contribution of this research is in developing an end-effector mechanism that integrates a magnetic gripper to facilitate pickup and retention of bolts while using a sliding system to ensure accurate positioning. In contrast to previous designs, our design integrates the two processes into one assembly system. Physical prototyping and experimental testing are being conducted to evaluate mechanical functionality, positioning accuracy, structural stability, and system integration to be able to develop a reliable, scalable end-effector system that supports robotic construction processes, reduces manual labor and injury risks, and advances automation in steel-frame construction.

Mentor(s):

Jiansong Zhang (Polytechnic)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9040

Virtual presentations available on the Fall Expo website from Nov. 16-20.

A Life-Cycle Comparison of Regional Bio-Based and Synthetic Insulation for Midwest Buildings

Social Science

Authors(s):

Divya Senthurchelvan† (Polytechnic); Audley S Eggold† (Liberal Arts); Brooke Avery Manley† (Liberal Arts); Cailin Marie Leber† (Liberal Arts)

Abstract:

Buildings and construction account for a large portion of global greenhouse gas emissions, driven by operational energy demands and the embodied carbon of conventional buildings. While bio-based insulation materials derived from regional agricultural residues (such as industrial hemp and corn stover) and cellulose may support natural carbon storage (keeping carbon locked inside plant materials) and reduced embodied impacts, their overall sustainability depends on whole-building dynamics. Lower embodied carbon can be negated by operational vulnerabilities like moisture degradation, poor fire resistance, or mold growth.

This research compiles and compares published life-cycle data to evaluate whether regionally sourced bio-based insulation materials are more sustainable than conventional synthetic options (such as spray polyurethane foam and fiberglass) across their entire life cycle in a Midwest climate. Candidate systems are evaluated across four stages: raw material extraction and harvesting, manufacturing, use-phase performance (including thermal conductivity, the ability to absorb and release indoor humidity, indoor air quality emissions, and flame retardancy), and end-of-life pathways (carbon emissions, reusability, and upcycling potential).

By integrating environmental, building-performance, and economic considerations, this research aims to establish an evidence-based framework for determining when regional agricultural residues and cellulose provide meaningful sustainability benefits compared with conventional insulation. Findings support informed material selection for Midwest buildings and promote circular building practices.

Mentor(s):

Genell Wells Ebbini (Liberal Arts)

Other Acknowledgment(s):

† Presenting Undergrad Author; ‡ Contributing Undergrad Author; * Undergrad Acknowledgment

Virtual Presentation Abstract Number: 9041

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Iterative Design and Prototyping of a Nerve Cuff Electrode for Neural Interfacing

STEM

Authors(s):
Kharine Aiden-Afi Yaye† (Engineering)

Abstract:
In biomedical engineering, intraoperative assessment of injured nerve function is time-critical, informing surgeons which nerves to resect, spare, or repair. It is typically performed with hook electrodes that require the user to hold the nerve off the underlying tissue at two points. Nerve cuff electrodes, developed for peripheral neuromodulation and neuroprosthetics, could replace hook electrodes to improve the ergonomics, speed, and safety of this procedure, and additive manufacturing can produce durable, scalable cuffs with high-performance contact materials. However, challenges remain in lead routing, component retention, and integrating a conductive wire that delivers electrical impulses through the cuff. This project asks how an existing nerve cuff can be redesigned for this use and how a conductive wire can be fit inside the cuff design. I hypothesize that a smoother, more curved geometry made from a flexible and a more rigid material will improve ease of lead routing and component retention compared to previous designs, and that adding curves and channel holes to hold the wire will allow it to fit within the cuff without significant routing, retention, or integration issues. The cuff was modeled in CAD and fabricated through iterative prototyping, and prototypes will be compared to previous designs on wire retention, ease of lead routing, and fit within the cuff. This work aims to demonstrate how iterative prototyping and additive manufacturing can address clinical needs in diagnostic device design, with future work focused on testing in a biological model.

Mentor(s):
Ken Yoshida (Engineering)

Other Acknowledgment(s):

Virtual Presentation Abstract Number: 9042

Virtual presentations available on the Fall Expo website from Nov. 16-20.

Non-Reciprocal Otherness: Toward an Ontology of Relational AI

Humanities

Authors(s):
Parinita Kadamby† (Liberal Arts|JMHC)

Abstract:
Generative AI chatbots increasingly function as relational partners, yet existing ontological categories (ex: tool, agent, person, mirror, fictional character) fail to capture their relational role. Users experience chatbots as comforting, attentive, and emotionally responsive, even while usually being aware that these systems lack consciousness or interiority. This project proposes a new ontological category, non-reciprocal otherness, to describe entities that present themselves as Others through language and responsiveness but remain structurally incapable of reciprocity, refusal, or mutual recognition. Drawing from phenomenology (Levinas, Beauvoir, Merleau-Ponty), AI ontology scholarship (Mahardhika; Bautista Roa & Díaz Sanabria; Fernández Tamames), and human-AI interaction research, this project articulates a conceptual framework that accounts for artificial intimacy without anthropomorphizing AI systems.

Mentor(s):
Jennifer Bay (Liberal Arts)

Other Acknowledgment(s):

SCHEDULE OF EVENTS

NOV. 17, 2026 | PMU BALLROOMS

9:00AM-10:00AM	Poster Session 1
10:30AM-11:30AM	Poster Session 2
12:00PM-1:00PM	Poster Session 3
1:30PM-2:30PM	Poster Session 4

NOV. 18, 2026 | STEWART CENTER

9:00AM-4:00PM	Talks, 214 & 218
10:30AM-11:30AM	AM Final Call, 278
1:30PM-2:30PM	PM Final Call, 278

NOV. 16-20, 2026 | ONLINE

View virtual talks at **purdue.edu/undergrad-research/conferences/fall**

SCAN FOR ABSTRACT BOOK

SAVE THESE DATES:

April 12-16, 2027: Spring Conference
April 28, 2027: Student Showcase in Indy
July 29, 2027: Summer Symposium
Nov. 15-19, 2027: Fall Expo

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