Lists, Loops and Conditionals

HORT 530

Lecture 10

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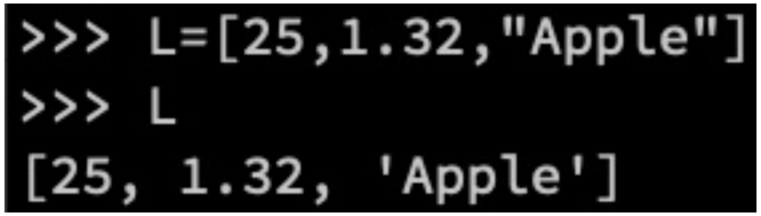
Core data types

- Numbers
- Strings
- Lists
- Dictionaries
- Tuples
- Files
- Sets

Lists

- A List is a general, sequence object where the individual items in the list can be different types. I.e., the same list can contain integers, floats, strings etc..
- Lists are mutable, i.e., a list can be changed without having to create a new list object



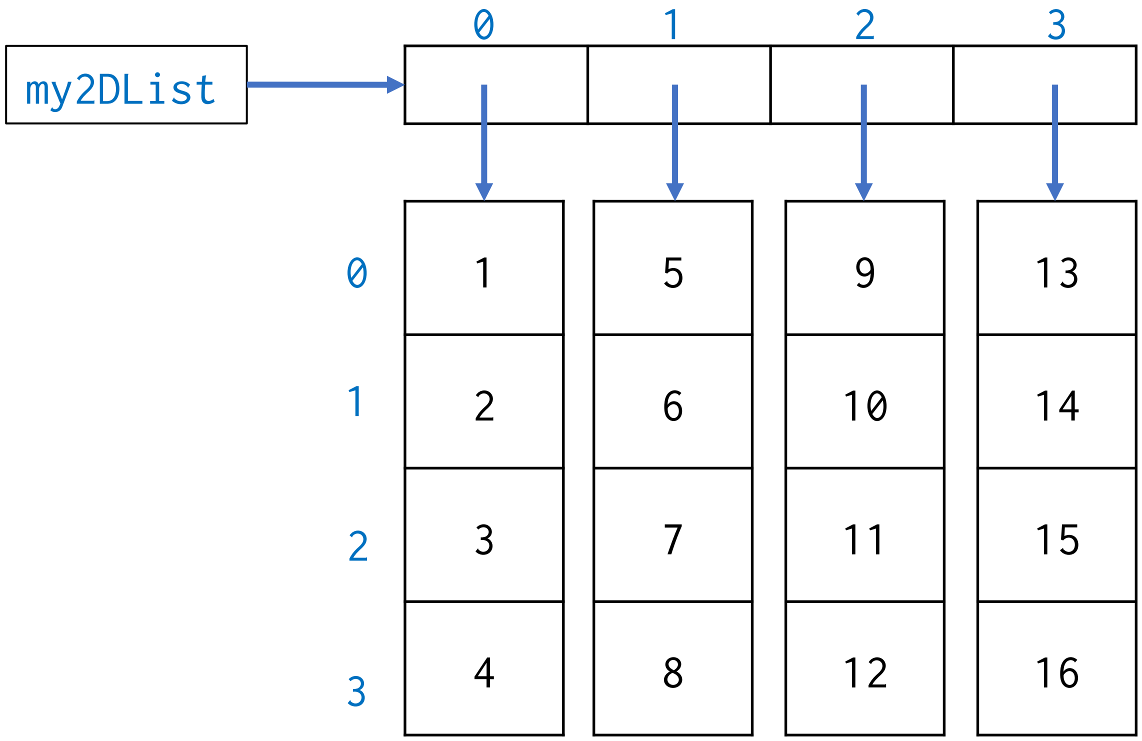
```
>>> L=[25,1.32,"Apple"]
>>> L
[25, 1.32, 'Apple']
```

Lists: Common Methods

- L.append() : Adds one item to the end of the list.
- L.extend() : Adds multiple items to the end of the list.
- L.pop(i) : Remove item 'i' from the list. Default:Last.
- L.reverse() : Reverse the order of items in list.
- L.insert(i,item): Inserts 'item' at position i.
- L.remove(item) : Finds 'item' in list and deletes it from the list.
- L.sort(): Sorts the list in- place i.e., changes the sequence in the list. (Sorting mixed data types only works on python2)

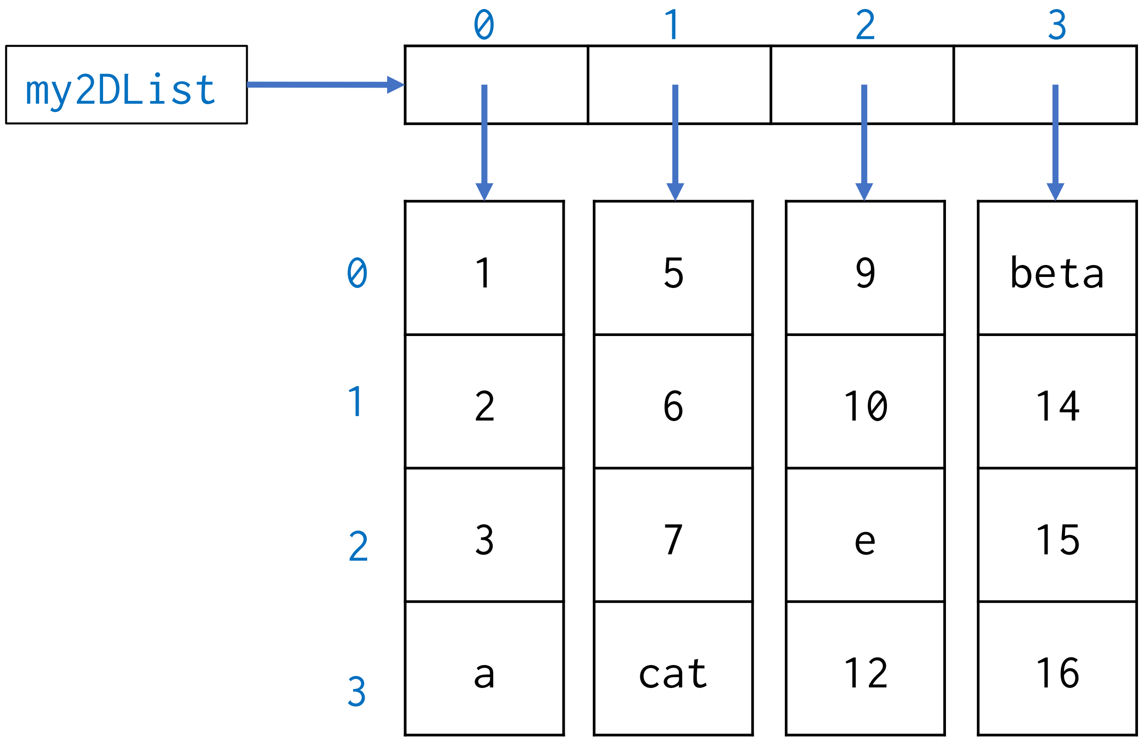
MultiDimensional Lists

- Lists are of arbitrary length and can easily be nested.
- Simplest nested lists are 2 –dimensional matrices.
- `my2DList = [[1,2,3,4],[5,6,7,8],[9,10,11,12],[13,14,15,16]]`



