Introduction to Programming with Python

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Note: modified from original LACC slides by Prof. Lucas Wanner, Prof. Mani Srivastava, Dr. Mark Gottscho, Dr. Bharathan Balaji

Welcome to LACC 2018 @ UCLA!

- Introductions
  - Name?
  - High school?
  - Favorite activity outside school?
  - Something interesting or different about you?
  - What excites you about computing or engineering?
- Before we get started…
  - Are you on **Piazza**?
  - Have you installed all the required software?
  - **PIAZZA:** slides, materials, forum, etc.

Los Angeles Computing Circle

- Originally started in 2011, held every summer except 2014
- Hosted by the UCLA Electrical Engineering department
- Objectives
    - Early exposure to STEM for high school students
    - Increase participation by under-represented groups in STEM
    - Strengthen bonds between UCLA and local communities in Los Angeles
    - Give students a taste of college-level education
    - Get students to think about their career goals and plan ahead

Instructors and TAs

- Instructors
  - Profs. Mani Srivastava, Puneet Gupta, and Lara Dolecek
  - Sandeep Singh (Ph.D. Student – Srivastava) – lead coordinator
  - Aishwarya Sivaraman (Ph.D. Student – Kim)
  - Wojciech Romaszkan (Ph.D. Student – Gupta)
  - Tianmu Li (Ph.D. Student – Gupta)
  - Hemant Saggar (Ph.D. Student – Prof. Pottie)
  - Zhengxu Xia (MS Student - Srivastava)
  - Bo-Jhang Ho (Ph.D. Candidate – Srivastava)
  - Siyi Yang (Ph.D. Student – Dolecek)
  - Eun Sun Lee (Ph.D. Student – Srivastava)
  - Fatima Anwar (Ph.D. Candidate – Srivastava)
- TAs
  - Tristan Melton
  - Lakshmi Rajesh

Logistics

- Summer course organized into eight “modules”
  - Each module covers a different topic with different graduate student instructor
  - Intended to introduce you to programming and engineering by focusing on real-world “applications” of technology
  - 2 days per topic, 2 topics per week
  - Each topic covered with 2-3 hour lecture and 1.5 days of in-class exercises & projects
- Exercises & projects
  - Each module will have short programming exercises during the lecture
  - During afternoon of module 2nd day, you will work on a mini-project
  - All exercise and project solutions due by 3:30PM on 2nd day of module (Tuesdays and Thursdays)
    - Projects will be demoed/presented but NOT graded

Topics

Spoiler Alert!!
(Not in order of teaching)

- Intro to Programming (Today)
- Algorithms
- Machine Learning
- Web APIs & Databases
- Mobile
- Social Networks
- 3D Printing
- Embedded Systems

Introduction

- What are the similarities and differences between a calculator and a computer?

© 2008 CNET Networks, Inc.

The ***fundamental*** difference between a computer and a calculators that computers are ***programmable!***

What does “**programmable**” mean?

A program is a “script” of operations stored in memory that tells a computer what to do.

Think of a program as a recipe for solving a problem. It’s a step-by-step procedure.

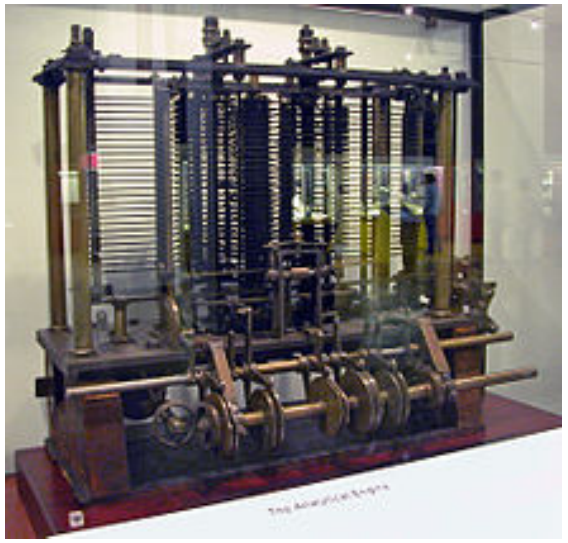
- A calculator can...
  - perform arithmetic operations
  - ~~perform logic operations~~
  - store values in memory
  - load values from memory

- A computer can...
  - perform arithmetic operations
  - perform logic operations
  - store values in memory
  - load values from memory

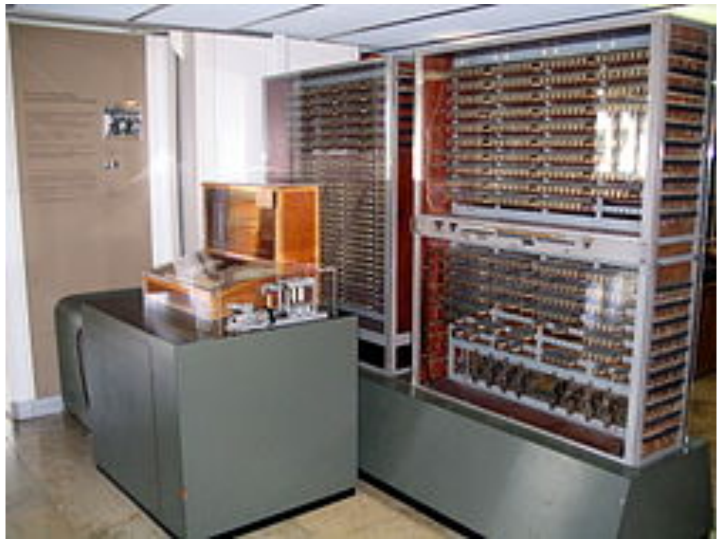
Unlike a calculator, a computer can make choices about what to do.
These are made using branches and loops in a procedure.
Essentially, decisions on what computation to do based on a condition.

A Bit of History:
Who invented the programmable computer?

- Charles Babbage originated the concept of and designed a mechanical programmable computer in 1837 called the “Analytical Engine”, but couldn’t finish it as the British Government ceased funding.
- The first programmable computers were not actually built until ~ 1940 using electromechanical relays (by German engineer Konrad Zuse)
- World's first electronic digital programmable computer (using vacuum tubes) was built by Eckert and Mauchly at U. Penn, but invention attributed to Atanasoff of Iowa State



Reconstruction of Babbage's Analytical Engine, the first general-purpose programmable computer.



Replica of Zuse's Z3, the first fully automatic, digital (electromechanical) general-purpose programmable computer.

ENIAC, the first electronic general-purpose computer

History: Alan Turing

- British mathematician and a father of computer science: helped crack German encryption in WW2 using the Enigma computing machine

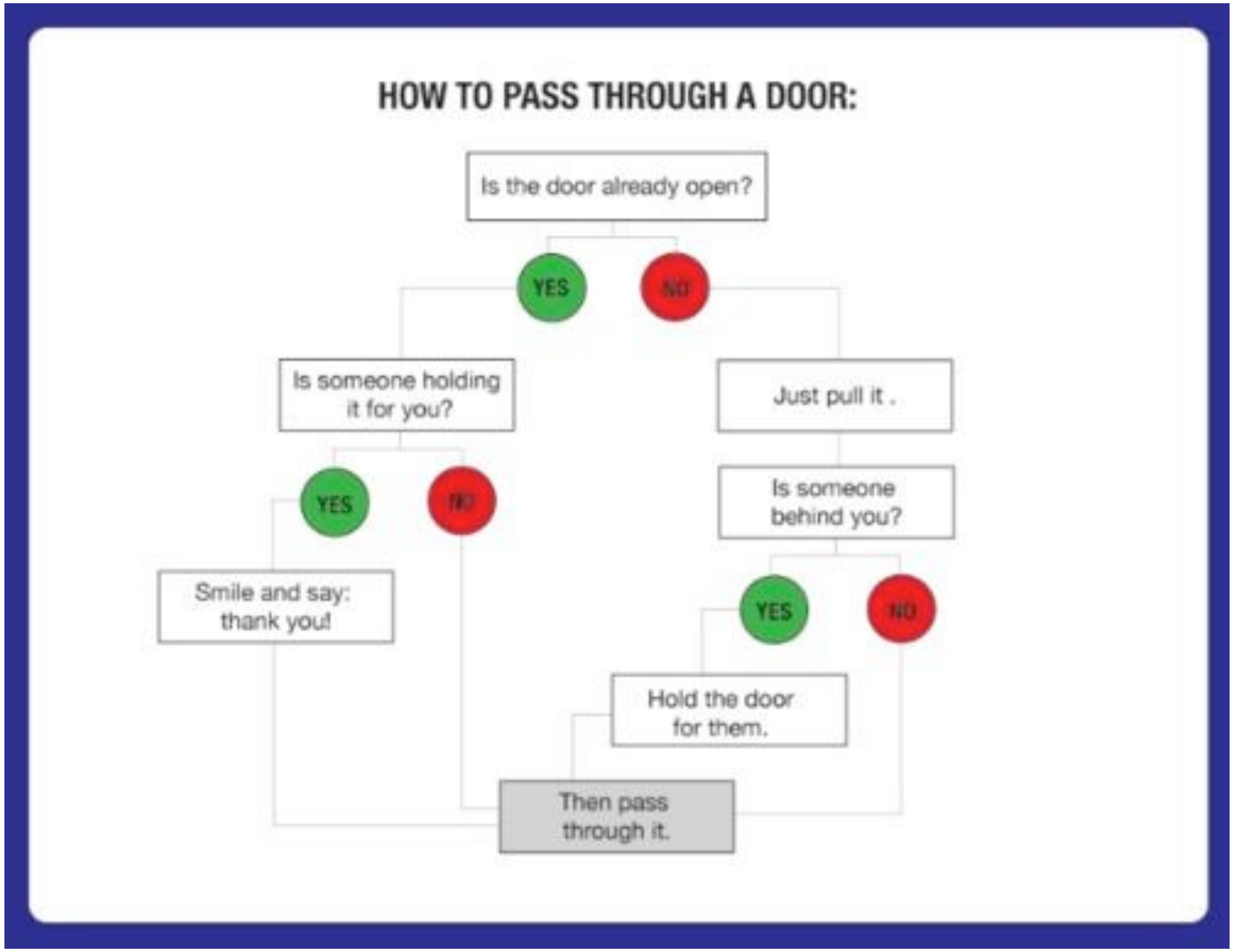
- Invented a hypothetical computing machine called the “Turing Machine” that helped formalize the theoretical limits of mechanical computation or algorithms, i.e. what sorts of things can be computed

- Universal Turing Machine == A Turing Machine that is able to simulate any other Turing Machine
  - Every real-world computer can be simulated by a UTM

- A real world computer or a programming language is called “Turing Complete” if it can simulate a UTM, or equivalently compute anything that can be computed

Conditional Branches

"A decision on which path to take based on some condition"


HOW TO PASS THROUGH A DOOR:
Is the door already open?
YES
NO
Is someone holding it for you?
Just pull it .
YES
NO
Is someone behind you?
Smile and say: thank you!
YES
NO
Hold the door for them.
Then pass through it.

How can we express a program?

Using real machine code (binary)?
1: “on”   0: “off”

```
… 10101001000000101011111 0010101 00011 10100101001 0100 100100100 0000000000 …
```

How do we humans do anything with this? Surely a better way…

How about machine language (**assembly code**) instead?

Code comments — human-readable explanations that don’t do anything in the program

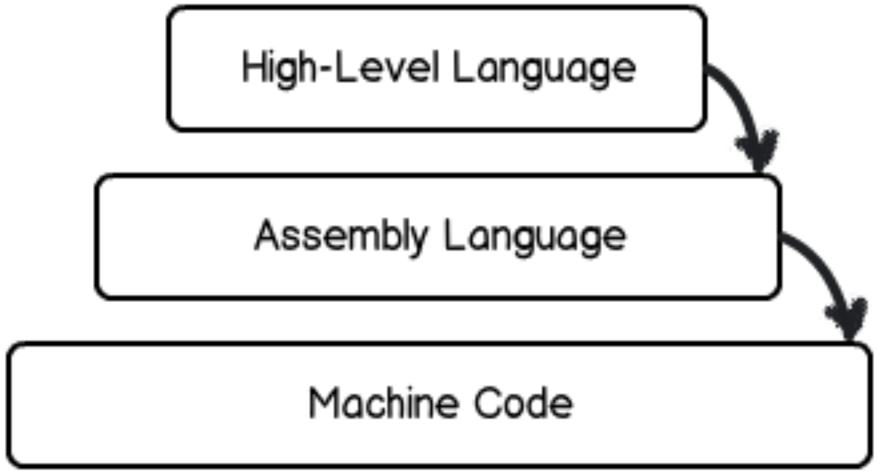
```
pass_door:
    ld register_1, door_status
    ld register_2, door_open
    beq register_1, register_2, holding
    call pull_door

holding:
    ...

pull_door:
    ...
```

```
# load contents from memory into register

# if register 1 and 2 are
  equal, go to (branch to) label
  “holding”
```

Can we do better still?

