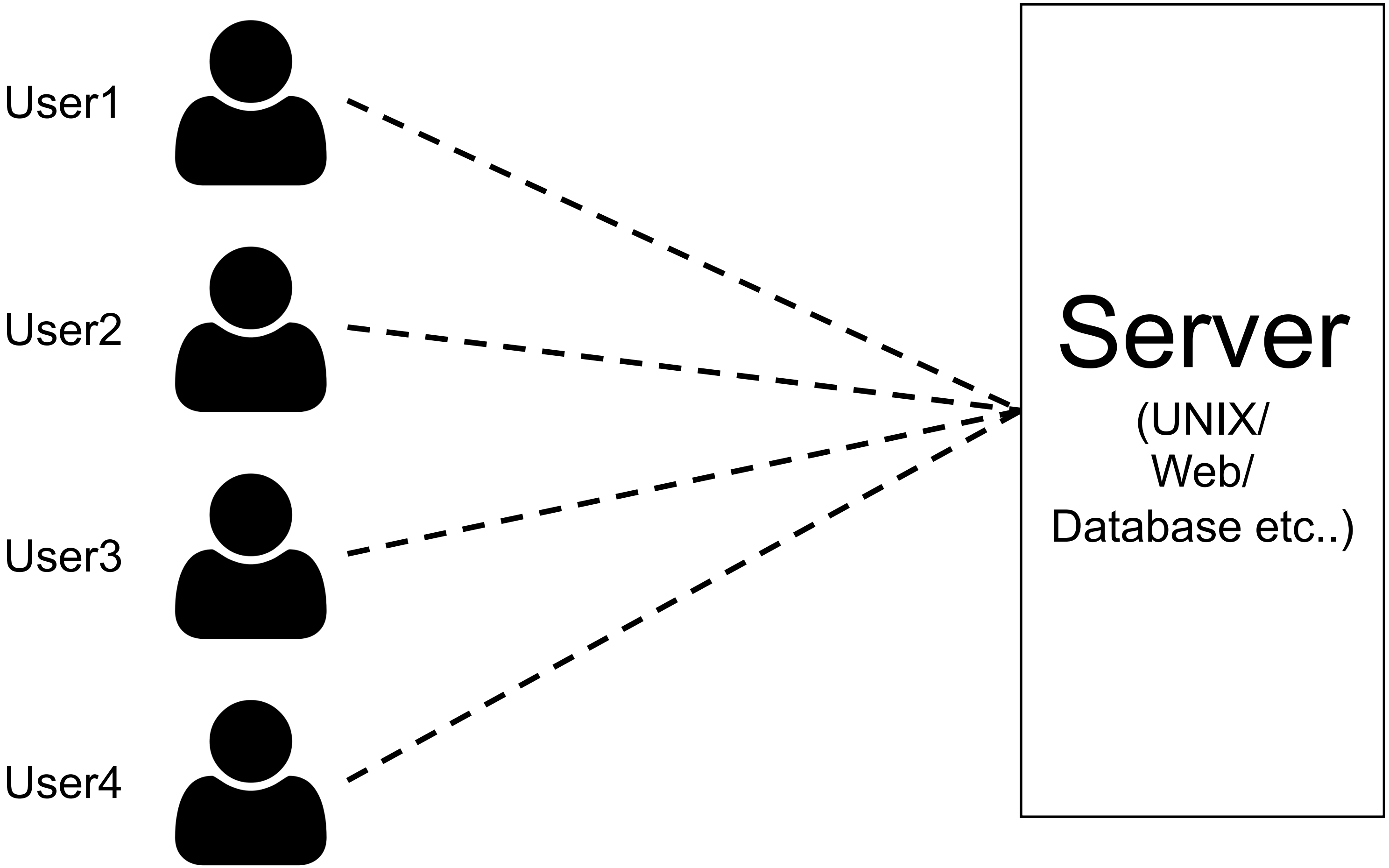
Basic UNIX commands

HORT 530

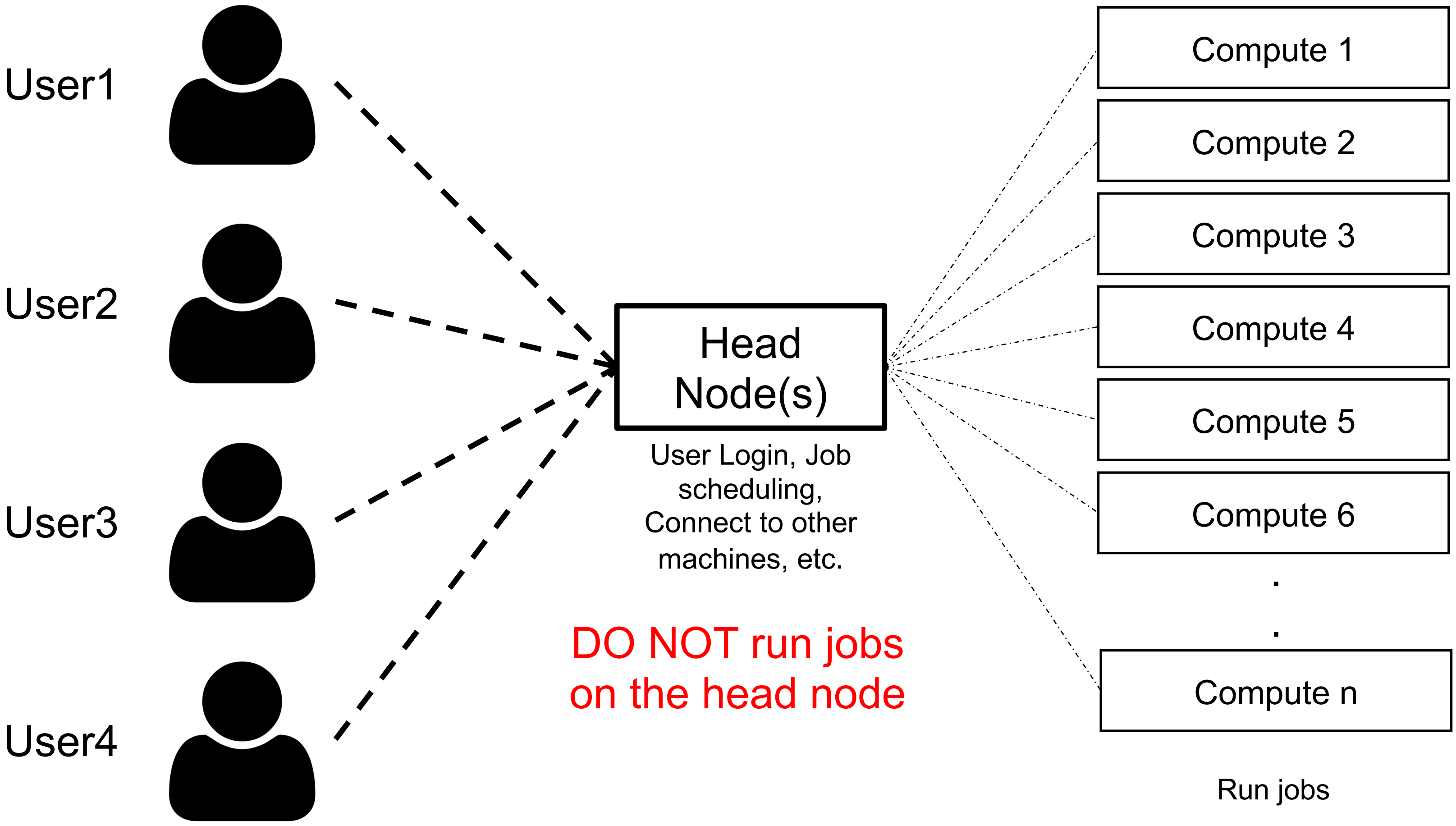
Lab 2

Instructor: Kranthi Varala

Client/Server architecture



High Performance Compute (HPC) cluster



User Login, Job scheduling, Connect to other machines, etc.

DO NOT run jobs on the head node

Run jobs

Scholar : Our class server

Sub-Cluster	Number of Nodes	Processors per Node	Cores per Node	Memory per Node
Head	7	Two 10-Core Intel CPUs	20	512-768 GB
A	20	Two 10-Core Intel CPUs	20	64 GB
G	4	Two 8-Core Intel CPUs	16	192 GB

- Scholar is a Linux cluster maintained by Purdue and is available for all computational classes.
- Secure Shell (SSH) protocol is the most common way to connect to remote UNIX/LINUX servers.
- The specific SSH client you use depends on your client (laptop) OS.

