# 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*

UCLA

# Welcome to LACC 2019 @ 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.



# Introduction

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



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

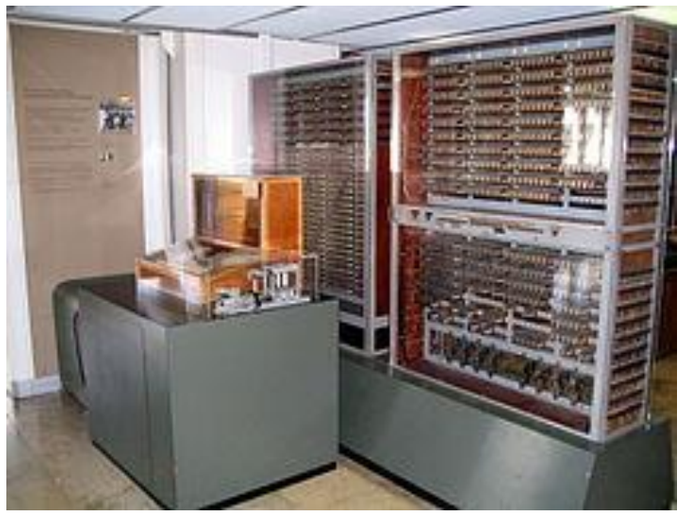
Unlike a calculator, a computer can make choices about what to do.
These are made using branches and loops in a procedure.
Essentially, decisions on what computation to do based on a condition.