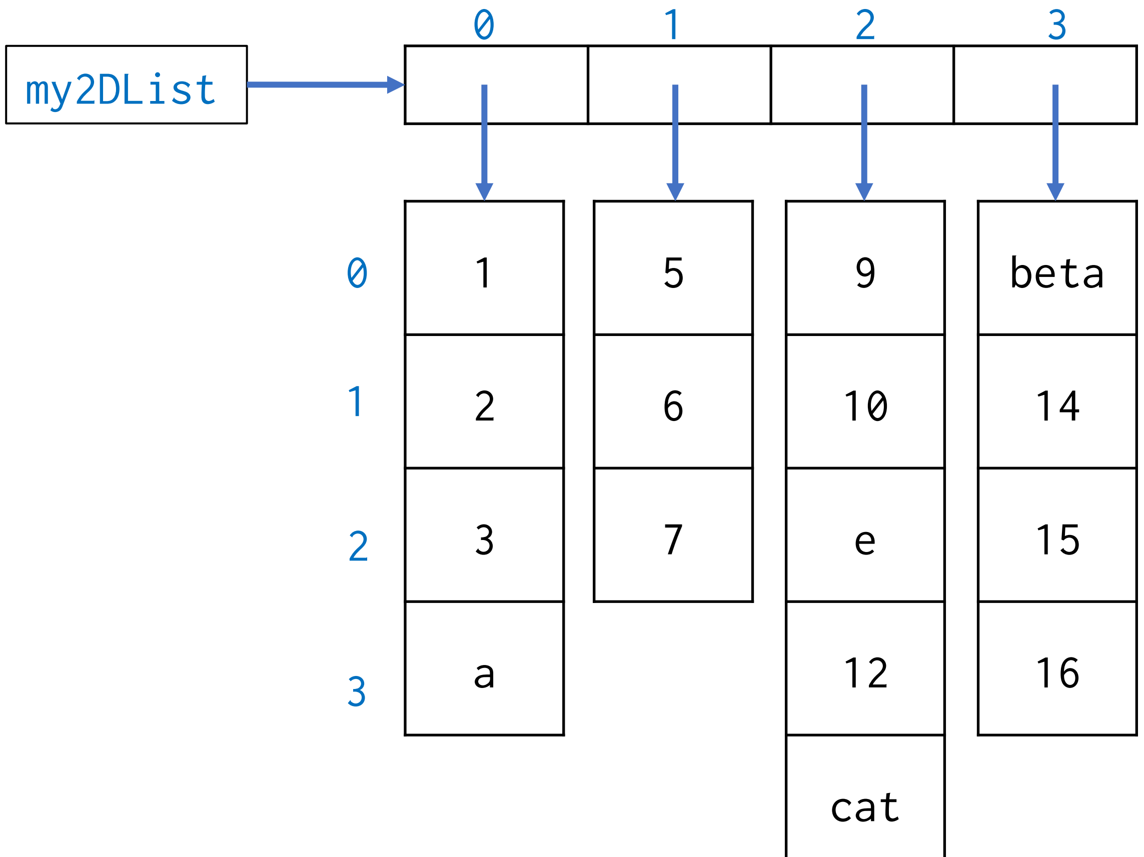
MultiDimensional Lists

- Nested Lists need not be homogeneous.
- `my2DList = [[1,2,3,'a'],[5,6,7,'cat'],[9,10,'e',12],['beta',14,15,16]]`



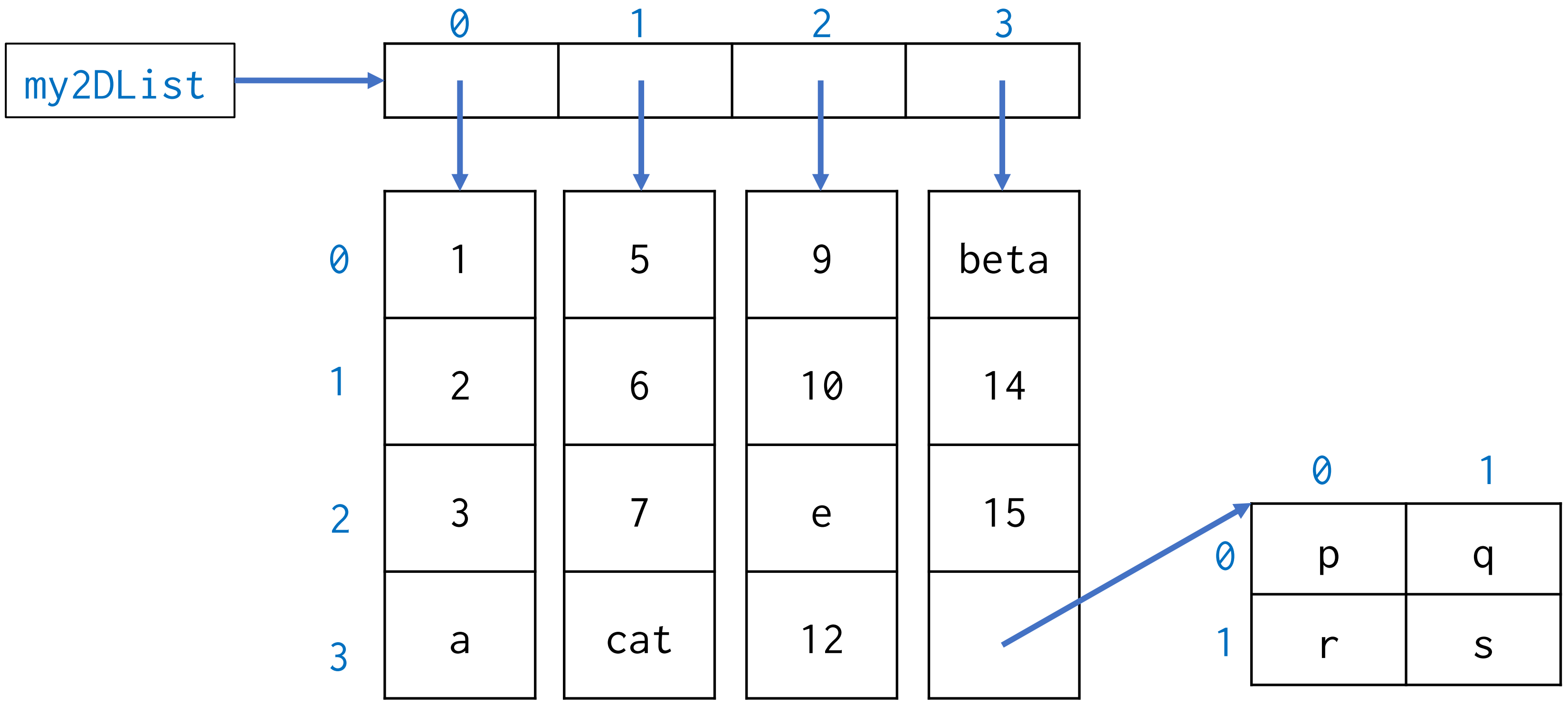
Arbitrary dimensional Lists

- Nested Lists need not be of the same length.
- `my2DList = [[1,2,3,'a'],[5,6,7],[9,10,'e',12,'cat'],['beta',14,15,16]]`



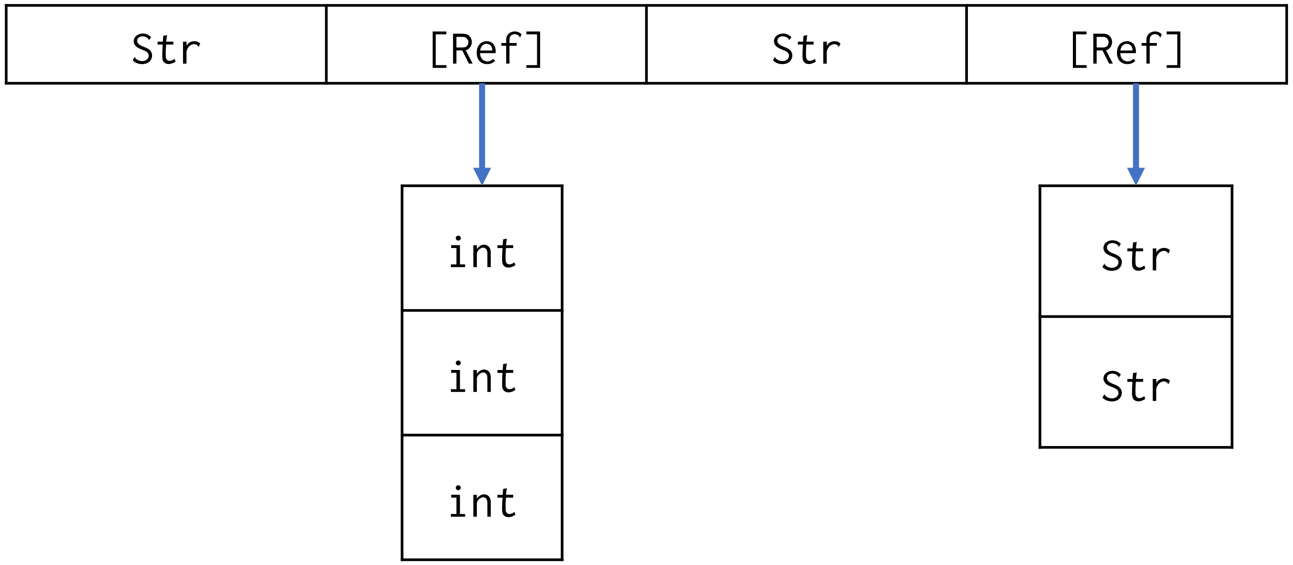
Arbitrary dimensional Lists

- Nested Lists can have arbitrary depth as well.
- `subL = [['p','q'],['r','s']]`
- `my2DList = [[1,2,3,'a'],[5,6,7,'cat'],[9,10,'e',12],['beta',14,15,subL]]`