Using a compute node interactively

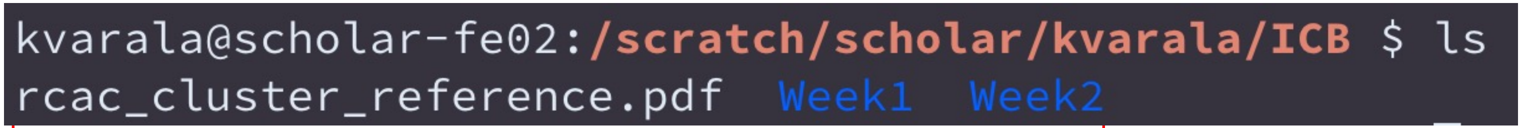
1. `ssh <yourID>@scholar.rcac.purdue.edu` ↵

   Log in to the head node.

2. `sinteractive -N1 -n1 -t 02:00:00` ↵

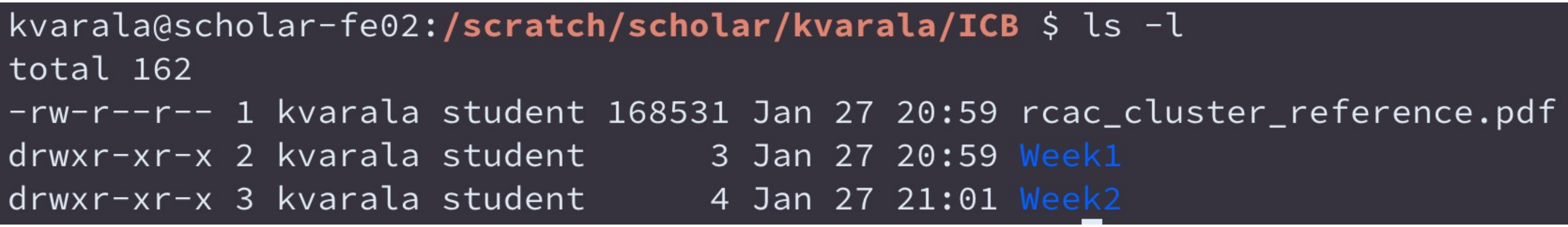
   Log in to the compute node to run jobs interactively.

ls on my scratch



```
kvarala@scholar-fe02:/scratch/scholar/kvarala/ICB $ ls
rcac_cluster_reference.pdf  Week1  Week2
```

Contents of my course folder on scratch



```
kvarala@scholar-fe02:/scratch/scholar/kvarala/ICB $ ls -l
total 162
-rw-r--r-- 1 kvarala student 168531 Jan 27 20:59 rcac_cluster_reference.pdf
drwxr-xr-x 2 kvarala student      3 Jan 27 20:59 Week1
drwxr-xr-x 3 kvarala student      4 Jan 27 21:01 Week2
```

Metadata about the contents

Contents of my scratch folder

Metadata on files and directories

- Metadata is information about the file that are not part of the contents of the file.
- Three main parts to it:
    - Ownership and access permissions
    - Size
    - Timestamp

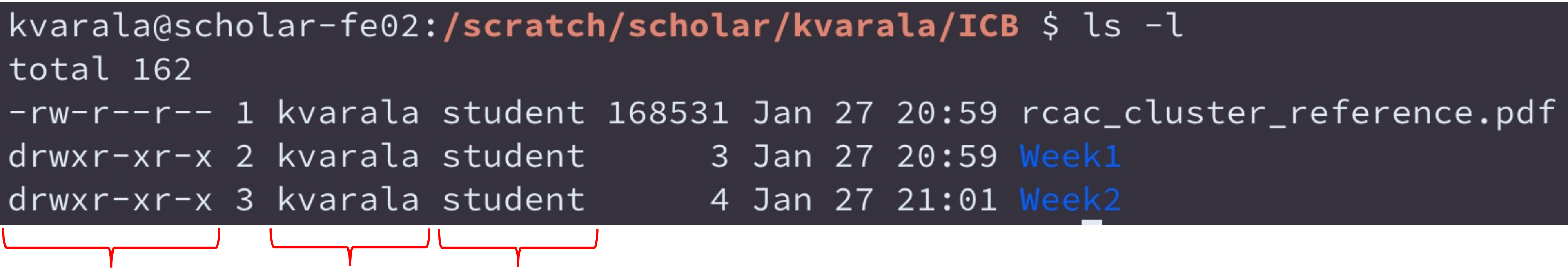
UNIX permissions

- Execute == x == 1 (Means traverse for directories)
- Write == w == 2
- Read == r == 4