# 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.*

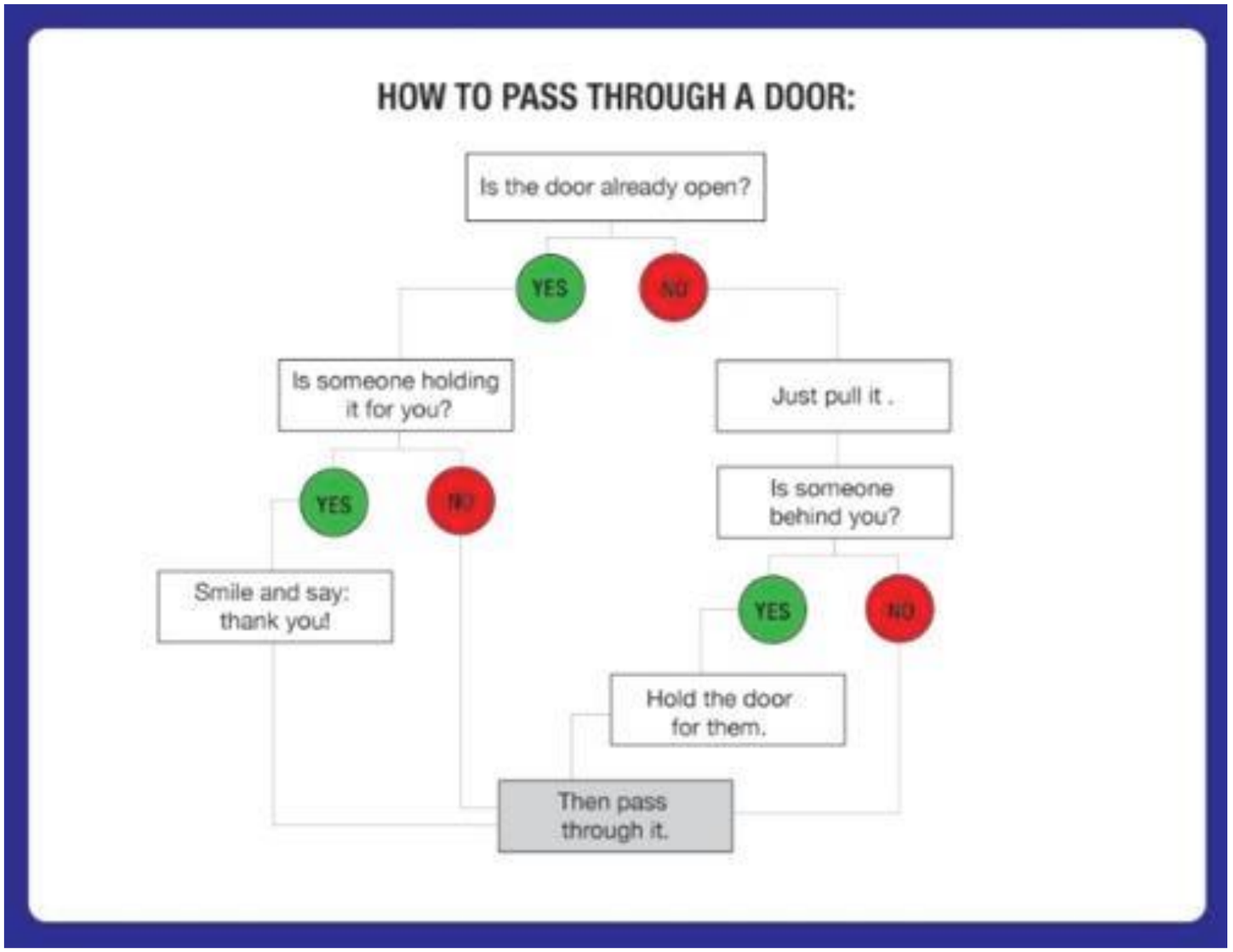


*Replica of Zuse's Z3, the first fully automatic, digital (electromechanical) general-purpose programmable computer.*


*ENIAC, the first electronic general-purpose computer*

# Conditional Branches

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



# 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

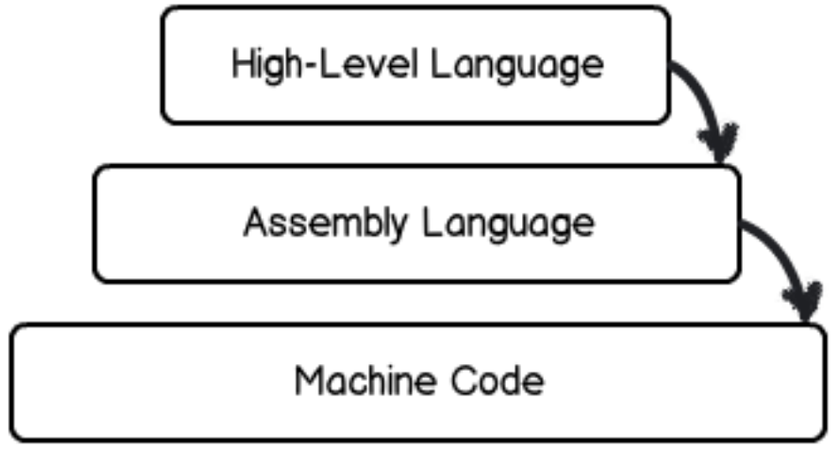
```
pass_door:
    ld register_1, door_status              # load contents from memory into register
    ld register_2, door_open
    beq register_1, register_2, holding     # if register 1 and 2 are
    call pull_door                            equal, go to (branch to) label
                                              “holding”
holding:
    ...

pull_door:
    ...
```



# 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?

# 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:**

```c
#include <stdio.h>

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

- **Java:**