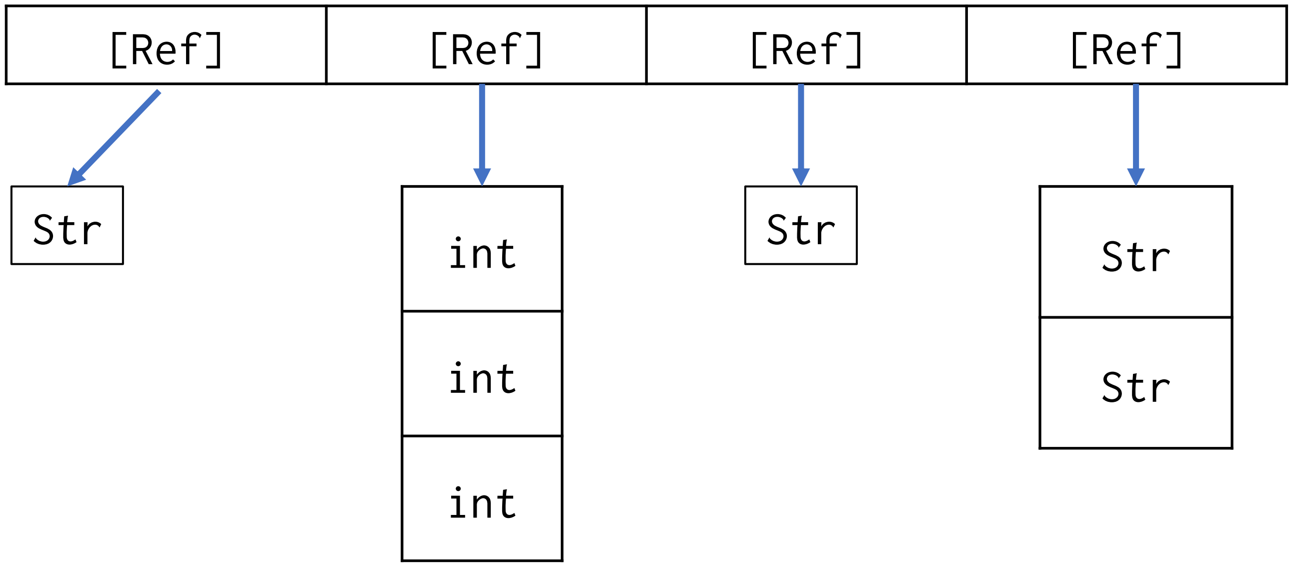
Lists as sequences of references

- `myList = ['Name',[Month,Date,Year],Address,[Home,Cell]]`



Lists as sequences of references

- `myList = ['Name',[Month,Date,Year],Address,[Home,Cell]]`



Lists are mutable!!

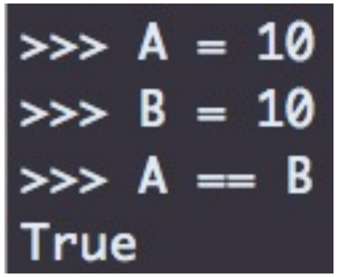
```
>>>subL = [['p','q'],['r','s']]
>>>myList = [[1,2,3,'a'],[5,6,7,'cat'],[9,10,'e',12],['beta',14,15,subL]]
>>>myList
[[1,2,3,'a'],[5,6,7,'cat'],[9,10,'e',12],['beta',14,15,[['p','q'],['r','s']]]]
>>>subL[0][1]
'q'
>>>subL[0][1] = 'z'
>>>myList
[[1,2,3,'a'],[5,6,7,'cat'],[9,10,'e',12],['beta',14,15,[['p','z'],['r','s']]]]
```

Working with Lists

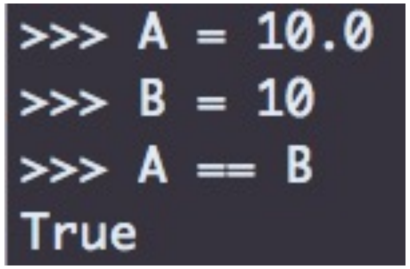
- Lists are a great way to store values in an ordered way. E.g., First Names.
- Multiple lists with related values can be stored and retrieved based on index. E.g., List1 -> First Names, List2->Last Names.
- When working with lists, we need a quick and robust way to iterate over them, i.e., retrieve each item separately.
- Loops with conditional statements are the most common way to iterate over lists.

Relational Operators

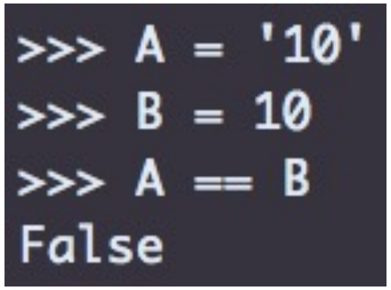
- These operators compare the value of two 'expressions' and returns a Boolean value.



```
>>> A = 10
>>> B = 10
>>> A == B
True
```



```
>>> A = 10.0
>>> B = 10
>>> A == B
True
```



```
>>> A = '10'
>>> B = 10
>>> A == B
False
```

- Beware of comparing across data types, especially when reading values in from command line or files.

Relational Operators

==	equal	True if expressions are equal
!=	not equal	True if expressions are not equal
>	Greater than	True if left is greater than the right
<	Less than	True if left is less than the right
>=	greater than OR equal	
<=	less than OR equal	
is	identity	True if the left is the same object as right
in	contains	True if the object on left is contained in object on right (Useful for finding values in list)

Assignment Operators

A += B	increase A by value of B
A -= B	decrease A by value of B
A *= B	multiply A by B and assign value to A
A /= B	divide A by B and assign value to A
A **=B	raise value of A to the power of B
A %= B	modulus of A by B, assigned to A
A //= B	floor of A divided by B, assigned to A

- String context:
  - S1 += S2   add string on right to the one on left
  - S1 *= A   Make A copies of S1 and concatenate them to S1

Boolean Operators

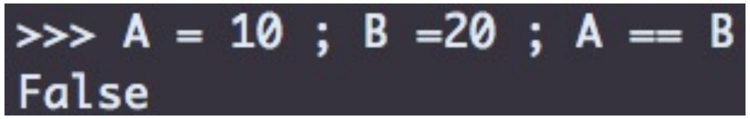
Combines two or more statements that return a Boolean value.

A and B	True if both A and B are true
A or B	True if either A or B is true
not A	Reverse the Boolean given by A
xor(A,B)	True if only one of A or B is True

A	B	A and B	A or B	Not A	xor(A,B)
TRUE	TRUE	TRUE	TRUE	FALSE	FALSE
TRUE	FALSE	FALSE	TRUE	FALSE	TRUE
FALSE	TRUE	FALSE	TRUE	TRUE	TRUE
FALSE	FALSE	FALSE	FALSE	TRUE	FALSE

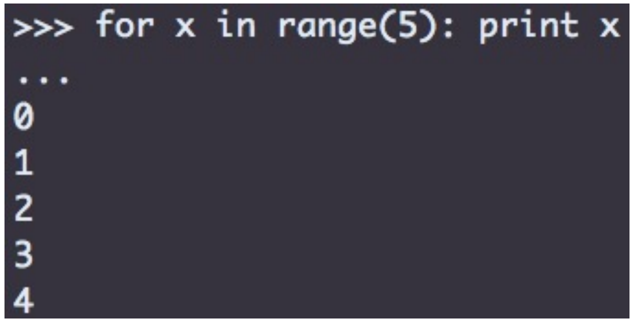
General Python Syntax rules

- End of line is end of statement
- Statements at the same indentation level are in the same block (e.g., within a loop or condition)
- End of indentation is end of block
- Exceptions:
  - Semi colon ; separates statements on the same line



```
>>> A = 10 ; B =20 ; A == B
False
```

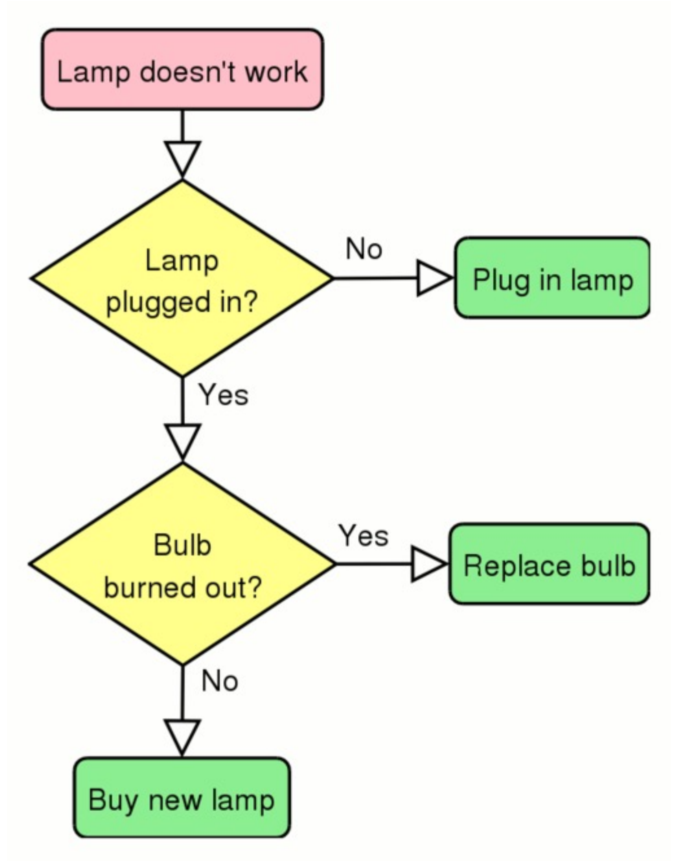
  - Single line blocks are allowed without indentation



```
>>> for x in range(5): print x
...
0
1
2
3
4
```

Branching logic

- Used to implement alternate paths for the logic flow.