Common Permission settings	Indicator	Numeric code
Read-only	r--	4
Read & execute	r-x	5
Read & write	rw-	6
Read, write, execute	rwx	7
??	??	3

Ownership and Access

- Every file/directory has a defined owner, which is one user.



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```

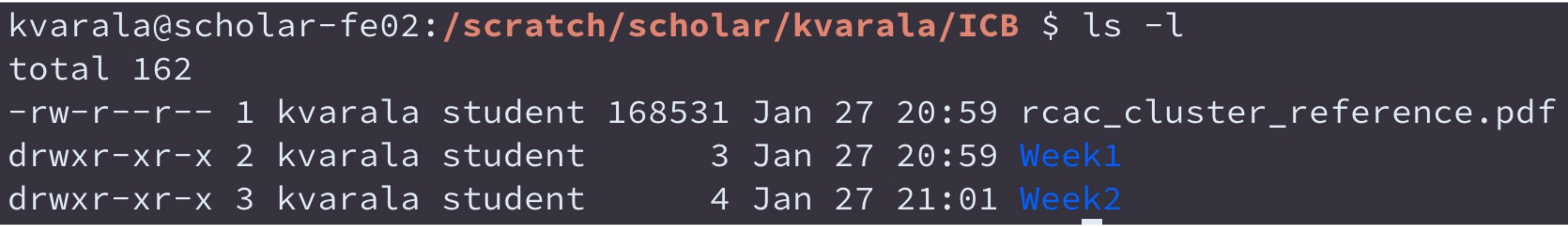
Permissions

Owner

Group

- Owner controls who can access the file/directory by setting the permissions.
- Each user is a part of one or more groups. Each file belongs to one of the groups that the user belongs to.