- We actually code in high-level, human-readable **programming languages**
  - Allow us to express programs in a way that is closer to natural languages
  - Provide libraries of commonly-used sub-tasks (functions)
  - **Translate high level code into machine code** through compilers or interpreters

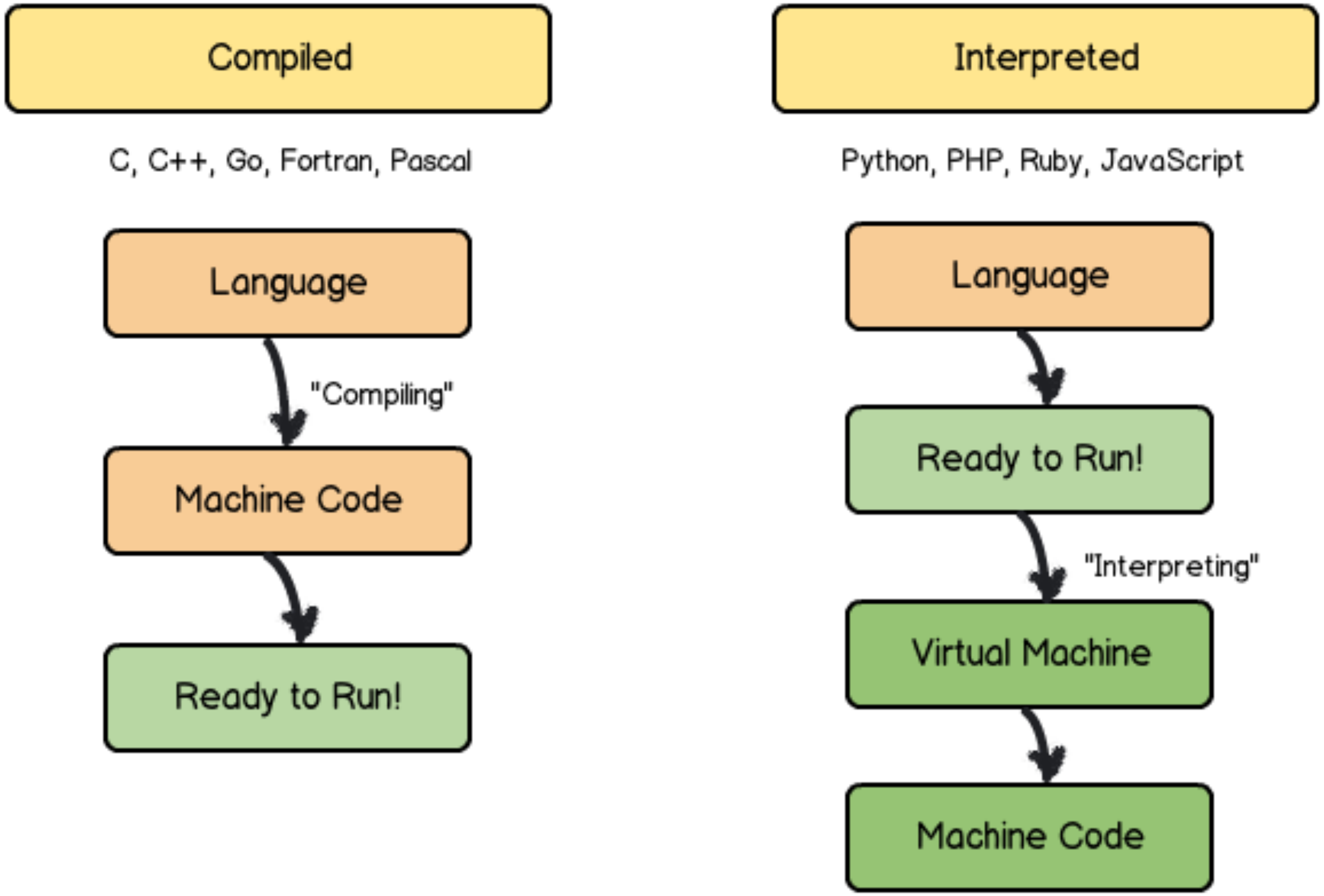
- Given a language providing…
  - function definitions and calls, f(x)
  - a library function, print("text")
  - comparisons, x == y
  - assignments, x = y
  - conditional statements, if (condition) ... else …



Ref: http://shawnbiddle.com/js101/slides/class1.html#/6

- …how can we write the "pass door" program?

Compiled vs. Interpreted Programs



Compiled

C, C++, Go, Fortran, Pascal

Language

"Compiling"

Machine Code

Ready to Run!

Interpreted

Python, PHP, Ruby, JavaScript

Language

Ready to Run!

"Interpreting"

Virtual Machine

Machine Code

Ref: http://shawnbiddle.com/js101/slides/class1.html#/10

Part of the “Pass door” program in “Pseudocode”

```
function pass_door()
   if (door_status == door_open)
      if (hold_status == someone_holding)
         print(“Thank you”)
      else
         pull_door()


function pull_door()
   door_status = door_open
   ...
```

```
# function definition
# conditional statements,
  comparisons
# call library function

# call function




# assignment of value to variable
```

Programming in Python

- **Why can't we program in English?**
- Why do we need so many programming languages?
- Why Python?

Why do we choose Python?

- **Python has simple syntax.**
  -- English has straightforward grammar.

- **Python comes with a great set of tools.**
  -- English has abbreviations and idioms.

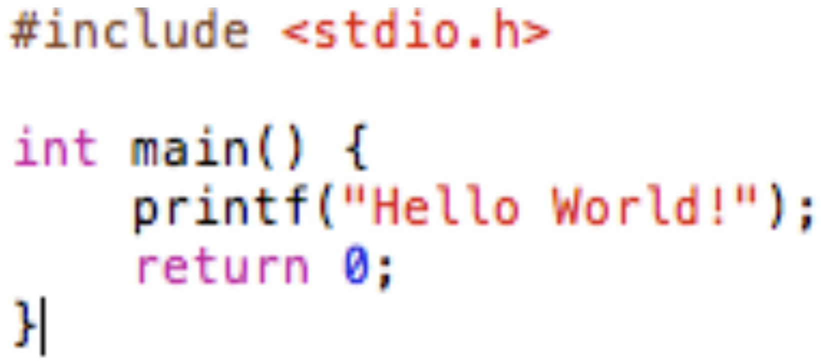
- **Python programs can be run on Linux, MAC, etc.**
  -- English is spoken by people from the whole wide world.

- **Python is relatively easy to debug.**
  -- English mistakes are easy to be found.

How simple is Python?

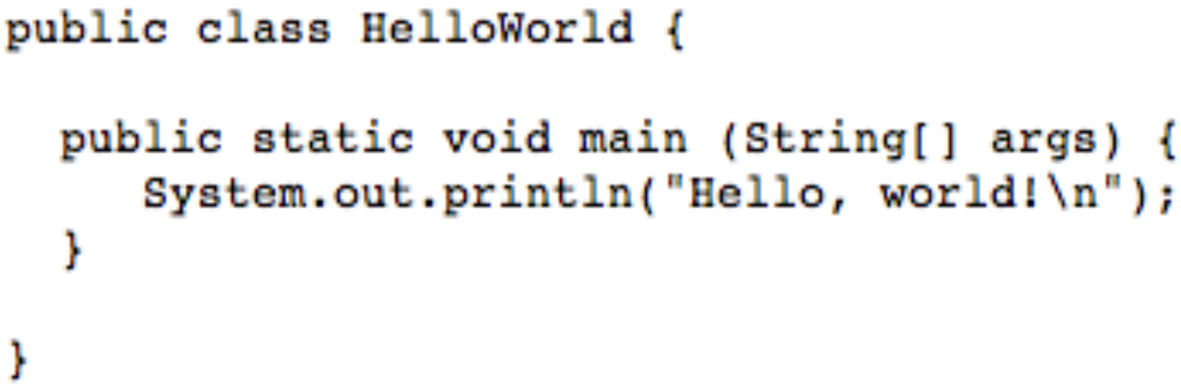
- To print “Hello world!” on screen, C, Java and Python need to do:

- **C:**



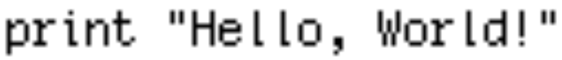
```
#include <stdio.h>

int main() {
    printf("Hello World!");
    return 0;
}
```

- **Java:**



```
public class HelloWorld {

  public static void main (String[] args) {
     System.out.println("Hello, world!\n");
  }

}
```

- **Python:**



```
print "Hello, World!"
```

Find Python around you

- Python is used everywhere!
  - **Web applications (server side):**
    - YouTube
    - Facebook
    - Dropbox (original)
    - Pinterest
    - MoinMoin, a popular wiki engine

Find Python around you

- Python is used everywhere!
  - **Applications (client side):**
    - Original BitTorrent client, along with several derivatives
    - Ubuntu Software Center, a graphical package manager
    - Dropbox (desktop application)
    - Mercurial

Find Python around you

- Python is used everywhere!
  - **Web frameworks:**
    - Google App Engine
    - Django

Find Python around you

- Python is used everywhere!
  - **Video games:**
    - Civilization IV
    - Battlefield 2

Getting Python

- **Python Official Website: http://www.python.org**
- Lots of "packages" that add capabilities to the basic language and "tools" that make writing, running, and debugging easier
- Free and commercial "distributions" that bundle core Python with useful packages and tools and simplify installation, e.g.
  - **Anaconda: https://store.continuum.io/cshop/anaconda/**
  - Enthought Canopy: https://www.enthought.com/products/canopy/
- Browser-based Python (limited functionality)
  - http://www.tutorialspoint.com/ipython_terminal_online.php
  - http://www.tutorialspoint.com/execute_python_online.php
  - http://repl.it/languages/Python
  - http://pythonfiddle.com

Free Python Learning Material on the Web

- Official Tutorial: https://docs.python.org/2/tutorial/
- TutorialsPoint: http://www.tutorialspoint.com/python/index.htm
- Google: https://developers.google.com/edu/python/
- LearnPython: http://www.learnpython.org
- Code Academy: http://www.codecademy.com/en/tracks/python

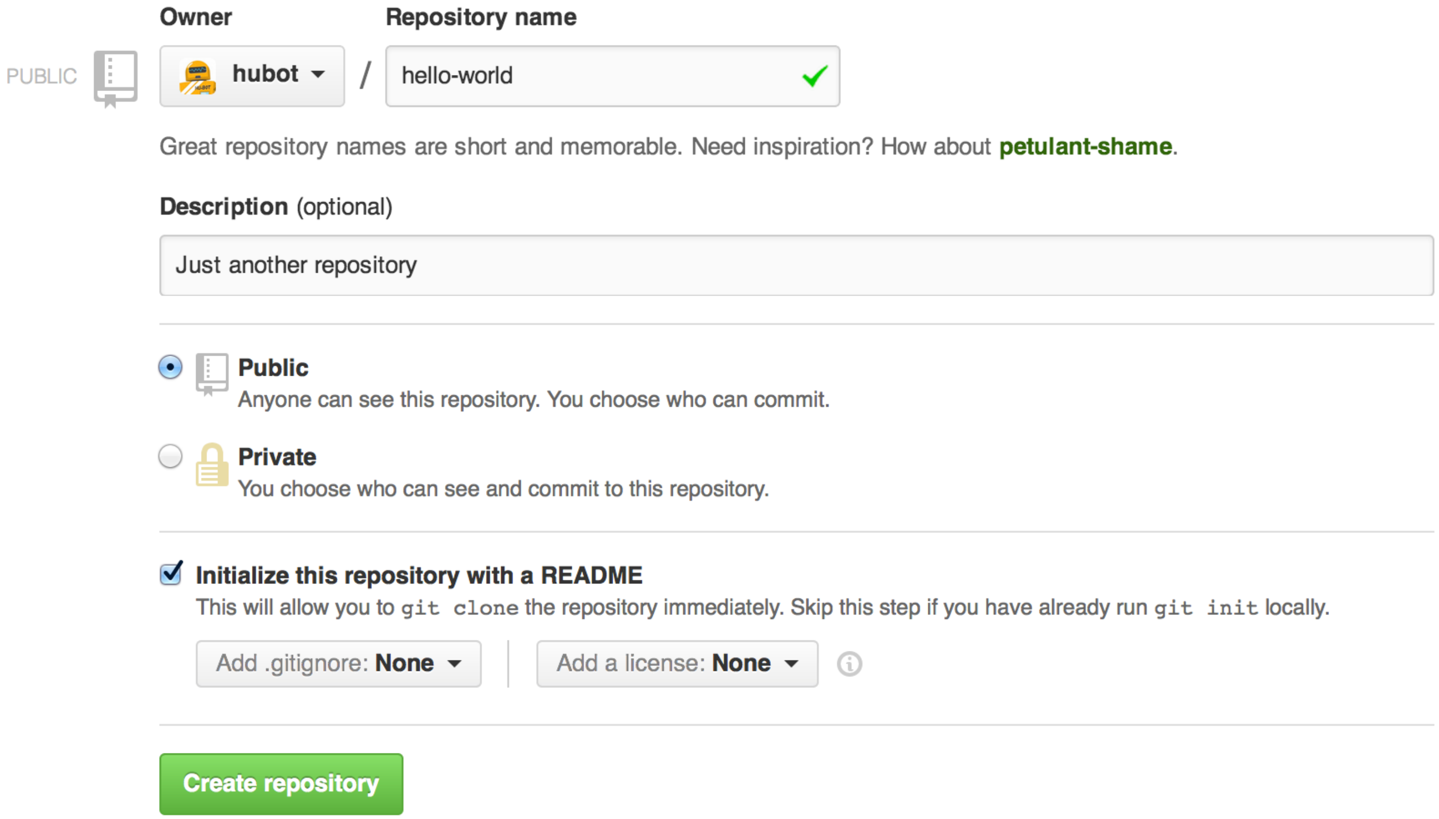
- And many many more…

What is GitHub?