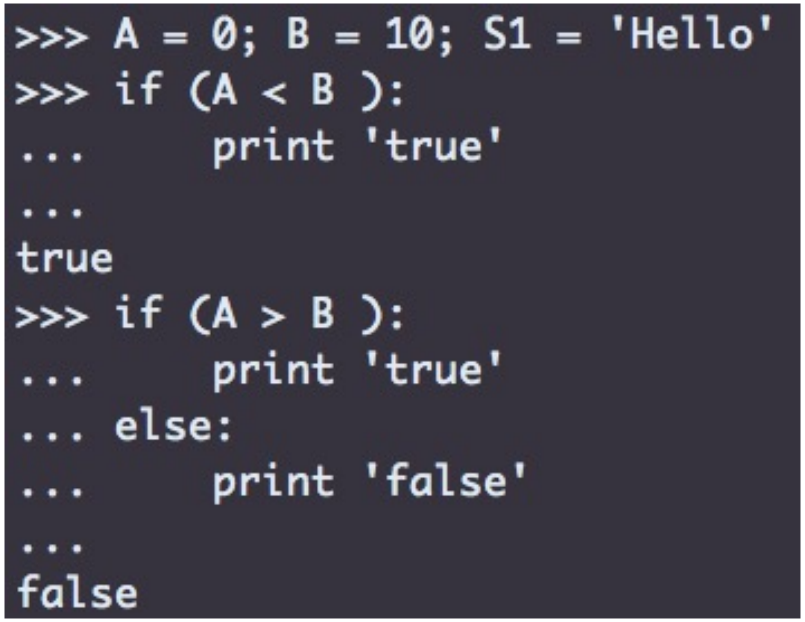
https://upload.wikimedia.org/wikipedia/commons/4/44/LampFlowchart.png

If/elif/else statements

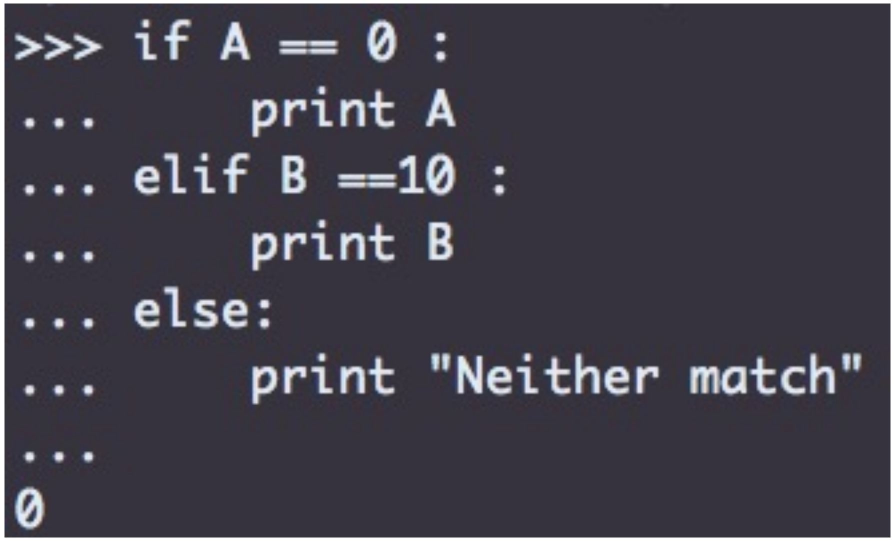
```
if test1:
    statement 1
elif test2:
    statement 2
else:
    statement 3
```

- Both the elif and else blocks are optional.

if/elif/else statements

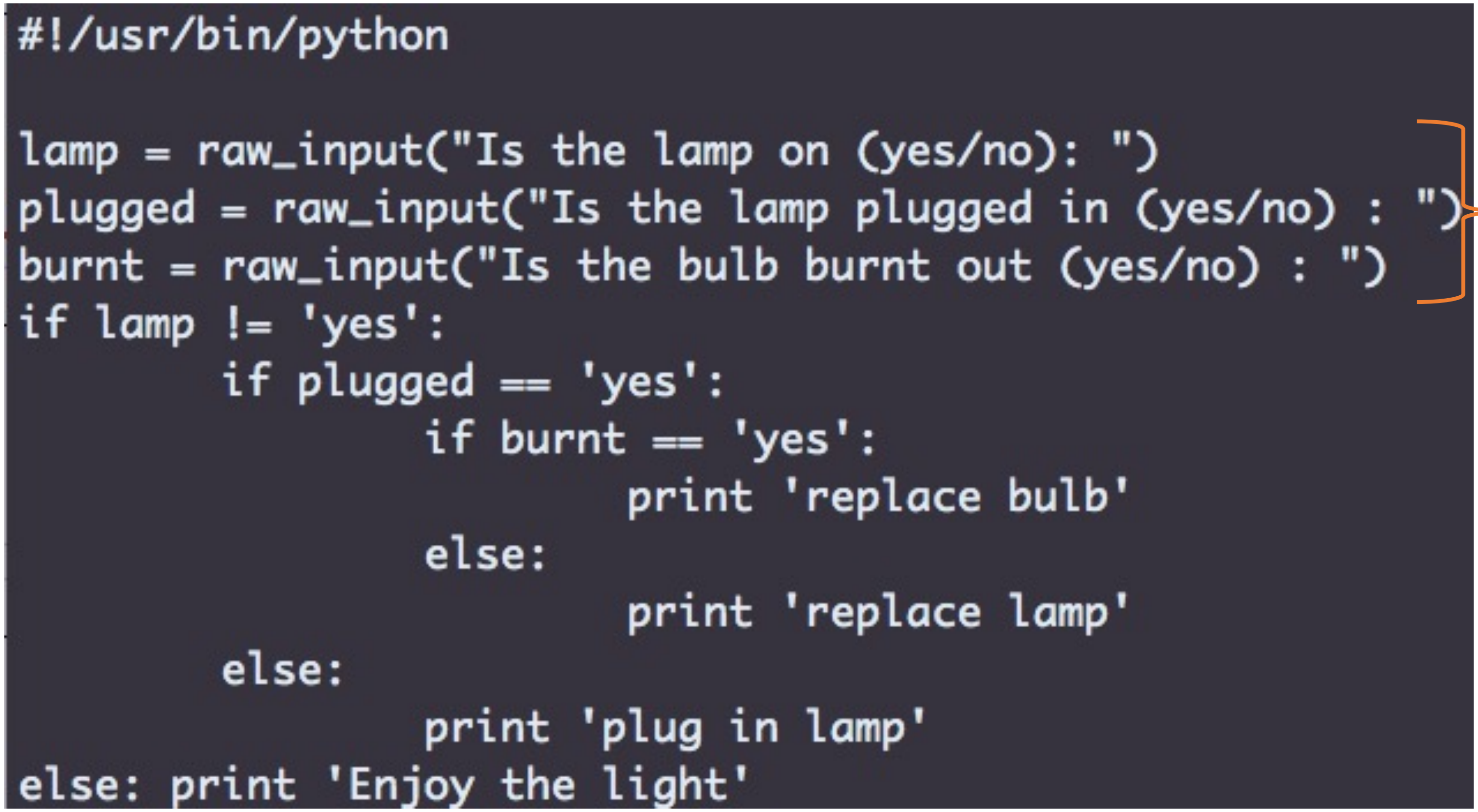


```
>>> A = 0; B = 10; S1 = 'Hello'
>>> if (A < B ):
...     print 'true'
...
true
>>> if (A > B ):
...     print 'true'
... else:
...     print 'false'
...
false
```



```
>>> if A == 0 :
...     print A
... elif B ==10 :
...     print B
... else:
...     print "Neither match"
...
0
```

Lamp flowchart with if/else



```
#!/usr/bin/python

lamp = raw_input("Is the lamp on (yes/no): ")
plugged = raw_input("Is the lamp plugged in (yes/no) : ")
burnt = raw_input("Is the bulb burnt out (yes/no) : ")
if lamp != 'yes':
        if plugged == 'yes':
                if burnt == 'yes':
                        print 'replace bulb'
                else:
                        print 'replace lamp'
        else:
                print 'plug in lamp'
else: print 'Enjoy the light'
```

Accepts input from user, as a string

Truth and Boolean tests in Python

- All objects in python have an inherent true or false value.
- Any nonempty object is true.
  - For Integers : Any non-zero number is true
- Zero, empty objects and special object 'None' are false.
- Comparisons return the values True or False