UNIX permissions



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```
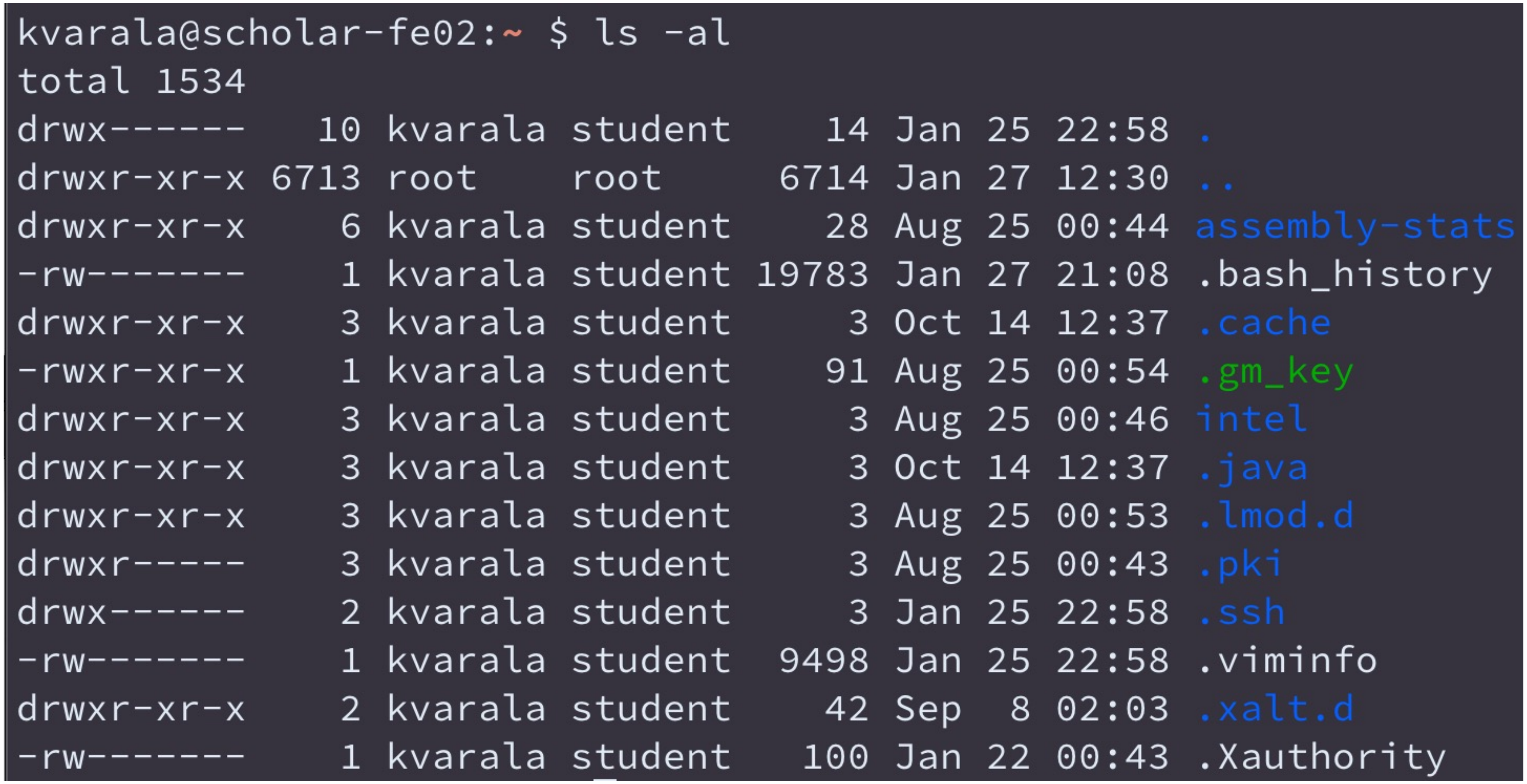

Permissions

- First character is - for a file and d for a directory.
- Characters 2-4 refer to permissions the owner sets for himself.
- Characters 5-7 are permissions for the group listed.
- Characters 8-10 are permissions for the world (i.e., every other user)

Common Permission settings	Indicator	Numeric code
Read-only	r--	4
Read & execute	r-x	5
Read & write	rw-	6
Read, write, execute	rwx	7

Hidden files and directories



```
kvarala@scholar-fe02:~ $ ls -al
total 1534
drwx------   10 kvarala student    14 Jan 25 22:58 .
drwxr-xr-x 6713 root    root     6714 Jan 27 12:30 ..
drwxr-xr-x    6 kvarala student    28 Aug 25 00:44 assembly-stats
-rw-------    1 kvarala student 19783 Jan 27 21:08 .bash_history
drwxr-xr-x    3 kvarala student     3 Oct 14 12:37 .cache
-rwxr-xr-x    1 kvarala student    91 Aug 25 00:54 .gm_key
drwxr-xr-x    3 kvarala student     3 Aug 25 00:46 intel
drwxr-xr-x    3 kvarala student     3 Oct 14 12:37 .java
drwxr-xr-x    3 kvarala student     3 Aug 25 00:53 .lmod.d
drwxr-----    3 kvarala student     3 Aug 25 00:43 .pki
drwx------    2 kvarala student     3 Jan 25 22:58 .ssh
-rw-------    1 kvarala student  9498 Jan 25 22:58 .viminfo
drwxr-xr-x    2 kvarala student    42 Sep  8 02:03 .xalt.d
-rw-------    1 kvarala student   100 Jan 22 00:43 .Xauthority
```

Files or directories whose name starts with . are considered hidden so `ls` does not list them

Working with directories

- `pwd` -> lists the present working directory
- `mkdir` -> makes a new directory
- `cd` -> change directory
- `rmdir` -> remove directory
- Try using cd with path:
  - `cd /scratch/scholar/kvarala/ICB`
  - `cd ./Week1`
  - `cd ../Week2`

File commands

- `mv` is the move command that moves a file. This command is also used for renaming files.
- `rm` is the remove command and will remove the file or empty directory listed as argument.
- `cat` is the concatenate command that joins the contents of all files given as arguments.