- A code hosting platform for version control and collaboration
  - Similar to Dropbox
- It lets you work together on projects with others and from anywhere

Creating a Repository

- Go to ***github.com*** and sign in to your accounts.
- In the upper right corner, next to your avatar or identicon, click and then select ***New repository***.
- Name your repository hello-world.
- Write a short description.
- Select ***Initialize this repository with a README***.



PUBLIC

Owner hubot / **Repository name** hello-world ✓

Great repository names are short and memorable. Need inspiration? How about **petulant-shame**.

Description (optional)

Just another repository

● **Public**
Anyone can see this repository. You choose who can commit.

○ **Private**
You choose who can see and commit to this repository.

☑ **Initialize this repository with a README**
This will allow you to `git clone` the repository immediately. Skip this step if you have already run `git init` locally.

Branch

- Have you ever saved different versions of a file? Something like:
  - Submission.txt
  - Submission-v2.txt
  - Submission-final.txt

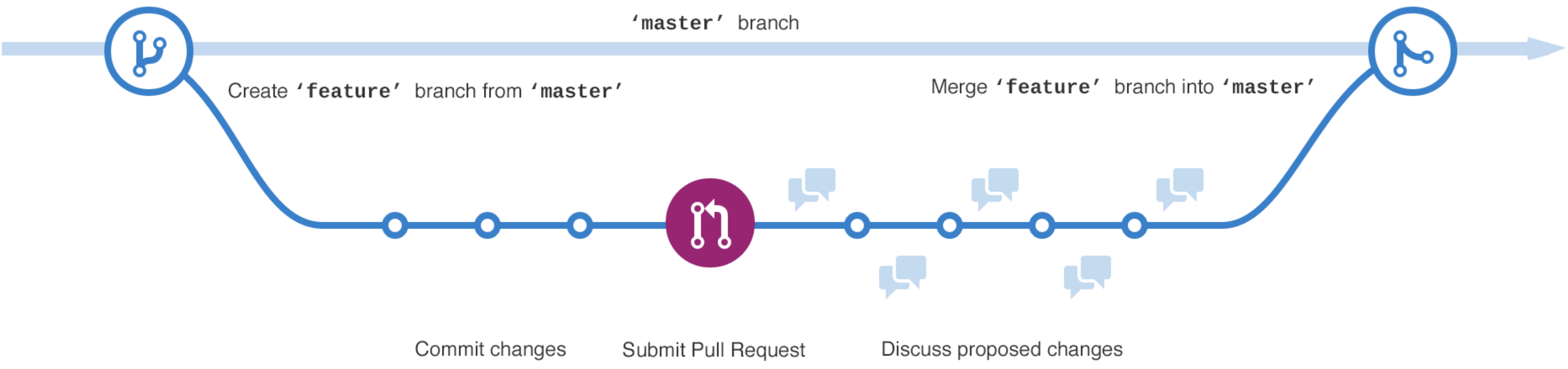
- Branches accomplish similar goals in GitHub repositories.

- ***Branching*** is the way to work on different versions of a repository at one time.

Branch

- By default your repository has one branch named *master*. We create new branches in the repository to experiment before committing (saving) them to *master*.

- When creating a branch off the master, we are making a copy of master.


'master' branch
Create 'feature' branch from 'master'
Merge 'feature' branch into 'master'
Commit changes
Submit Pull Request
Discuss proposed changes

Creating a new branch

- Go to your new repository hello-world.
- Click the drop down at the top of the file list that says ***branch: master***.
- Type a branch name, readme-edits, into the new branch text box.
- Select the blue ***Create branch*** box or hit “Enter” on your keyboard.

Cloning

- ***Cloning*** is copying the created repository from Github to your local machine.

- Run the following command on your terminal
  - ***git clone <url>***

- By default when you clone, it is in master branch. To make changes in the created new branch, type the following command
  - ***git branch readme-edits***

- Now go to the folder where you cloned and you should see a readme file. Open it and add some text “Hello World, My first readme!”

Making changes and saving them

- To save the changes made locally, we need to ***commit.*** Each commit has an associated message, which describes why a change was made.

- We edited readme file in the previous step. To see what files are changed, type the following command:
  - ***git status***

- We need to add the file we want to ***commit***(save).
  - ***git add readme***

- Now, we are ready to push our changes to the online repository.
  - ***git push***

Jupyter Notebooks

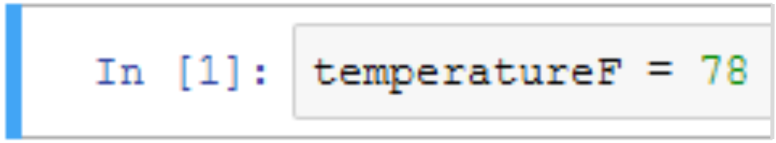
- **Jupyter Notebook App** is an application running inside the browser. It allows you to edit and run code via a web browser.
- It is a document that contains code (e.g. python) and text elements.
- For this course, we will be using Jupyter notebooks with Azure.
- To install it locally follow - http://jupyter.org/install (this is optional).

Python Basics: Variables, Types & Operators

- **What is a Variable?**
  A variable is a place in memory, which has a name, and where you can store a value (a number, phrase, etc.).

- **Assigning Values to Variables:**
  - Python variables are declared automatically when you assign a value to a variable.
  - The equal sign (=) is used to assign values to variables.

- **Values may be of different "types"**



```
In [1]: temperatureF = 78
```

- **Operations over Variables and Values**

Python Operators

🕮 **What is an operator?**

- Python operators are very similar to the mathematical operators we use everyday. For example, +, -, *…

Python Basic Operators

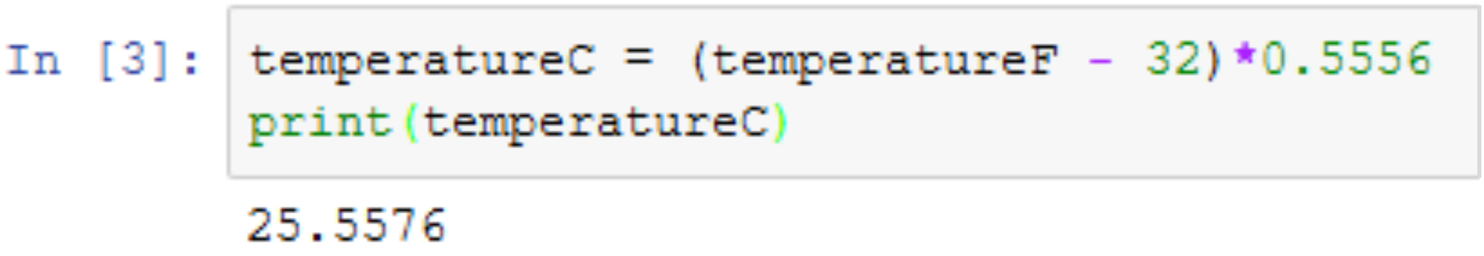
📖**Python Operator Types:**

- 🌍 Arithmetic Operator
- 🌍 Comparison Operators
- 🌍 Logical (or Relational) Operators
- 🌍 Assignment Operator

Python Arithmetic Operators

Assume variable **a** holds 10 and variable **b** holds 20 then:

Addition	a **+** b = 30
Subtraction	b **–** a = 10
Multiplication	a ***** b = 200
Division	b **/** a = 2
Reminder	b **%** a = 0
Exponent	a ****** b = 10^{20}

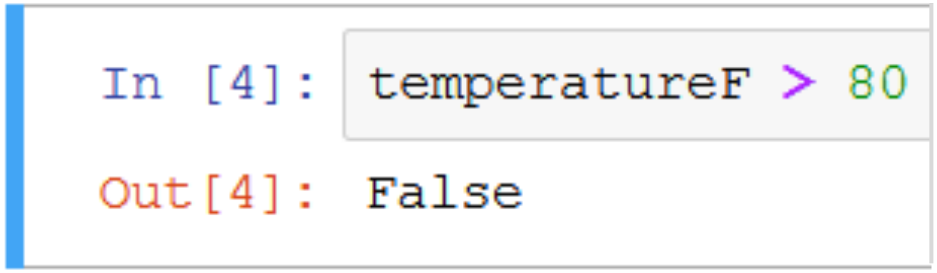


```
In [3]: temperatureC = (temperatureF - 32)*0.5556
        print(temperatureC)

        25.5576
```

Python Comparison Operators

Assume variable **a** holds 10 and variable **b** holds 20 then:

Equality	a == b = False
Inequality	a != b = True
Less than	a < b = True
Greater than	a > b = False
Less than or equal	a **<=** b = True
Greater than or equal	a **>=** b = False

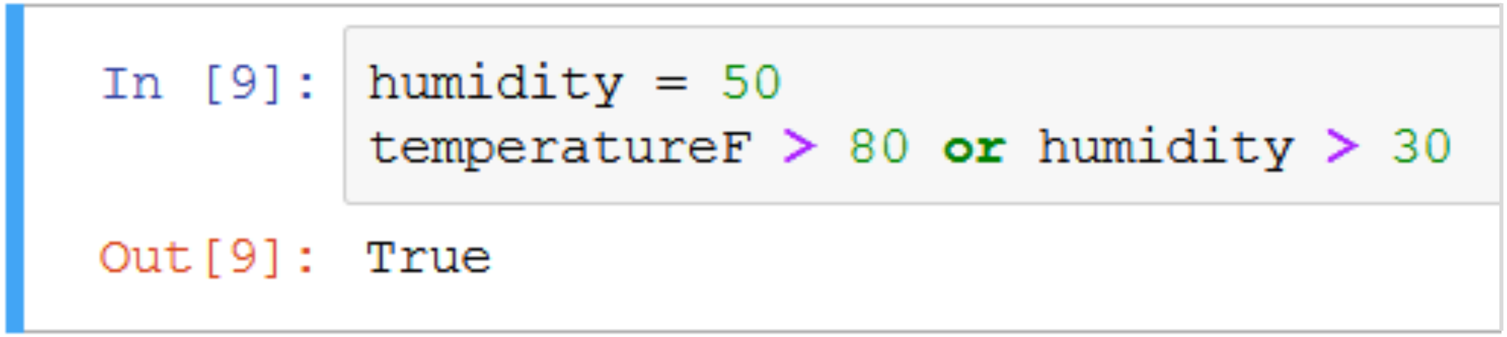


```
In [4]: temperatureF > 80

Out[4]: False
```

Python Logical Operators

Assume variable **a** holds True and variable **b** holds False then:

Logical AND	a **and** b = False
Logical OR	a **or** b = True
Logical NOT	**not** a = False



```
In [9]: humidity = 50
        temperatureF > 80 or humidity > 30

Out[9]: True
```

Python Data Types

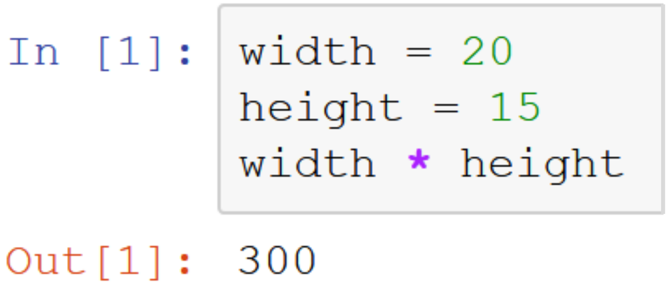
- In computer programming, a data type is a classification identifying one of various types of data, just like in real life we separate words “Hello!” and numbers “12345”.

- **Standard Data Types in Python:**
  - **Numbers**, e.g., 1000
  - **String**, e.g., “Hello world!”
  - **Boolean** e.g. True
  - **List**, a container e.g., [365, 12, 30]
  - **Dictionary**, a key-indexed container.