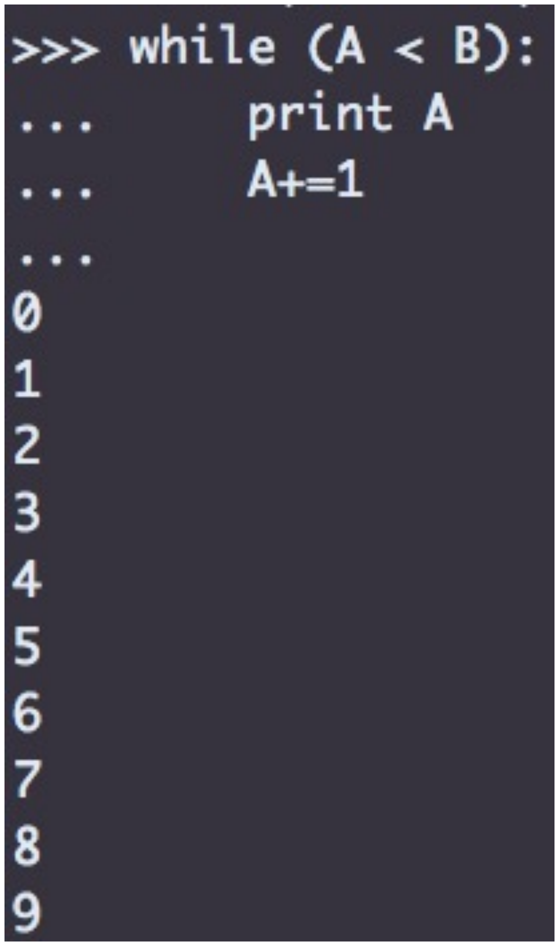
Loops/Iterations

- A loop is a block of statements that repeats all the statements within the block until the exit condition is met.
- Statements in a loop are defined by indenting them relative to the loop start.
- Loop ends when indentation ends.
- Python has two forms of loops: for and while
- E.g. >>> for x in range(10)
- E.g. >>>while (A==10)

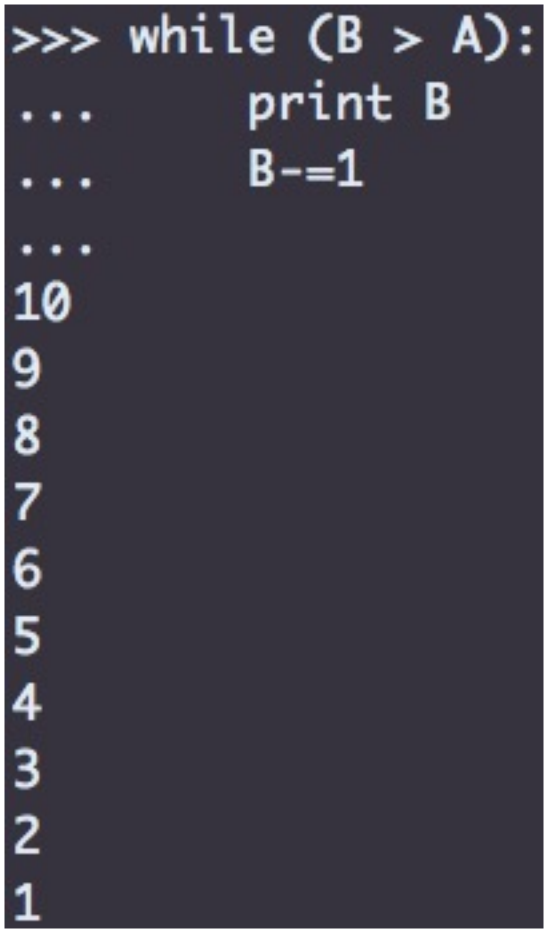
while loops

- while condition:
  ```
  statement 1
  statement 2
  .
  .
  ```
- Most generic form of loop, that checks whether the condition is true at the start of each iteration.
- Expects the condition to become false at some point during the iterations of the loop.
- If condition is never changed, this creates an 'infinite' loop. i.e., the program will get stuck in this loop for ever.

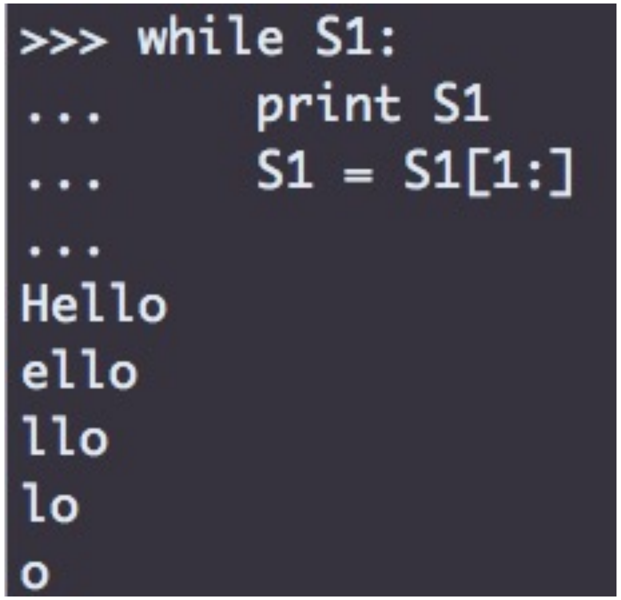
Example while loops



```
>>> while (A < B):
...     print A
...     A+=1
...
0
1
2
3
4
5
6
7
8
9
```



```
>>> while (B > A):
...     print B
...     B-=1
...
10
9
8
7
6
5
4
3
2
1
```

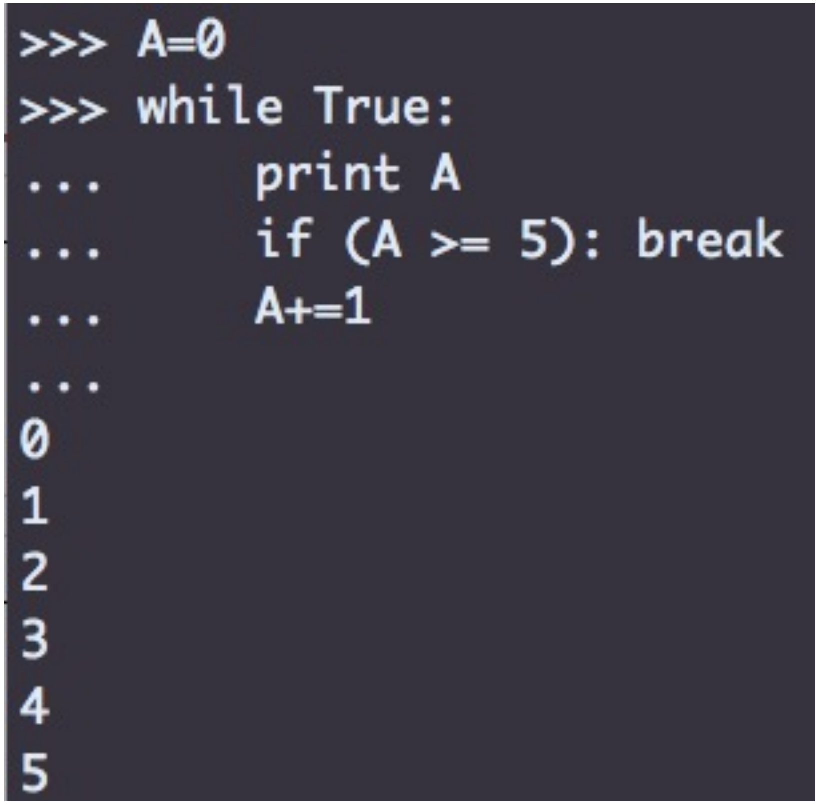


```
>>> while S1:
...     print S1
...     S1 = S1[1:]
...
Hello
ello
llo
lo
o
```