Exercises

Basic UNIX commands

	Pair#1	Pair#2	Pair#3	Pair#4	Pair#5	Pair#6
Week2	Maria, Hui	Chris, Sharlene	Freddie, Xiaohui	Brenden, Emily	Scott, Carl	Mithila, Meredith

Secure File Transfer (SFTP)

- An application of SSH protocol to transfer files instead of commands.

- SFTP clients used to establish file transfer connection.

- Windows: WinSCP (https://winscp.net/eng/download.php)
- MacOS: FileZilla (https://filezilla-project.org/download.php?platform=osx)

- Copy the Course syllabus file to your home directory on Scholar.

History: Keeping a record

- First let’s make sure we keep a record of all the commands we use.
- In the Bash shell (your default shell on scholar) every command you enter is stored in memory while shell is active.
- When you quit the shell, this ‘`history`’ is stored in a file called .bash_history that is in your home folder.
- Default size for history in memory and in the file is 1000 commands.
- You can recover your history of commands by typing: `history` in your command line.

Customizing your shell

- In the Bash shell, you can add aliases or modify PATH using the .bash_profile file.
- ~/.bash_profile is read every time a new shell is created.
- Create a new file called bash_profile.txt on your local computer and add the following two lines to it:

  ```
  alias ltr='ls -ltr'
  alias scratch='cd /scratch/scholar/<yourID>'

  export PATH=$PATH:$HOME/bin
  ```

- Now copy this file to your home folder on Scholar using your SCP client.

Creating and working with directories

```
cd /scratch/scholar/<YourID>/

mkdir Lab2_Exercises

cd Lab2_Exercises
```

Copy file

- Copy file from /scratch/scholar/kvarala to your scratch: Absolute path
- `cp /scratch/scholar/kvarala/ICB/rcac_cluster_reference.pdf /scratch/scholar/<YourID>/Lab2_Exercises`
- `ls /scratch/scholar/<YourID>/Lab2_Exercises`
- `ls -l /scratch/scholar/<YourID>/Lab2_Exercises`

Relative path

- `cd /scratch/scholar/<YourID>/Lab2_Exercises`
- `cp ../../kvarala/ICB/rcac_cluster_reference.pdf .`
- Now try the `cp` command with the `–p` switch

Move file

- Move file from your scratch to your home:
  Absolute path
- `cd /scratch/scholar/<YourID>/Lab2_Exercises`
- `mv /scratch/scholar/<YourID>/Lab2_Exercises/rcac_cluster_reference.pdf /home/<yourID>`
- `ls -l /scratch/scholar/<YourID>/`
- `ls -l /home/<YourID>/`

Relative path

- `cd /scratch/scholar/<YourID>/Lab2_Exercises`
- `mv ~/rcac_cluster_reference.pdf .`
- `ls -l /scratch/scholar/<YourID>/Lab2_Exercises`
- `ls -l /home/<YourID>/`

Customizing your shell

- Now move the bash_profile.txt file in your home directory to .bash_profile
- `mv bash_profile.txt ~/.bash_profile`
- Type the command: `ltr`

- logout of the shell and log back in.

- Now, again type the command: `ltr`

Remove file

- Remove file from your scratch:

Absolute path

```
cp /scratch/scholar/<YourID>/Lab2_Exercises/rcac_cluster_reference.pdf /scratch/scholar/<yourID>/temporary_copy
ls -l /scratch/scholar/<YourID>/Lab2_Exercises
rm /scratch/scholar/<YourID>/Lab2_Exercises/temporary_copy
ls -l /scratch/scholar/<YourID>/Lab2_Exercises
```

Relative path (be VERY careful)

```
cd /scratch/scholar/<YourID>/
cp rcac_cluster_reference.pdf ~/temporary_copy
rm ~/temporary_copy
ls -l /home/<YourID>/
```

Viewing files

```
cd /scratch/scholar/<YourID>/Lab2_Exercises

cp -pr /scratch/scholar/kvarala/ICB/Week2/Files .

ls -l

cd Files

cat Pasture.txt

cat WoodPile.txt

less North_of_Boston.txt
   quit less display with the ‘q’ key

head North_of_Boston.txt

tail North_of_Boston.txt
```