Python Types: Numbers

Numbers

- Store numeric values,
- Example:

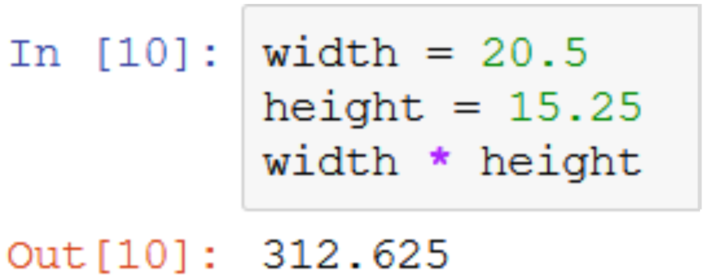


```
In [1]: width = 20
        height = 15
        width * height

Out[1]: 300
```

- In this example, “width = 20” defines variable width to be 20, and “height = 15” defines height to be 15.

- After initializing width and height, we can calculate width * height as shown in the example.

- To use real numbers, add a dot:



```
In [10]: width = 20.5
         height = 15.25
         width * height

Out[10]: 312.625
```

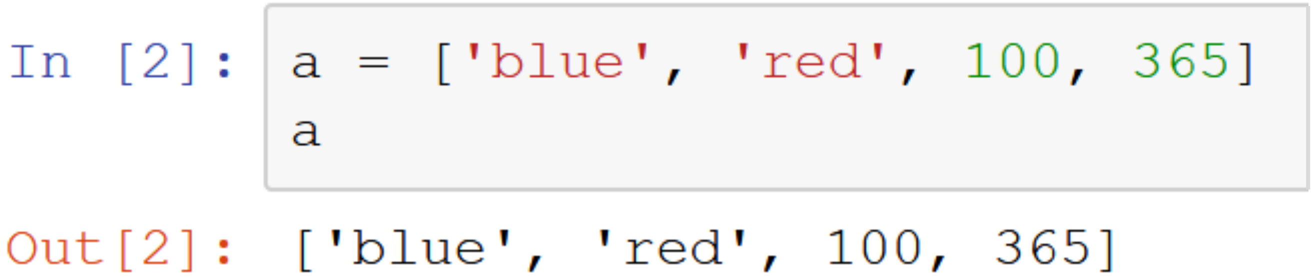
Warm-up

- Start up the Jupyter notebook
- Do the “Warm-up” part (instructions included)
- Feel free to ask questions

Python Types: Lists

Lists:

- Lists are the most versatile of Python’s compound data types. A list contains items separated by commas and enclosed within square brackets.
- Example:



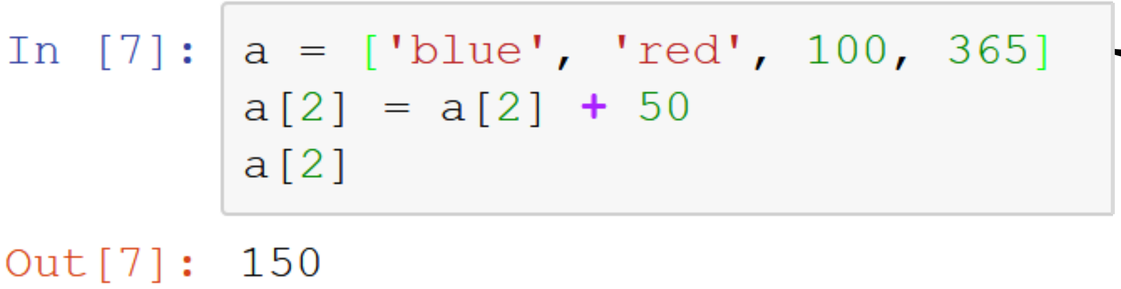
```
In [2]:  a = ['blue', 'red', 100, 365]
         a

Out[2]:  ['blue', 'red', 100, 365]
```

- In this example, we assign four items to list a. The items are string ‘blue’, string ‘red’, number 100, and number 365.
- We print a’s items in the second command, and get its four items printed.
- Note that items in the list have different types (string and int) – this is not common among programming languages.

Python Types: Lists

Lists:

- It is possible to change individual elements of a list.
- Example:



```
In [7]: a = ['blue', 'red', 100, 365]
        a[2] = a[2] + 50
        a[2]

Out[7]: 150
```

Note that list's subscript starts from 0

- In this example we modify the **third** element in the list by adding 50 to its value
- We then print the third element by using *name*[*index*]

Python Types: Lists

Lists:

- Many “operations” and “methods” available for lists:

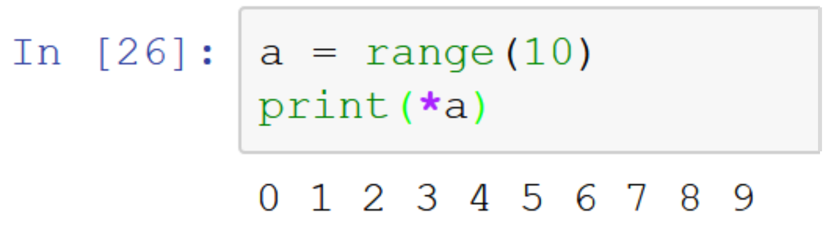
Is the value in the list?	100 in a = True
Is the value not in the list?	‘yellow’ not in a = True
Length of the list	len(a) = 4
Index of an element	a.index(‘red’) = 1
Append element	a.append(10)
Reverse the list	a.reverse()

+ sort, concatenate, insert, sum and many more at: https://docs.python.org/2/tutorial/datastructures.html#more-on-lists

Python Types: Range

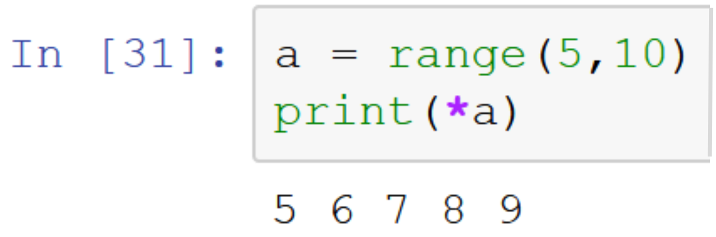
Creating number sequences:

- **range(n)** for integer n > 0 returns the list [0, 1, … n-1]



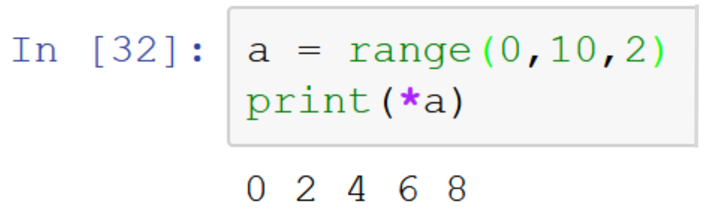
```
In [26]: a = range(10)
         print(*a)

         0 1 2 3 4 5 6 7 8 9
```

- **range(m,n)** returns the list [m, m+1, … n-1]



```
In [31]: a = range(5,10)
         print(*a)

         5 6 7 8 9
```

- **range(m,n,o)** returns the list [m, m+o, … n-1]



```
In [32]: a = range(0,10,2)
         print(*a)

         0 2 4 6 8
```

Exercise # 1

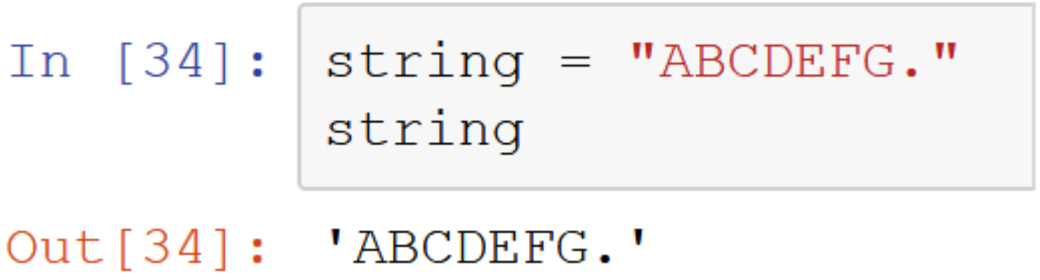
- Go to Exercise 1 section in your Jupyter Notebook
- Given a list L = [2, 3, 4, 5, 6]
  - Print the second item in this list.
  - Get the sum of all the values in this list.
  - Append value 7 after value 6 into the list.

  - Look at https://docs.python.org/2/tutorial/datastructures.html#more-on-lists for various methods available for list data type

Python Types: Strings

Strings:

- Strings in Python are identified as a contiguous set of characters in between quotation marks.
- Example:



```
In [34]: string = "ABCDEFG."
         string

Out[34]: 'ABCDEFG.'
```

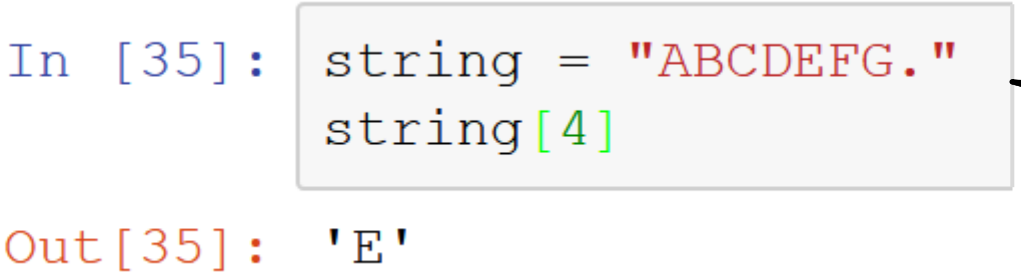
- In this example, we assign “ABCDEFG.” to variable string. And we print string.
- The result we get is still “ABCDEFG.”
- You can use double “ or single ‘ quotation marks for strings in Python, they are equivalent.

Python Types: Strings

Strings:

- ○ Strings can be subscripted (indexed). This is because they are essentially lists of characters.

- ○ Example: In the string defined as str = “ABCDEFG.”, we query the **fifth** letter in this string.



```
In [35]: string = "ABCDEFG."
         string[4]

Out[35]: 'E'
```

Because it’s a list, first letter has index 0

Python Types: Strings

Strings:

- Many “operations” and “methods” available for strings:

Is the letter in the string?	‘A’ in string = True
Is the substring in the string?	‘CDE’ in string = True
Length of the string	len(string) = 8
Index of a letter (first)	string.index(‘A’) = 0
Append element	string + “Z” = “ABCDEFG.Z”
Make lowercase	string.lower() = “abcdefg.”

and many more at
https://docs.python.org/2/library/stdtypes.html#string-methods

Exercise # 2

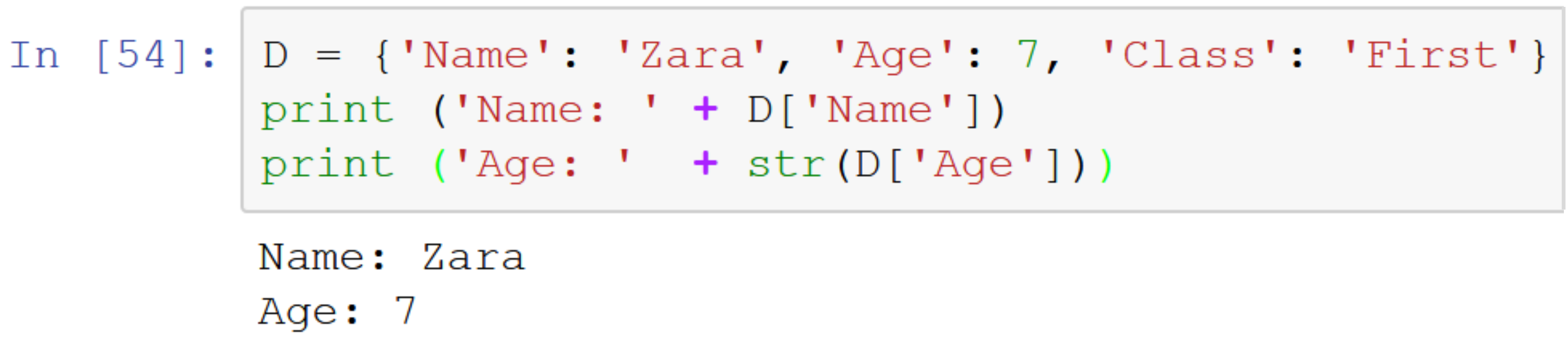
- Go to Exercise 2 section in your Jupyter Notebook
- Given a string S: “This is an example string”
    - Print the fifth letter in the string.
    - Capitalize all letters.
    - Replace spaces with hyphens (a bit more advance).
    - Look at https://docs.python.org/2/library/stdtypes.html#string-methods for various methods available for list data type

Python Types: Dictionaries

Dictionaries:

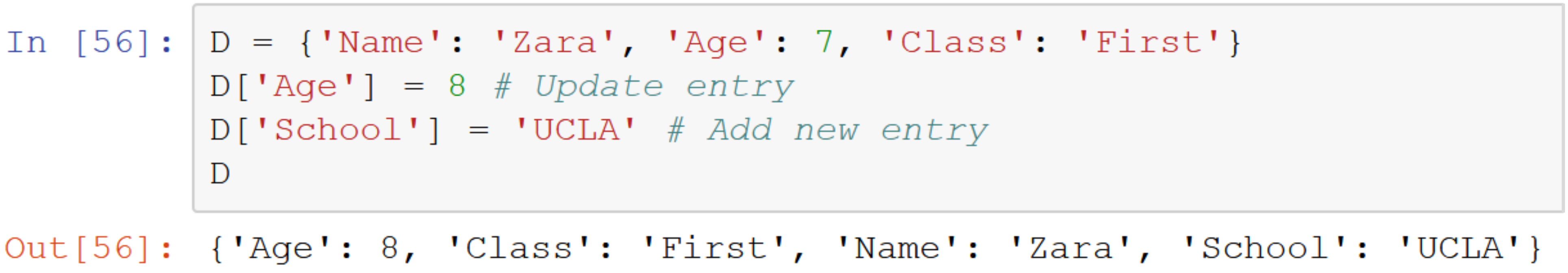
- Represents a set of key-value pairs where keys are unique (i.e. numbers, strings) but values need not be. It’s not ordered.