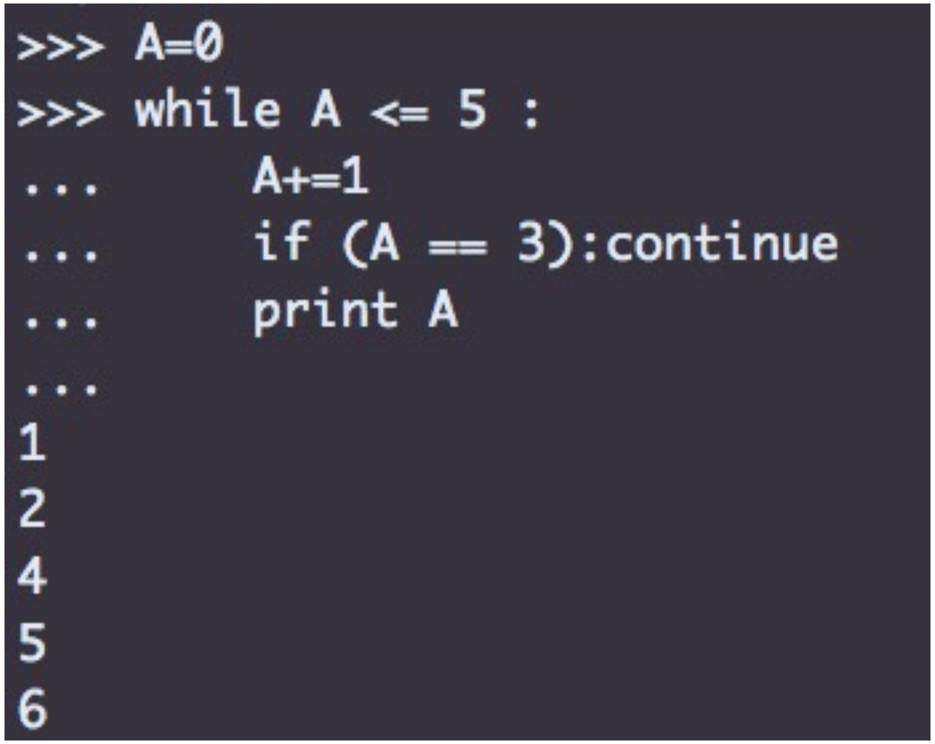
Altering while loops

- Normally, a loop ends only when exit condition is met.
- break statement forces the current loop to exit.
- continue statement skips the rest of the block and goes to the next iteration of the loop.
- pass statement is a placeholder for empty blocks.

Altering while loops



```
>>> A=0
>>> while True:
...     print A
...     if (A >= 5): break
...     A+=1
...
0
1
2
3
4
5
```



```
>>> A=0
>>> while A <= 5 :
...     A+=1
...     if (A == 3):continue
...     print A
...
1
2
4
5
6
```

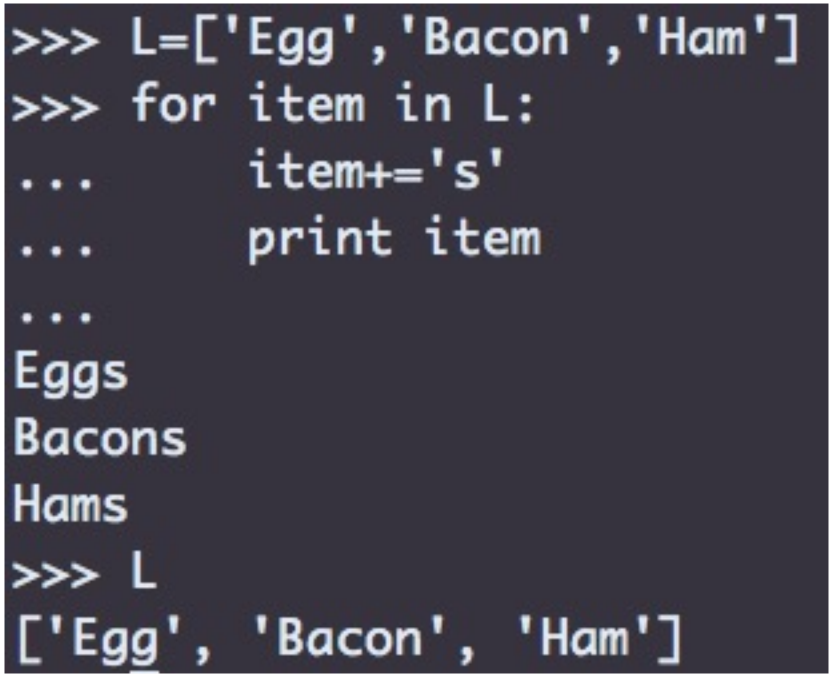
for loops

- for item in sequence:

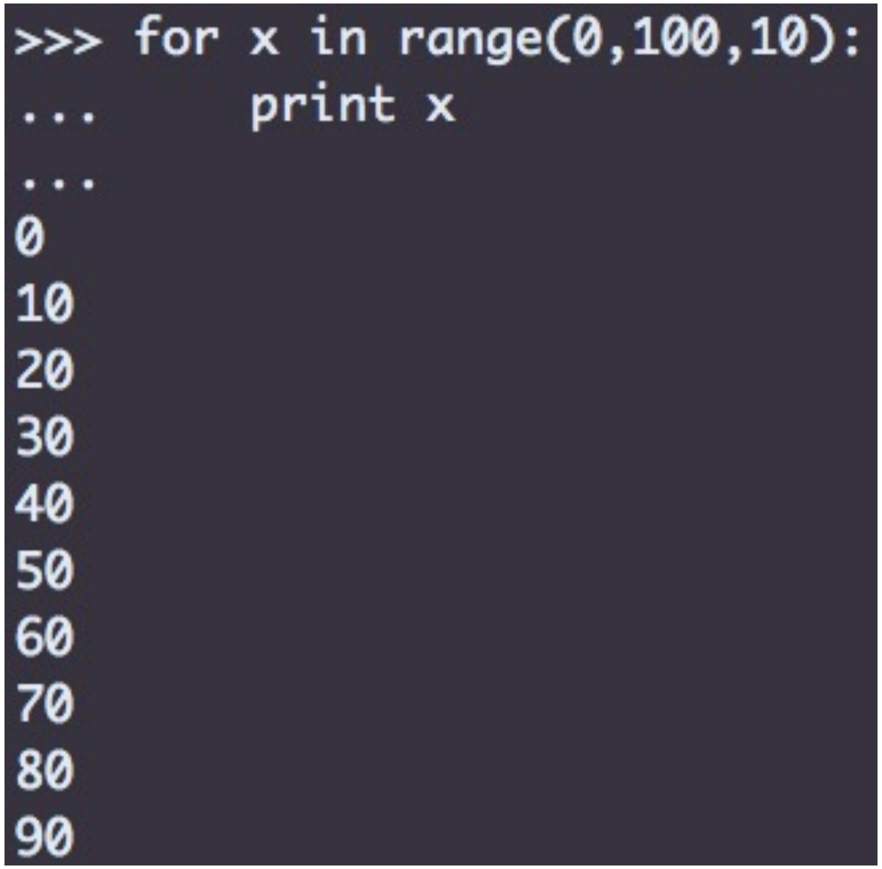
```
statement 1
statement 2
.
.
```

- Generic iterator for items in a ordered sequence such as lists, tuples etc.
- On each iteration retrieves one item from the list and assigns it to the variable specified.
- Automatically moves to the next item in the order.
- Value of variable may be altered within the for loop, but change is not made in the list.

for loops



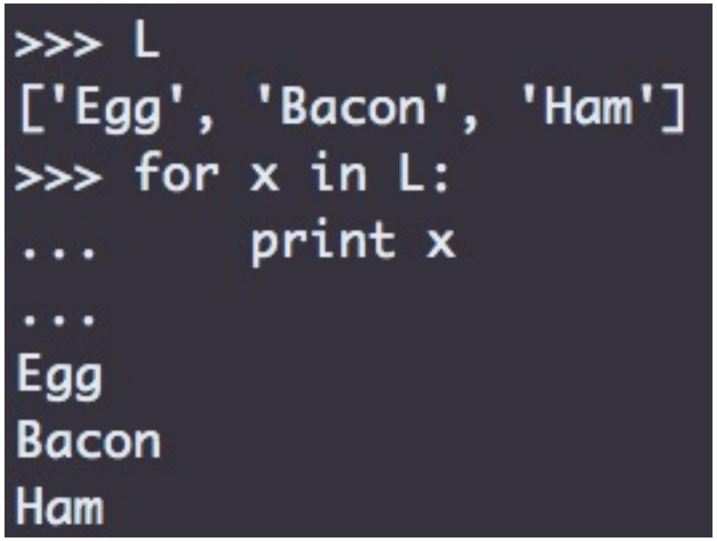
```
>>> L=['Egg','Bacon','Ham']
>>> for item in L:
...     item+='s'
...     print item
...
Eggs
Bacons
Hams
>>> L
['Egg', 'Bacon', 'Ham']
```



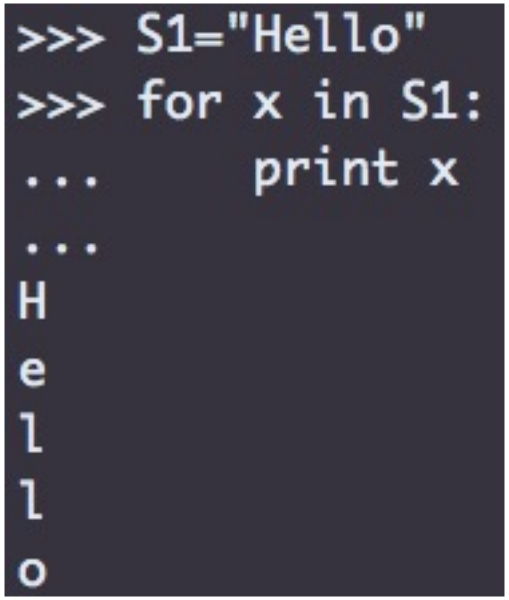
```
>>> for x in range(0,100,10):
...     print x
...
0
10
20
30
40
50
60
70
80
90
```