Changing file permissions

```
cd /scratch/scholar/<YourID>/Lab2_Exercises/Files
ls -l Pasture.txt

chmod 755 Pasture.txt
ls -l Pasture.txt

chmod -x Pasture.txt
ls -l Pasture.txt

chmod 666 Pasture.txt
ls -l Pasture.txt

chmod -w Pasture.txt
ls -l Pasture.txt
```

I/O streams

- Each command has 3 Input/Output streams:
  - STDIN : Standard Input is the default stream that inputs data into a command. Example: keyboard, file etc.
  - STDOUT : Standard Output is the default output stream of the command. Example: Terminal
  - STDERR: Standard Error is where the errors from the program are displayed: Example: Terminal

Creating pipelines from commands

- The STDIN and STDOUT of each command can be redirected to combine programs together.

- For example, the STDOUT of one program can be sent to the STDIN of another program.

- STDIN and STDOUT streams can be redirected using the following symbols:
    1. `>`
    2. `<`
    3. `|`

Redirecting STDIN and STDOUT

```
cat North_of_Boston.txt | less
```

Here, the STDOUT of `cat` is sent to the STDIN of `less.`

```
cat Pasture.txt > New_Pasture.txt
```

Here, the STDOUT of `cat` is sent to a new file called New_Pasture.txt

```
less < New_Pasture.txt
```

Here the file New_Pasture.txt is sent to the STDIN of less

```
cat Pasture.txt WoodPile.txt >2Poems.txt
```

Capturing STDERR

Errors from running commands are sent to STDERR. By default, STDERR is shown on your monitor.

```
nonsense_command
-bash: nonsense_command: command not found
```

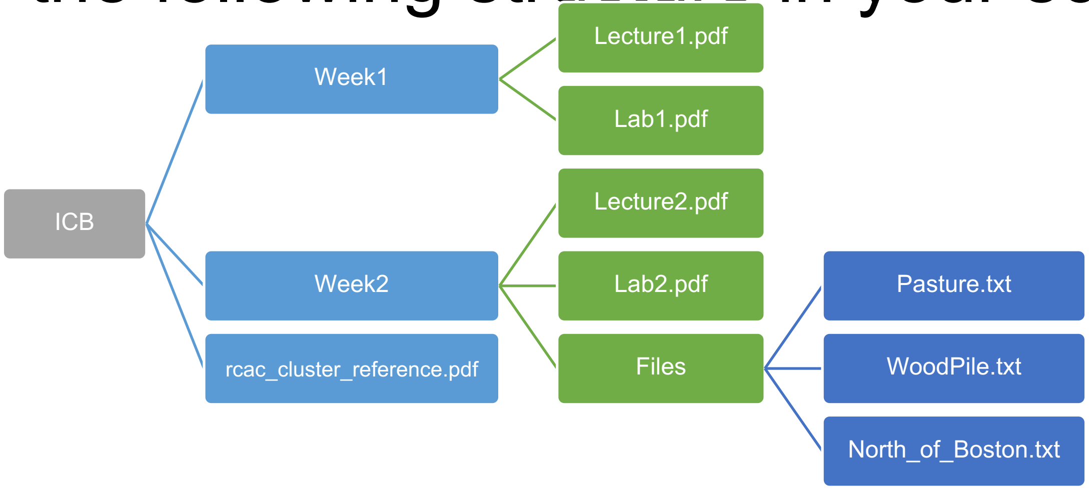
Here, the STDERR of `nonsense_command` is sent to the monitor

```
nonsense_command 2>err.log
```

Here the file STDERR of `nonsense_command` is sent to the file err.log

Try these on your own

- Try moving to these locations with the cd command:
  - /home/<yourID>
  - /scratch/scholar/kvarala/ICB/
  - /usr/bin/
  - /root/
- Create the following structure in your scratch space:



ICB

Week1

Week2

rcac_cluster_reference.pdf

Lecture1.pdf

Lab1.pdf

Lecture2.pdf

Lab2.pdf

Files

Pasture.txt

WoodPile.txt

North_of_Boston.txt

Learning about UNIX commands

- `which <cmd>`
  - Tells you the location of the command
- `man <cmd>`
  - Displays the manual for the command
- `<cmd> --help/-h`
  - Displays a short list of options for the command