- Example:



```
In [54]: D = {'Name': 'Zara', 'Age': 7, 'Class': 'First'}
         print ('Name: ' + D['Name'])
         print ('Age: '  + str(D['Age']))

         Name: Zara
         Age: 7
```

- Updating a dictionary



```
In [56]: D = {'Name': 'Zara', 'Age': 7, 'Class': 'First'}
         D['Age'] = 8 # Update entry
         D['School'] = 'UCLA' # Add new entry
         D

Out[56]: {'Age': 8, 'Class': 'First', 'Name': 'Zara', 'School': 'UCLA'}
```

Exercise # 3

- Go to Exercise 3 section in your Jupyter Notebook
- Given two dictionaries, D and E, do the following:

  - Add John's and Tom's surnames with "Surname" as a key.
  - Change John's city to NY.
  - Create a list F with both dictionaries as it's elements.
  - Print out the age of the first person on the list F.

  - Look at https://www.programiz.com/python-programming/methods/dictionary for various methods available for dictionary data type

Python Basics: Functions

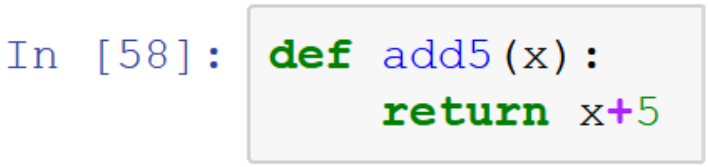
- **Defining and Calling Functions:**
  - A **function** is a block of organized, *reusable* code that is used to perform a single, related action.
  - Functions provides better *abstraction* and *modularity* for your application and a high degree of code reusing
    - Makes your code simpler and easier to read!
  - Calling a function: Once the basic structure is finalized, you can execute it by calling it from another function or directly from the Python prompt.

Defining Functions

- By defining a function, we can put a routine into this function, and we will be able to execute this routine simply by calling this function.

- For example, we introduce a function “add5”, which add t onto the integer we passed into the function.

- Example:

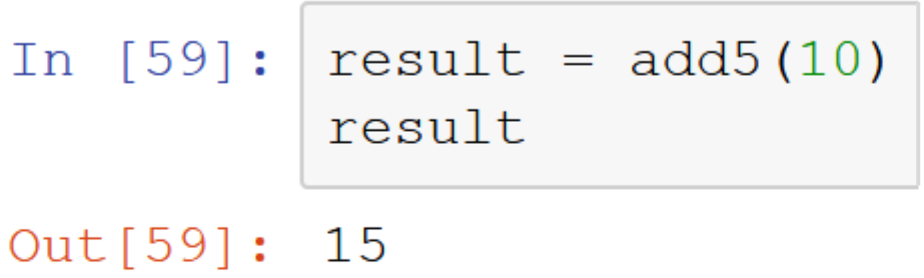


```
In [58]: def add5(x):
             return x+5
```

- In this function, x is the integer we passed into the function. And the function will return the value of x+5 back.

Calling the Function

- To call the function add5 we just defined, we simply do:



```
In [59]: result = add5(10)
         result

Out[59]: 15
```

- By passing number 10 into the add5 function, 5 is added.
- The result then equals to 15.

❖PYTHON PROGRAMMING CAN BE YOUR CALCULATOR!

Exercise # 4

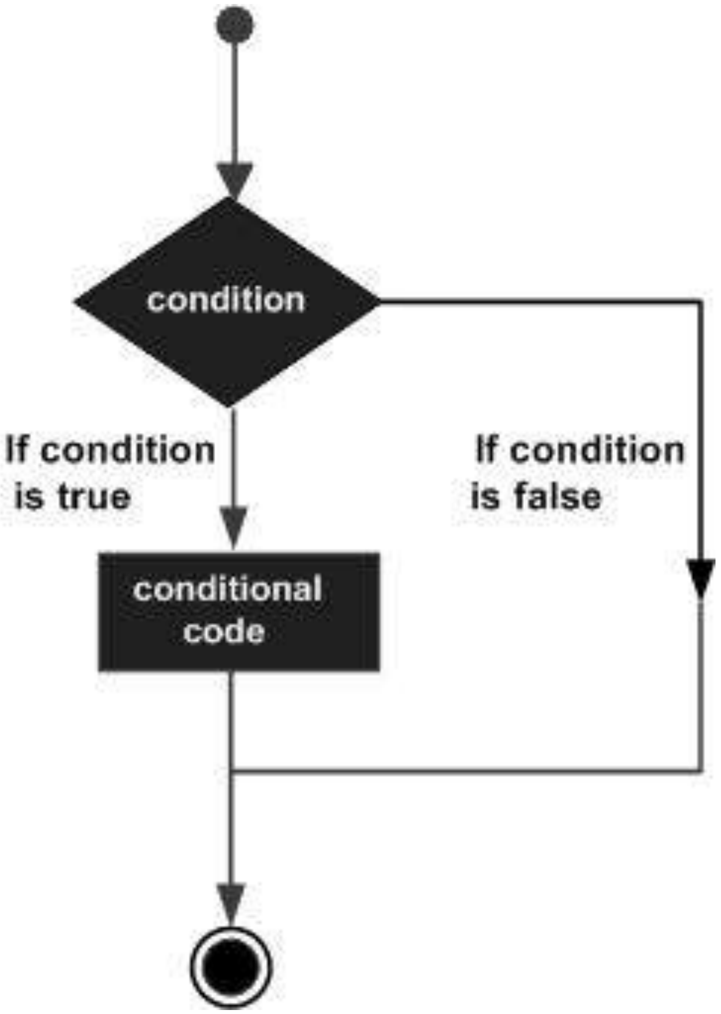
Write a function that does the following things:

- The function takes a number x into the function.
- In the function, deduct 10 from x.
- If the result of the deduction is greater than equal to 0, the function returns 1.
- If the result of the deduction is less than 0, the function return 0.

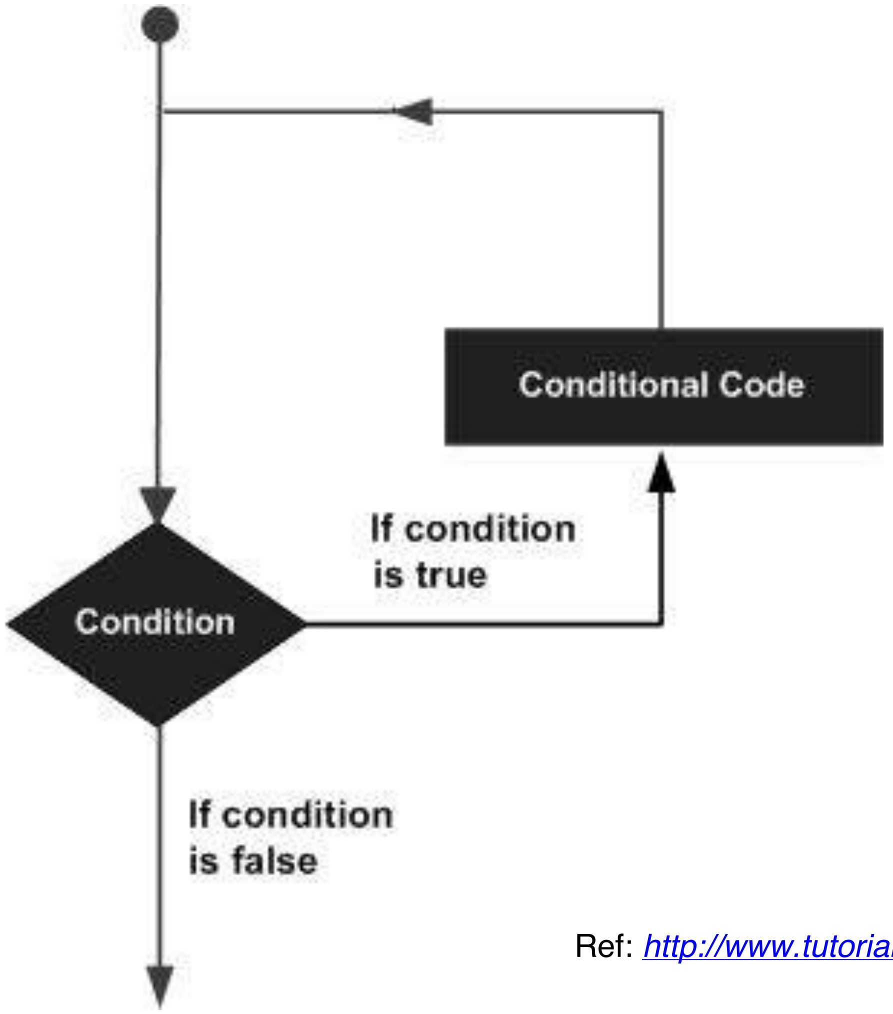
Beyond Sequential Execution: Control Flow Tools

- Programming languages provide various control structures that allow for more complicated execution paths instead of just sequential
  - *Make decisions* on what to do *dynamically* while the program runs!