Looping over Strings and Lists

- List is a general sequence object while String is a character sequence object.
- Both can be iterated over by a for loop:



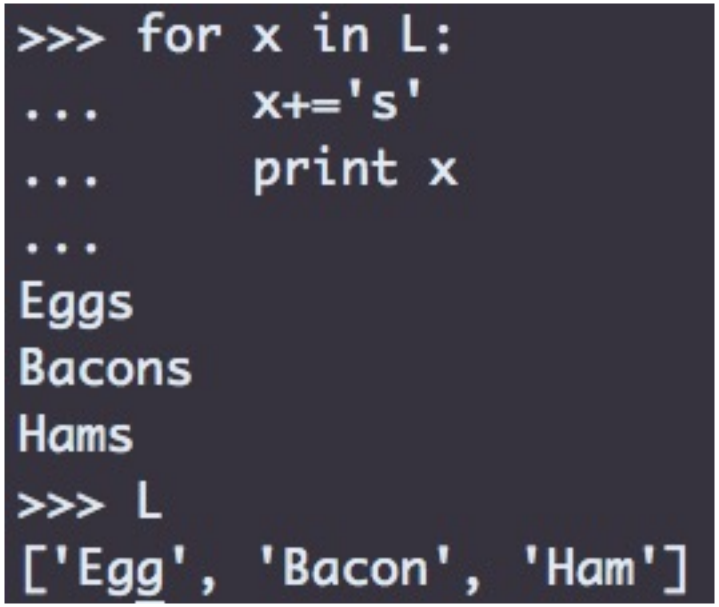
```
>>> L
['Egg', 'Bacon', 'Ham']
>>> for x in L:
...     print x
...
Egg
Bacon
Ham
```



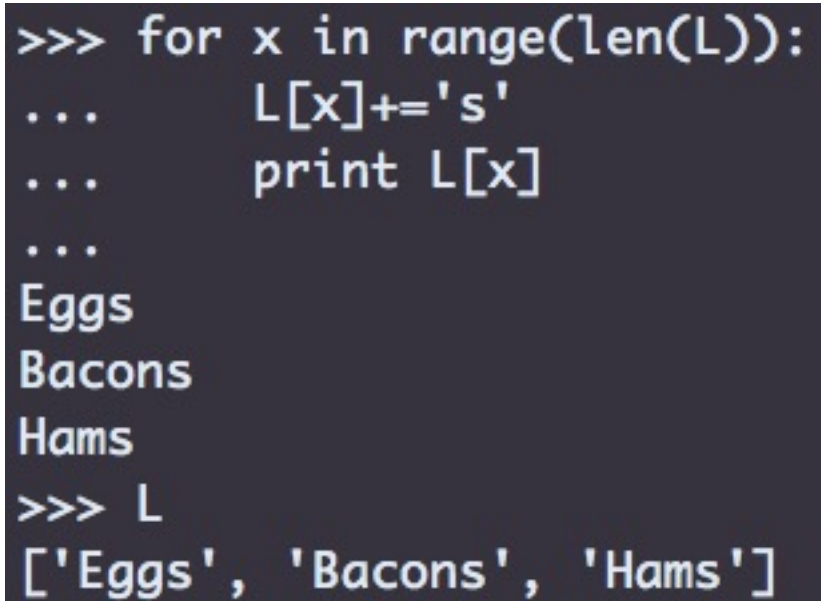
```
>>> S1="Hello"
>>> for x in S1:
...     print x
...
H
e
l
l
o
```

Looping over lists with and without index

- Looping with an index allows accessing the item within the list and changing it.



```
>>> for x in L:
...     x+='s'
...     print x
...
Eggs
Bacons
Hams
>>> L
['Egg', 'Bacon', 'Ham']
```



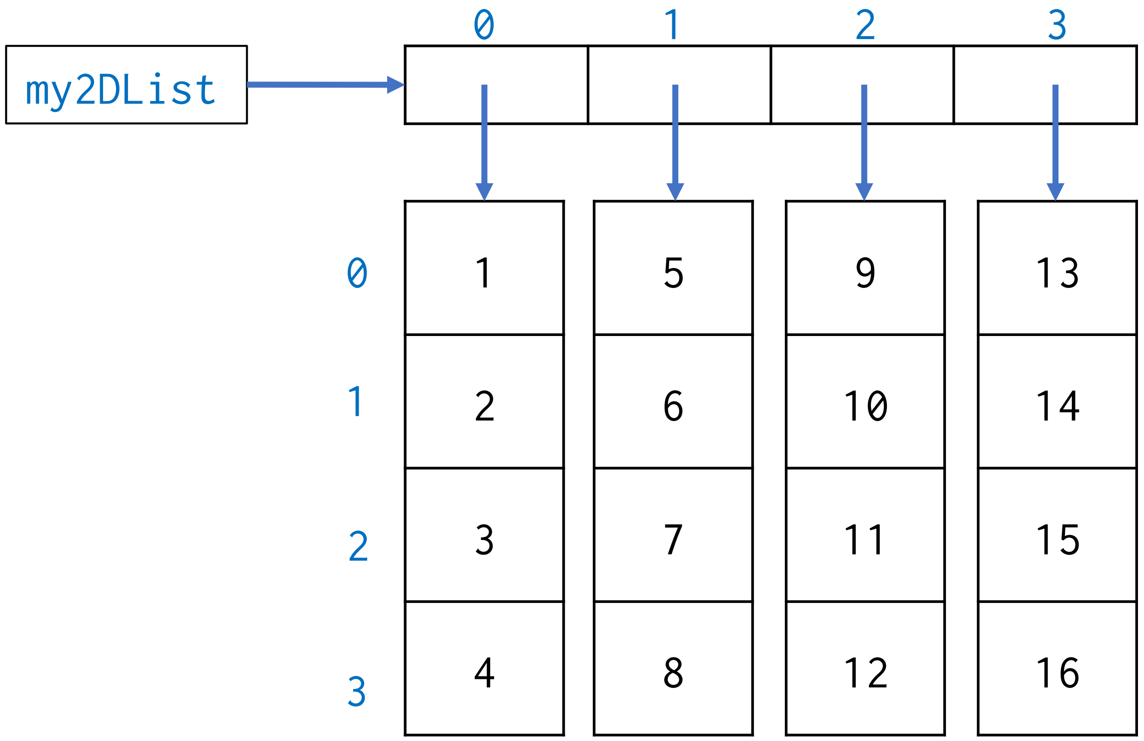
```
>>> for x in range(len(L)):
...     L[x]+='s'
...     print L[x]
...
Eggs
Bacons
Hams
>>> L
['Eggs', 'Bacons', 'Hams']
```

Nested Loops

- Loops can be nested just like the if/else statements.
- Indentation is again the key to creating nested loops.
- In a 2-level nested loop with x iterations on the outer loop and y iterations in the inner loop:
    - All statements in the outer loop will be executed x times
    - All statements in the inner loop will be executed x*y times

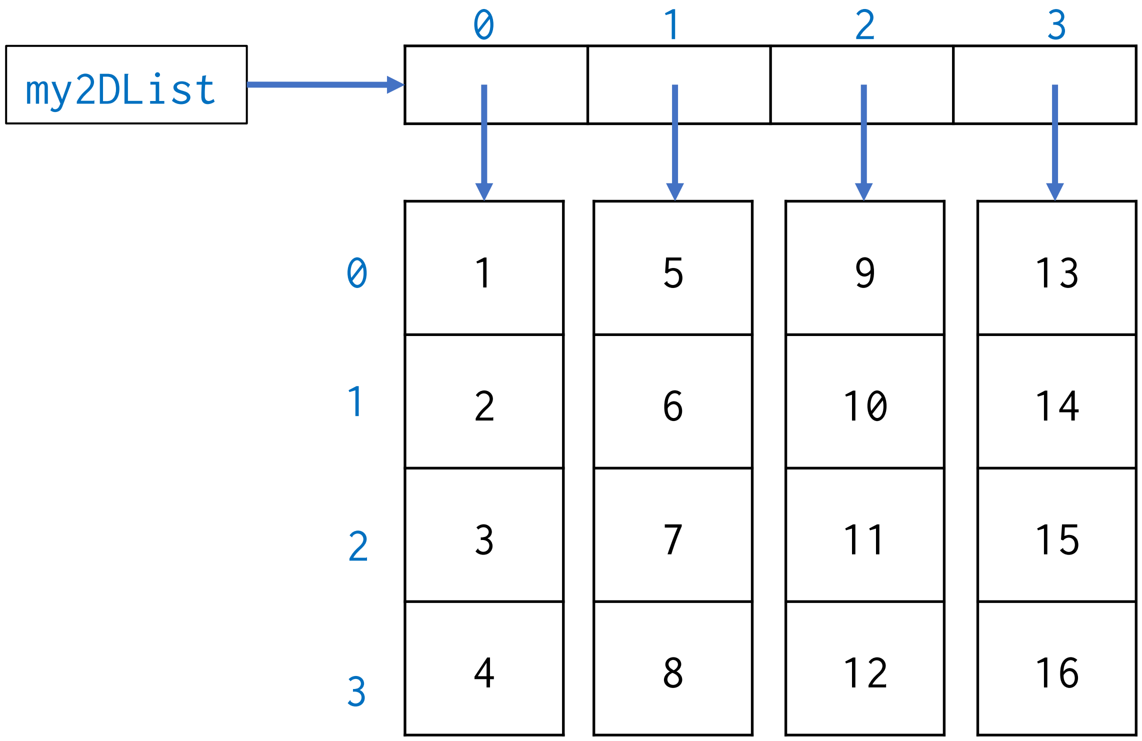
MultiDimensional Lists

```
my2DList = [[1,2,3,4],[5,6,7,8],[9,10,11,12],[13,14,15,16]]
```