If…then



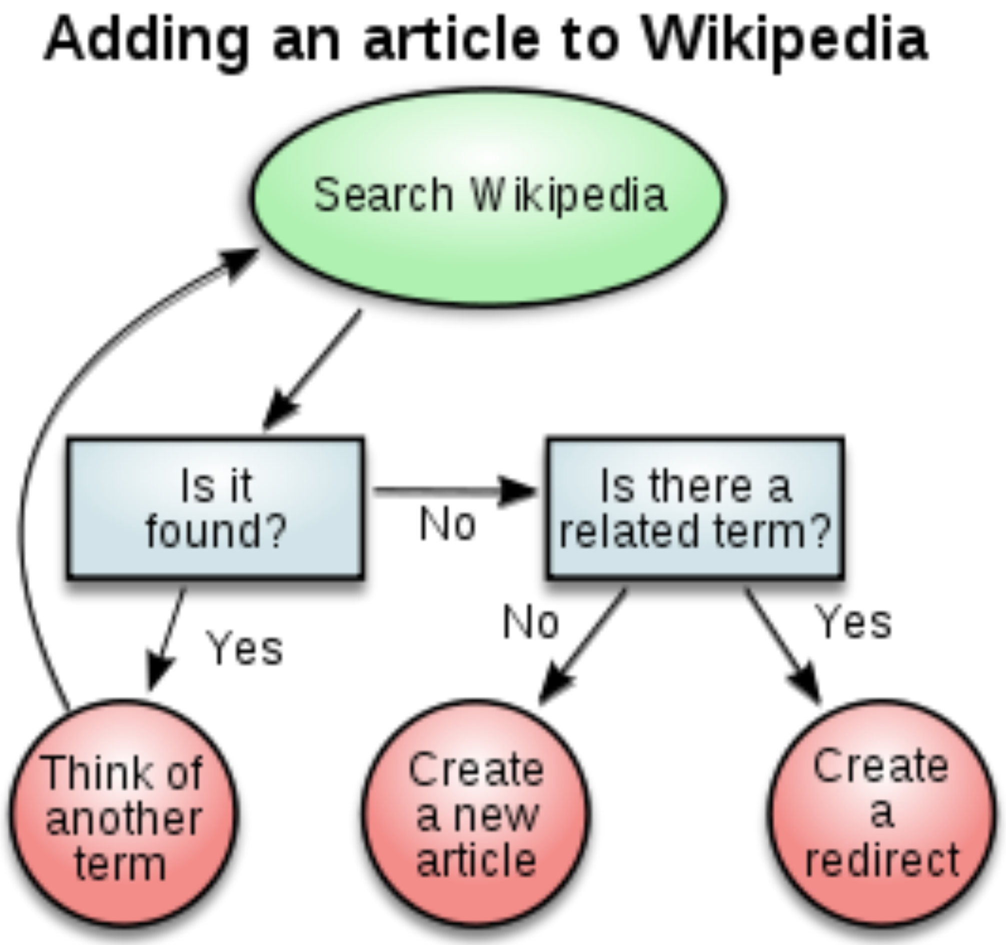
Loop



Ref: http://www.tutorialspoint.com/

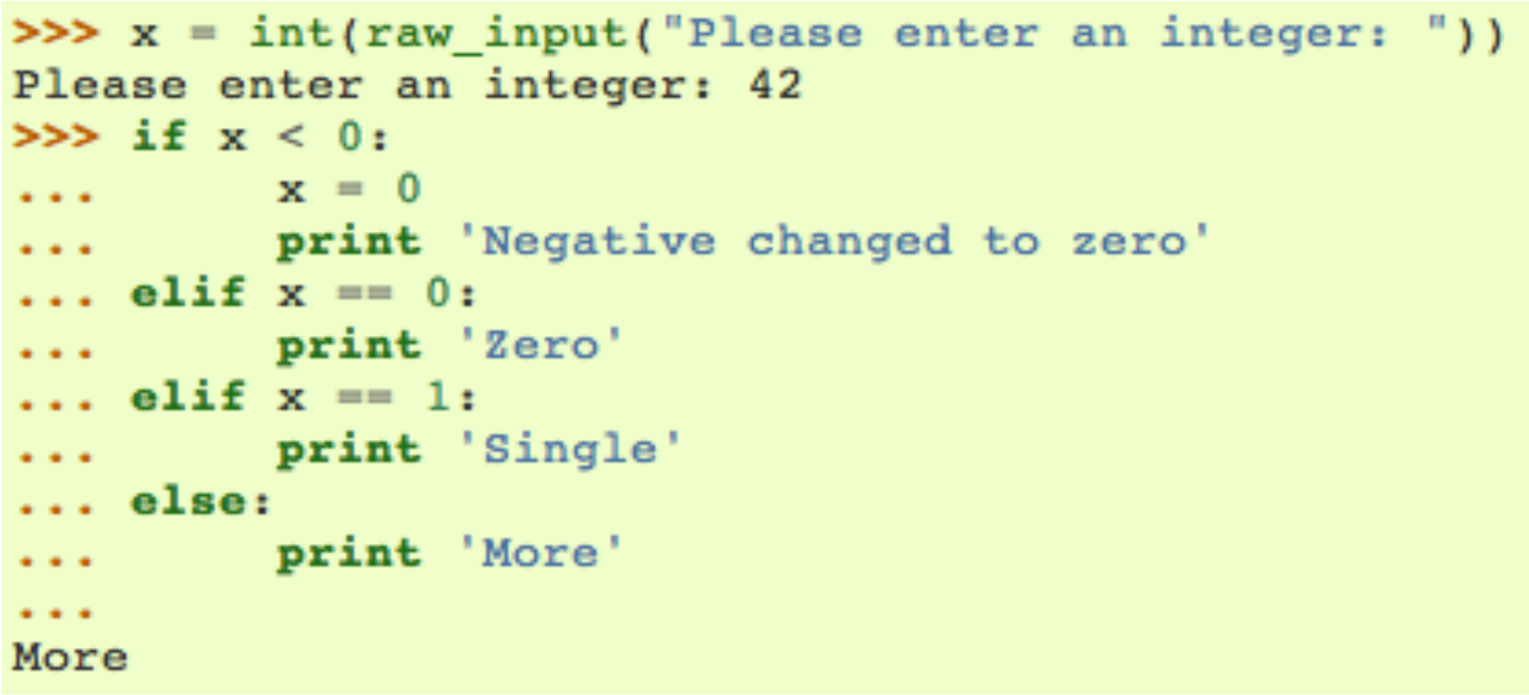
Python Basics: Decision Making

- **Decision Making:**
  - Conditional constructs are used to incorporate *decision making* into programs.
  - The result of this decision making determines the sequence in which a program will execute **instructions**.



Python Basics: Decision Making

- *if* **Statement**
  - The **if** statement contains a logical expression using which data is compared, and a decision is made based on the result of the comparison.
  - Example:

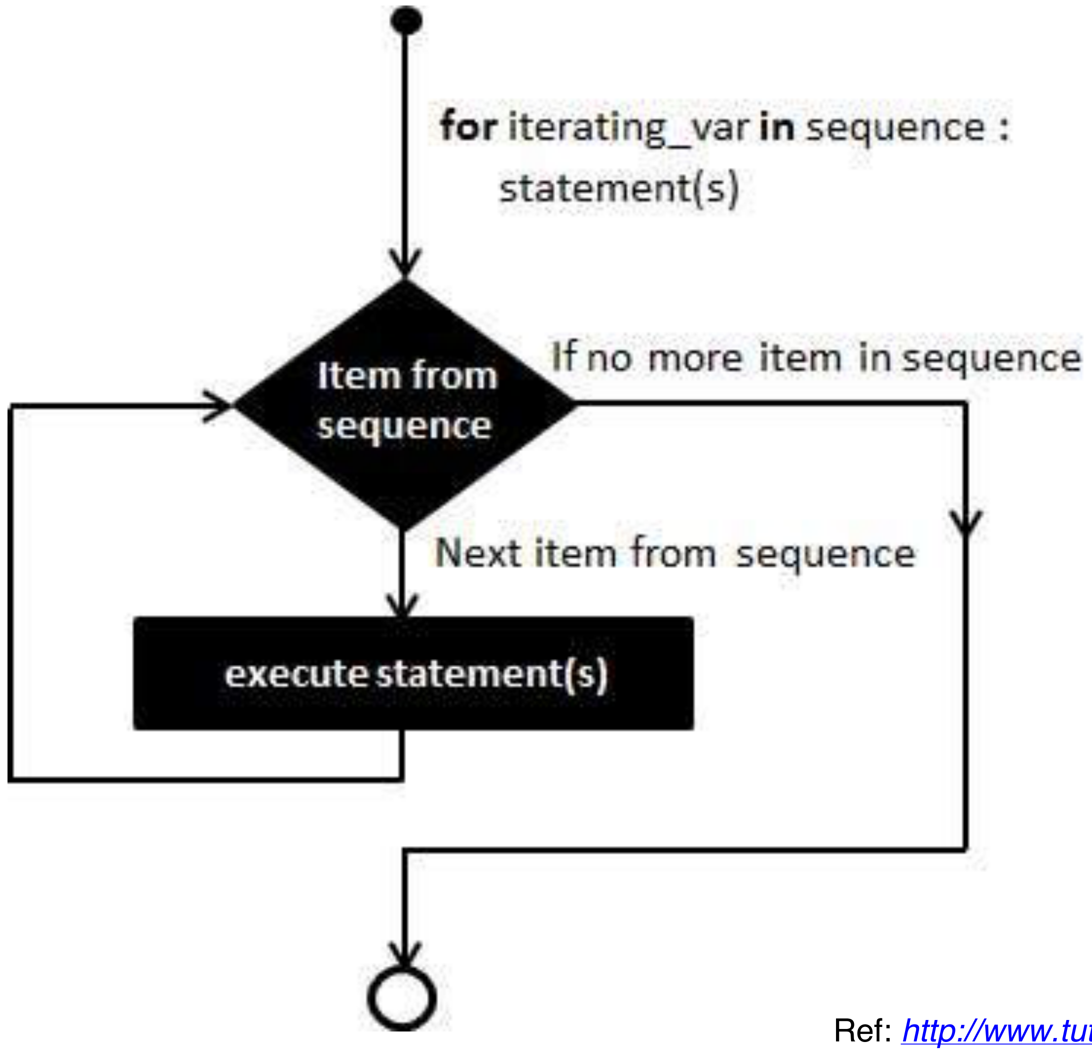


```
>>> x = int(raw_input("Please enter an integer: "))
Please enter an integer: 42
>>> if x < 0:
...      x = 0
...      print 'Negative changed to zero'
... elif x == 0:
...      print 'Zero'
... elif x == 1:
...      print 'Single'
... else:
...      print 'More'
...
More
```

  - In this example, we input integer 42, which is not less than 0, not equal to 0, and not equal to 1. Therefore, it falls into the option that “print ‘More’”.
  - Any non-zero and non-null values are treated as TRUE by Python

Python Basics: Looping

- ***for*** **statement**
  - The **for** loop in Python has the ability to iterate over the items of any sequence, such as a list, tuple, or a string.

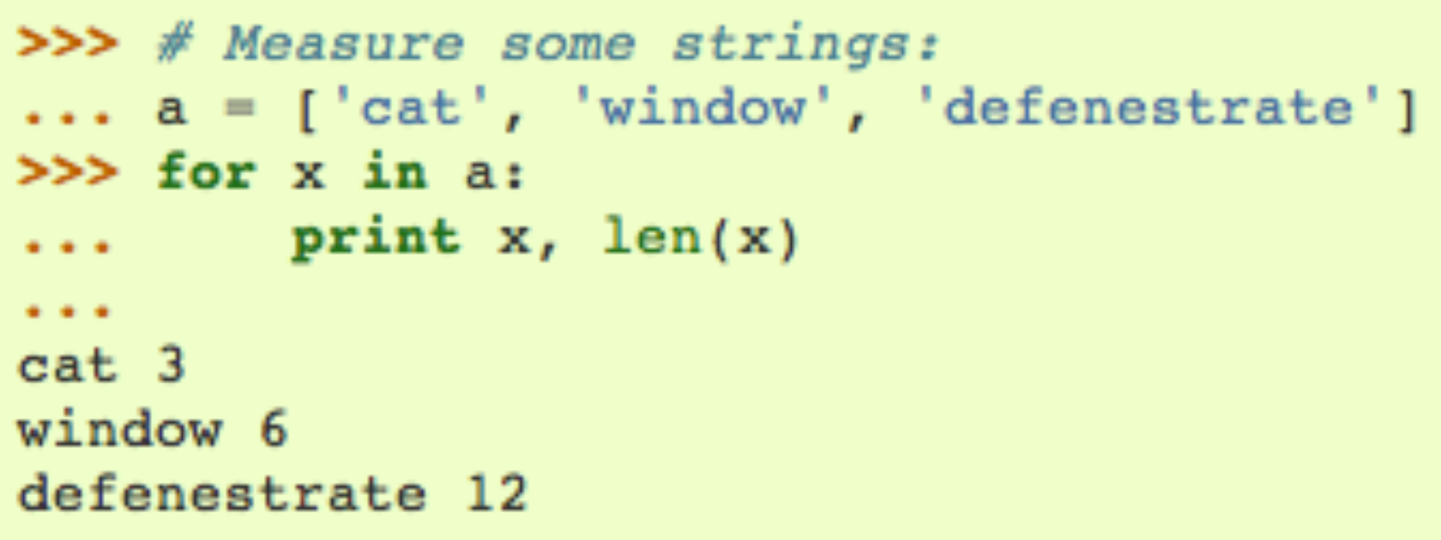


Ref: http://www.tutorialspoint.com/

Python Basics: Looping

- ***for* statement**
  - The **for** loop in Python has the ability to iterate over the items of any sequence, such as a list or a string.

  - Example:

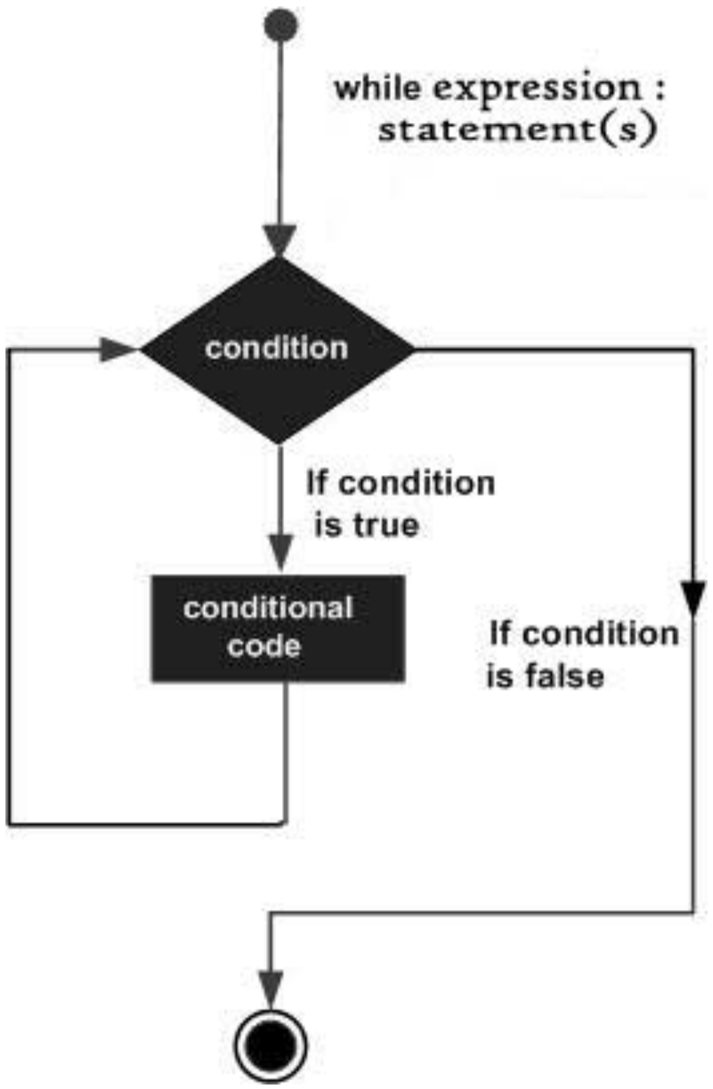


```
>>> # Measure some strings:
... a = ['cat', 'window', 'defenestrate']
>>> for x in a:
...     print x, len(x)
...
cat 3
window 6
defenestrate 12
```

  - In this example, all the items in list a get printed.
  - *len(x)* is a built-in function in Python, which returns the length of x.
  - In this example, x is a string, such as “cat”. len(x) returns “cat”’s length, which is 3.

Python Basics: Looping

- ***while*** **statement**
  - The **while** loop in Python has the ability to iterate over a statement or group of statements while a given condition is TRUE



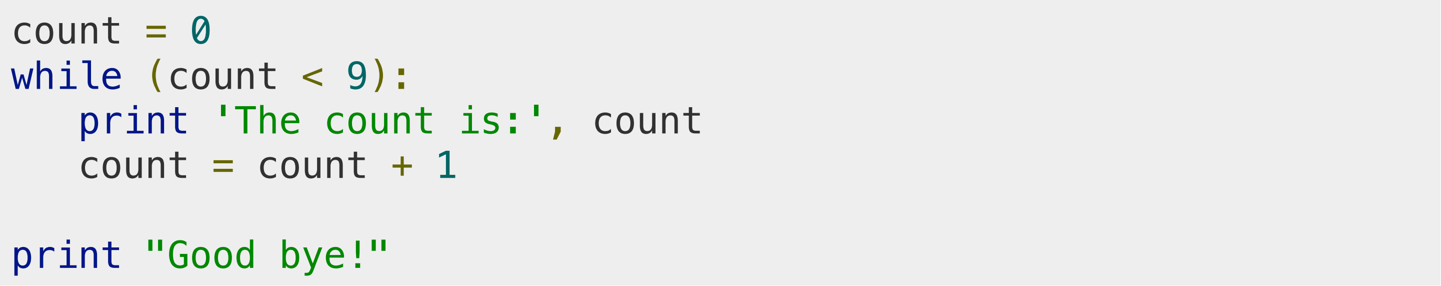
Ref: http://www.tutorialspoint.com/

Python Basics: Looping

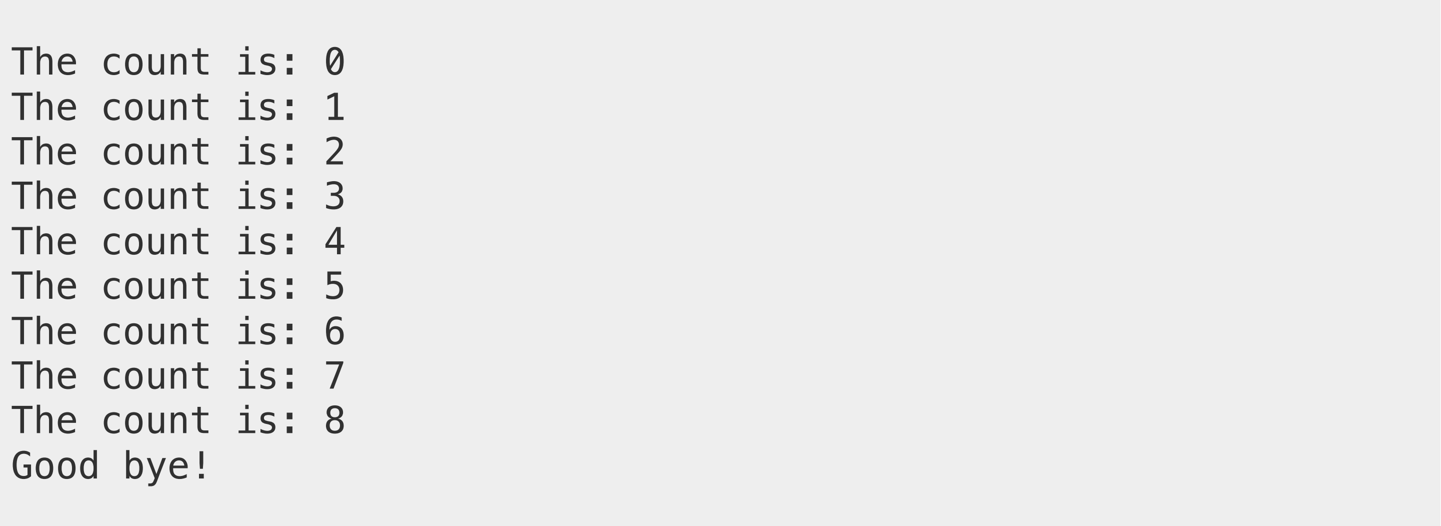
while **statement**

- The **while** loop in Python has the ability to iterate over a statement or group of statements while a given condition is TRUE

- Example:



```
count = 0
while (count < 9):
   print 'The count is:', count
   count = count + 1

print "Good bye!"
```

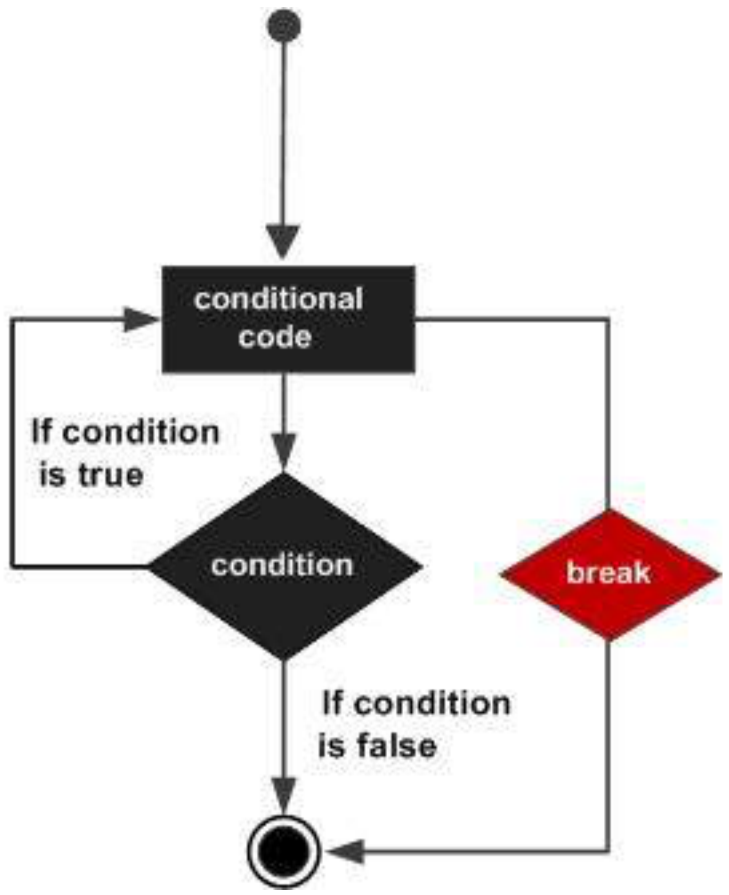


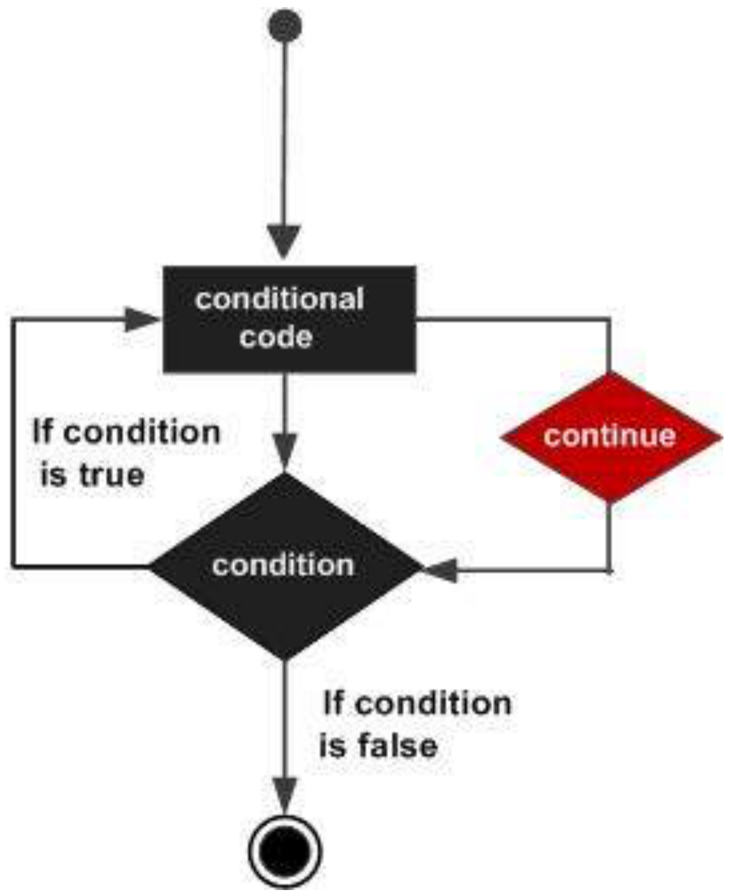
```
The count is: 0
The count is: 1
The count is: 2
The count is: 3
The count is: 4
The count is: 5
The count is: 6
The count is: 7
The count is: 8
Good bye!
```

Ref: http://www.tutorialspoint.com/

- Caution: “infinite loop” if a condition never becomes false.

Python Basics: Loop Control Statements





```
for letter in 'Python':
   if letter == 'h':
      break
   print 'Current Letter :', letter
```

```
for letter in 'Python':
   if letter == 'h':
      continue
   print 'Current Letter :', letter
```

Ref: http://www.tutorialspoint.com/

Exercise # 5

Given the list G (of dictionaries) below, do the following:

- Write a for loop that prints out all names.
- Write another for loop that adds up all ages and print the sum at the end.

Exercise # 6

Given the list D (of integers) below, do the following:

- Print only those values that are positive in the list

Recap with an Abstract View of a Computer

Processor
(executes steps in program)

```
>>> welcomeString = “Hello World”
>>> eliteFloat = 1337 - 0.00001
>>> fullName = [“Mark, “Gottscho”]
>>> if fullName[1] == “Gottscho”:
...     uni = “UCLA”
... else:
...     uni = “unknown”
...
>>> website = “www.google.com”
>>> print welcomeString
Hello World
>>> print “Searching on “ + website + “ is useful!”
Searching on www.google.com is useful!
>>> print str(eliteFloat) + “ is close to 1337”
1336.99999 is close to 1337
>>> negativeInt = -28
>>> if negativeInt < 0:
...     print “< 0”
...
< 0
>>> my_numbers = [1, 2, 3, 4, 5]
>>> for i in range(0,5):
... print my_numbers[i]
...
1
2
3
4
5
>>> negativeInt = -1
>>>
```

Memory
(stores progress of program)

Location	Variable Name	Value
0	welcomeString	“Hello World”
1		
2	eliteFloat	1336.99999
3	my_numbers	[1, 2, 3, 4, 5]
4	fullName	[“Mark”, “Gottscho”]
5	uni	“UCLA"
6		-28
7	website	“www.google.com”
8	negativeInt	-1

Python Modules and Namespaces

- A **module** is a file consisting of Python code which can define functions, variables etc.
  - The code for a module named *mname* normally resides in the file *mname.py* which is searched for in selected folders on the computer
  - Any Python source file can be used as as a module by executing an **import** statement in some other Python source file.

```
# file: support.py
def print_func( par ):
   print "Hello : ", par
   return
```

```
# some other file
import support
# Now one can call function defined in that module as follows
support.print_func("Zara")
```

- To prevent confusion with same variable and function names being used in different modules, they belong to a module's **namespace** which is a dictionary of variable names (keys) and their corresponding objects (values).
- Each function has its own *local namespace*, and a Python statement can directly access variables in the *local namespace* and in a *global namespace*.