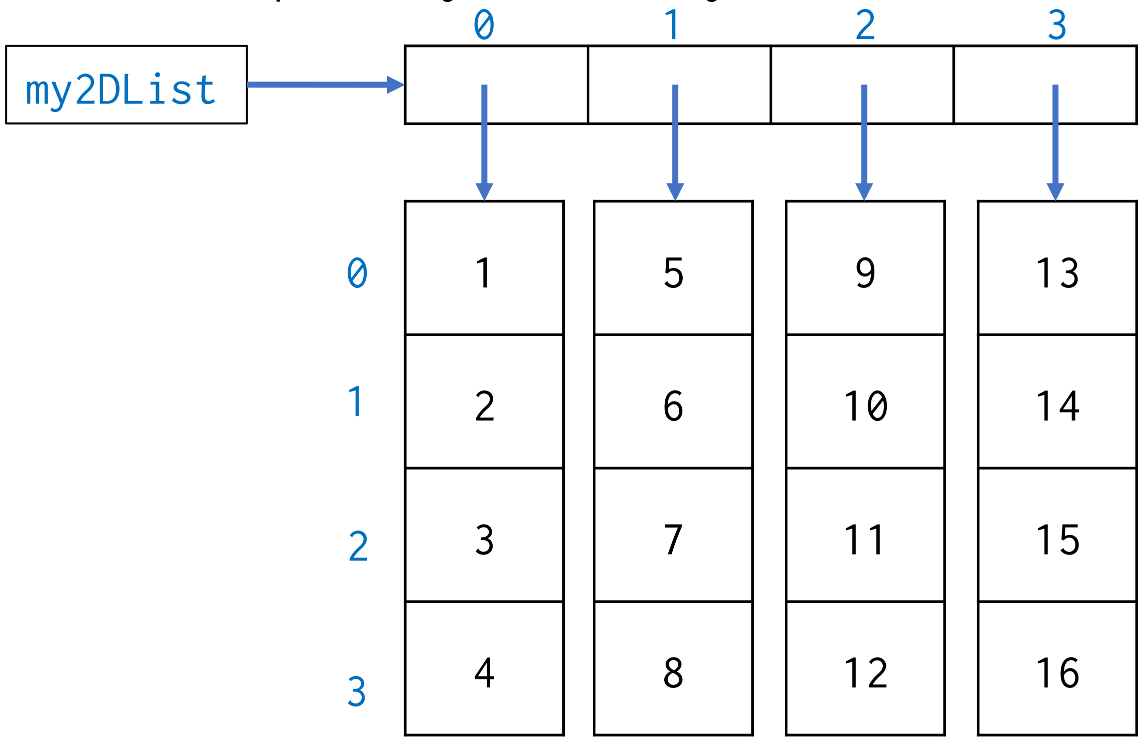
MultiDimensional Lists

```
my2DList = [[1,2,3,4],[5,6,7,8],[9,10,11,12],[13,14,15,16]]
for x in range(len(my2DList)):
        insideList=my2DList[x]
```



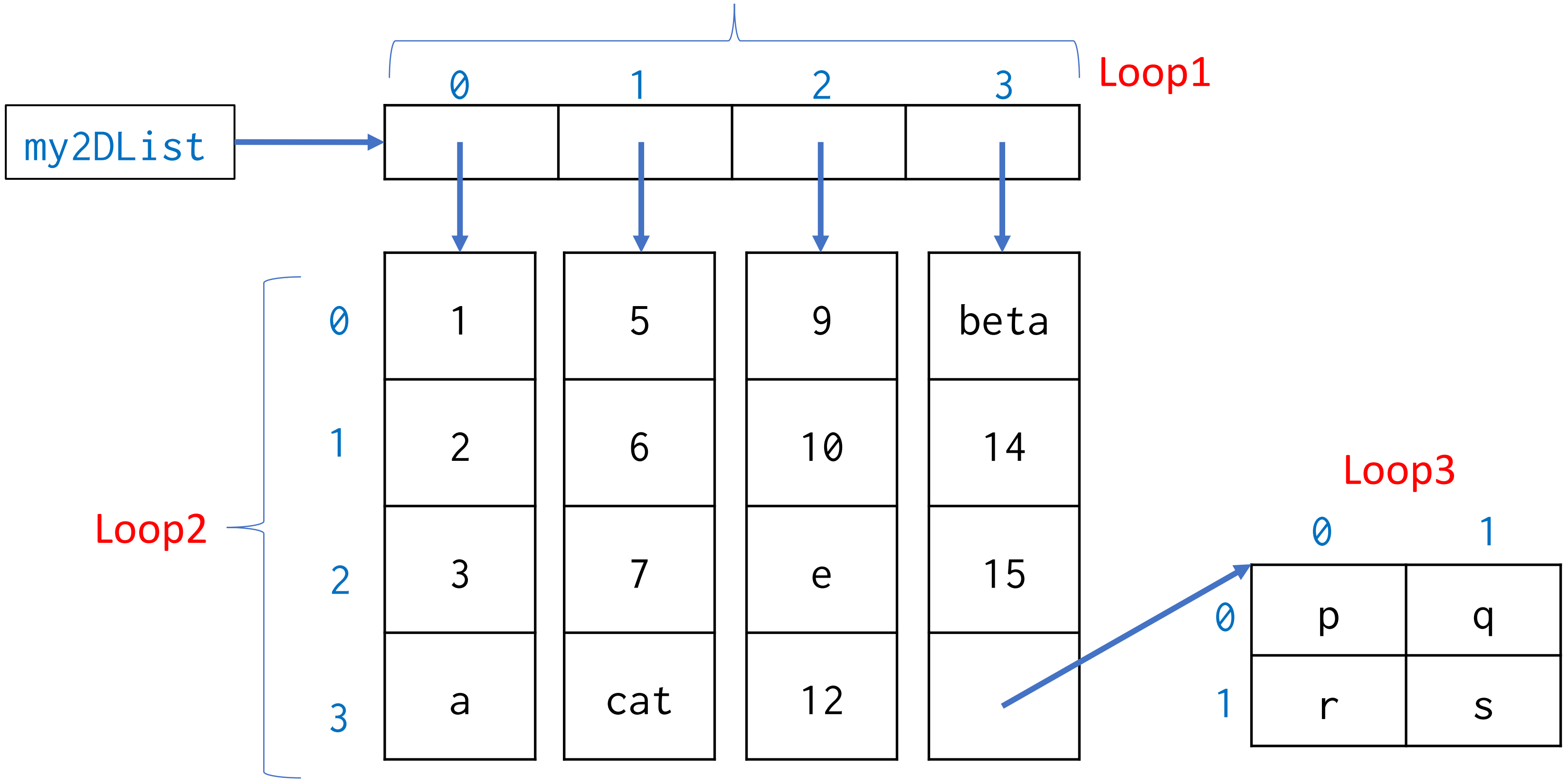
MultiDimensional Lists

```
my2DList = [[1,2,3,4],[5,6,7,8],[9,10,11,12],[13,14,15,16]]
for x in range(len(my2DList)):
        for y in range(len(my2DList[x])):
                print my2DList[x][y]
```



Arbitrary dimensional Lists

```
subL = [['p','q'],['r','s']]
my2DList = [[1,2,3,'a'],[5,6,7,'cat'],[9,10,'e',12],['beta',14,15,subL]]
```



Summary: Lists, Conditions and loops

- Lists : Best suited for ordered collections of items where the order or the items themselves may need to be changed.
- Lists are mutable, heterogenous and arbitrarily sized.
- Conditional statements with the proper comparison and boolean operators allow the creation of alternate execution paths in the code.
- Loops allow repeated execution of the same set of statements on all the objects within a sequence.
- Using an index based for loop is best suited for making changes to items within a list.
- Always ensure that your exit condition will be met.