Interacting with the External World

(Users, Files, Computers on the Internet …)

- Printing to the Screen

```
>>> print "Python is really a great language,", "isn't it?”;
Python is really a great language, isn't it?
```

- Reading Keyboard Input: *raw_input([prompt])*

```
# file.py

str = raw_input("Enter your input: ");
print "Received input is : ", str
```

```
Enter your input: Hello Python
Received input is :  Hello Python
```

- Reading and Writing Files

```
#!/usr/bin/python

# Open a file
fo = open("foo.txt", "wb")
fo.write( "Python is a great language.\nYeah its great!!\n");

# Close opend file
fo.close()
```

```
#!/usr/bin/python

# Open a file
fo = open("foo.txt", "r+")
str = fo.read(10);
print "Read String is : ", str
# Close opend file
fo.close()
```

Ref: http://www.tutorialspoint.com/

Interacting with the External World

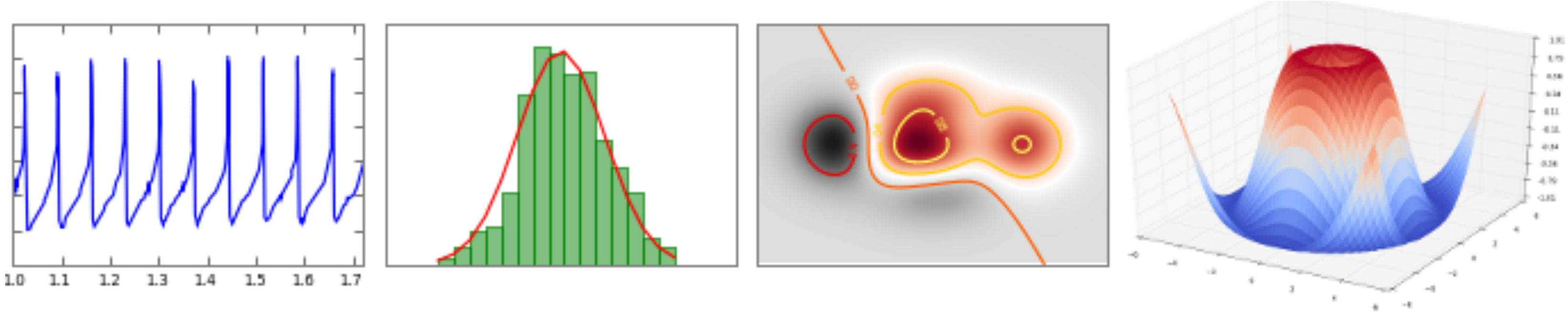
(Users, Files, Computers on the Internet …)

- Reading from Web Servers using url lib module

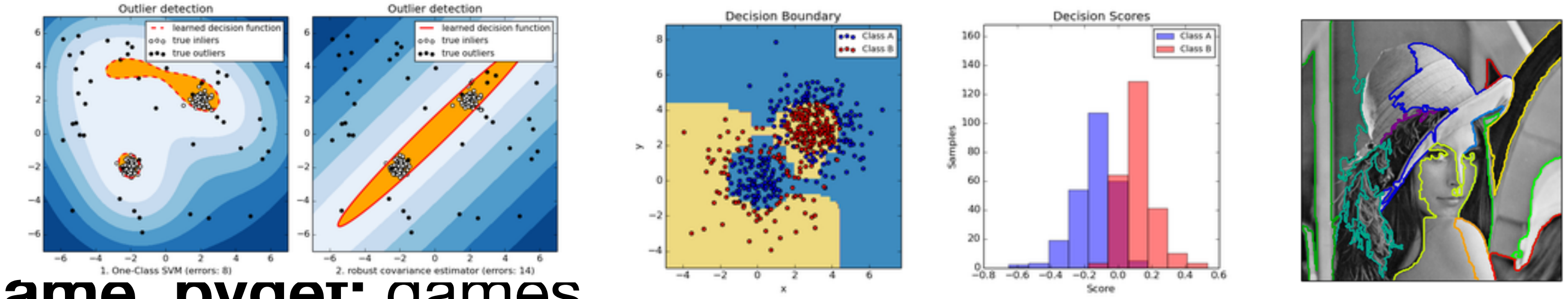
```
def wget(url):
  try:
    ufile = urllib.urlopen(url)
    if ufile.info().gettype() == 'text/html':
      print ufile.read()
  except IOError:
    print 'problem reading url:', url
```

Some Very Useful Python Modules

- **matplotlib:** a python 2D plotting library



- **NumPy:** computing with n-dimensional arrays
- **SciPy:** numerical integration and optimization
- **Sympy:** symbolic mathematics
- **scikit-learn:** data mining and machine learning



- **pygame, pyglet:** games
- and many many more…

Assignment #1:
English Word to Pig Latin Translator

- Pig Latin is a language game, where you move the first letter of the word to the end and add "ay." So "Python" becomes "ythonpay."

- Write a program in **Assignment 1** section in jupyter notebook, which when run will prompt the user with the phrase “Enter a word:”, and then output the word entered by the user translated into Pig Latin in lowercase unless the user’s entry is empty, non-alphabetical, or has multiple word in which case the output should be “Error: incorrect input”.

- Hint: break into your code into separate functions for getting user input, validating the input, translating it into Pig Latin etc.

Assignment #2:
Compute Statistics

- *Mean*, *mode*, and *median* are three common statistics of a set of numbers.

- Write a program in **Assignment 2** section in jupyter notebook, which when run will prompt the user with the phrase "Enter a comma separated list of numbers:", and then output on three separate lines the mean, mode, and median of the entered numbers as "Mean = …", "Mode = …" and "Median = …". The user may enter numbers as integers or real.

- Hint: Break into your code into separate functions for getting user input, computing mean, computing mode, computing median etc. Consider using the function *input()* instead of *raw_input()*- look up on the web as to how it works.

Assignment #3:
Frequency Analysis of Documents on the Web

- The relative frequencies (i.e. fractions of the total) of different letters in a document are very useful for a variety of purposes, such as compressing the document, encrypting it etc.

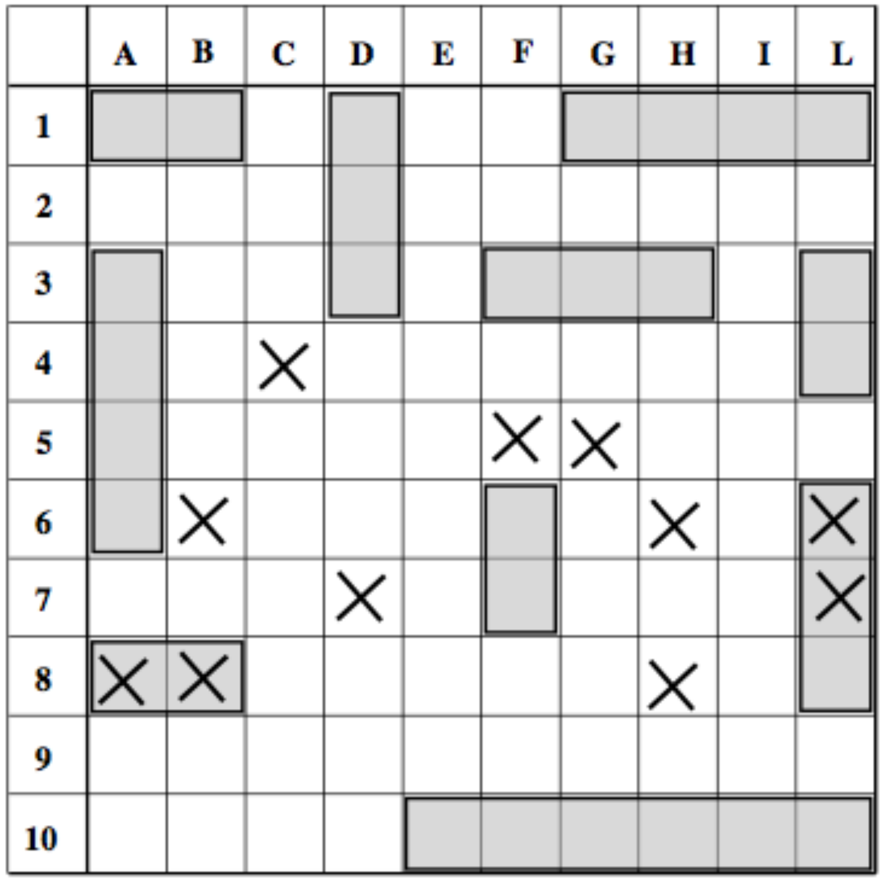
- Write a program in **Assignment 2** section in jupyter notebook, which when run will prompt the user with the phrase “Enter a URL:”, analyze the text at the URL, and then output a sorted (highest to lowest) listing of different English (a-z, A-Z) and numeric (0-9) characters and their respective fraction of the total one per line in the format “character fraction”. Count upper and lowercase versions of a character to be equivalent, and ignore any characters other that a-z, A-Z, 0-9. Print “Error reading URL” if the URL is not reachable or if it returns data of type other than something that starts with “text/”.

- Hint: what data type would you use?

Mini-Project: Battleship Game

- You must implement:
  - Ship placement
  - Hit detection
  - Game flow
  - In file **battleship.py**
- Advanced assignment
  - Automated playing
  - AI player
    - Ship placement
    - Shooting strategy

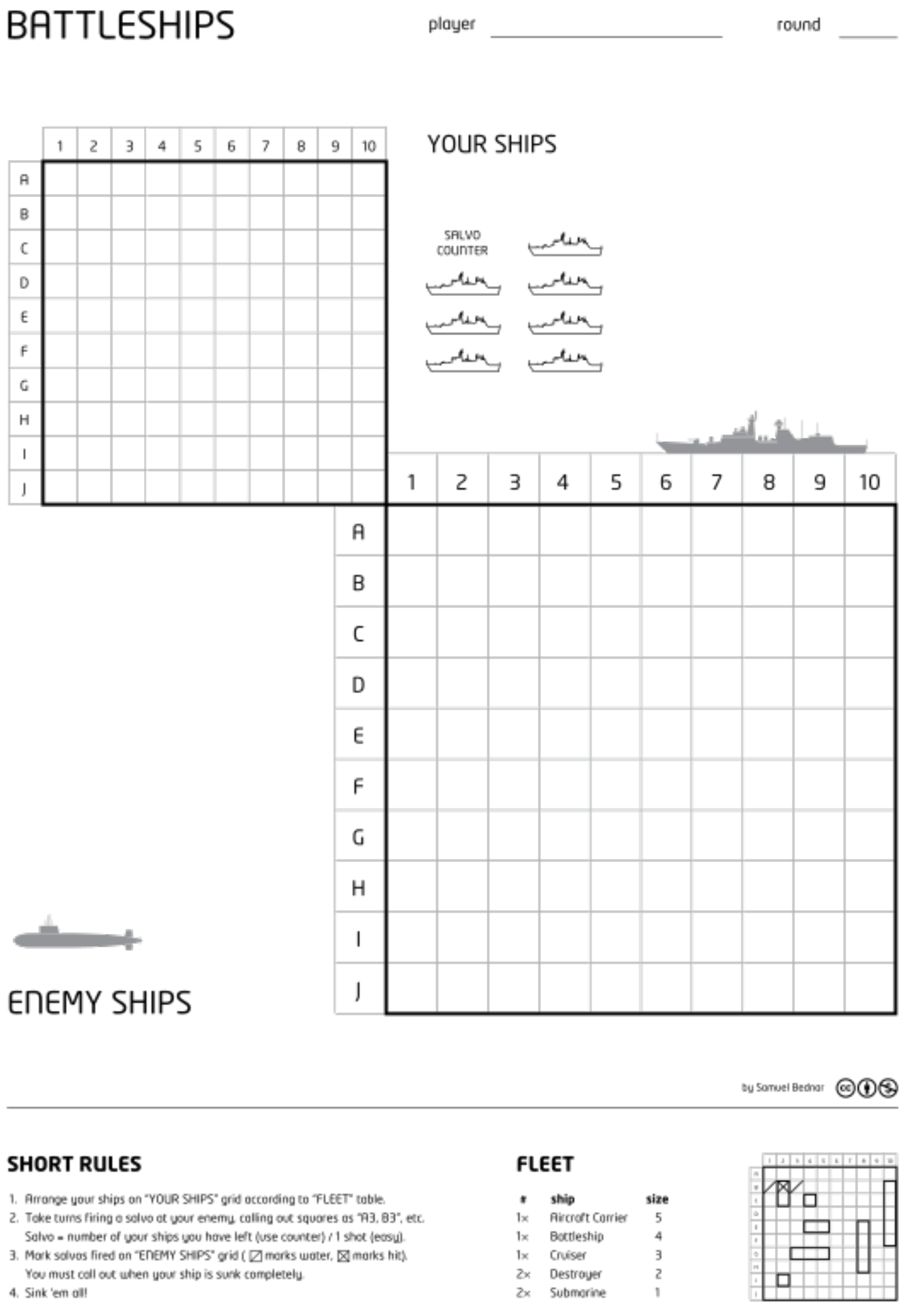
- Game details: http://en.wikipedia.org/wiki/Batt



Battleship: General Implementation Strategy

- How to represent your (and the enemy's) board
- How to determine valid ship placement
- How to detect hits
- How to structure game flow

- Assume 10x10 board



BATTLESHIPS

player ____________ round ____

YOUR SHIPS

SALVO COUNTER

ENEMY SHIPS

by Samuel Bednar

SHORT RULES

1. Arrange your ships on "YOUR SHIPS" grid according to "FLEET" table.
2. Take turns firing a salvo at your enemy, calling out squares as "A3, B3", etc.
   Salvo = number of your ships you have left (use counter) / 1 shot (easy).
3. Mark salvos fired on "ENEMY SHIPS" grid (◪ marks water, ☒ marks hit).
   You must call out when your ship is sunk completely.
4. Sink 'em all!

FLEET

#	ship	size
1×	Aircraft Carrier	5
1×	Battleship	4
1×	Cruiser	3
2×	Destroyer	2
2×	Submarine	1