```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…



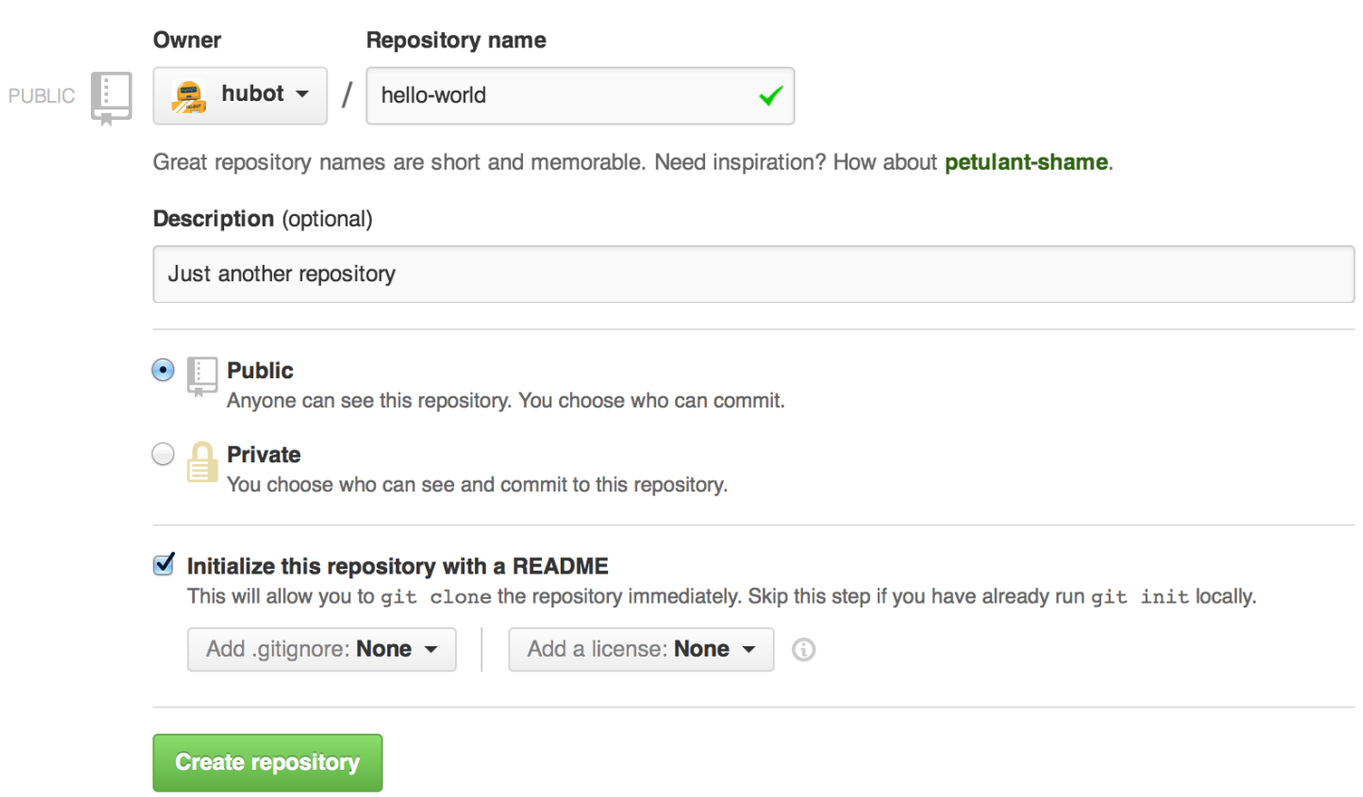
# What is GitHub?

- 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***.



# 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.

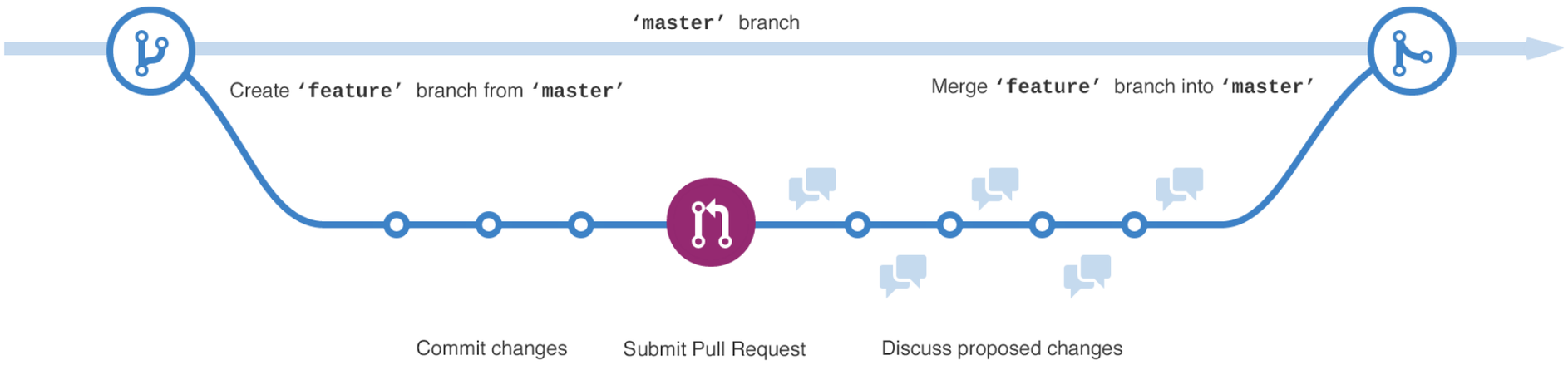
- ***Branching*** is the way to work on different versions of a repository at one time.



# 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.



# 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!**

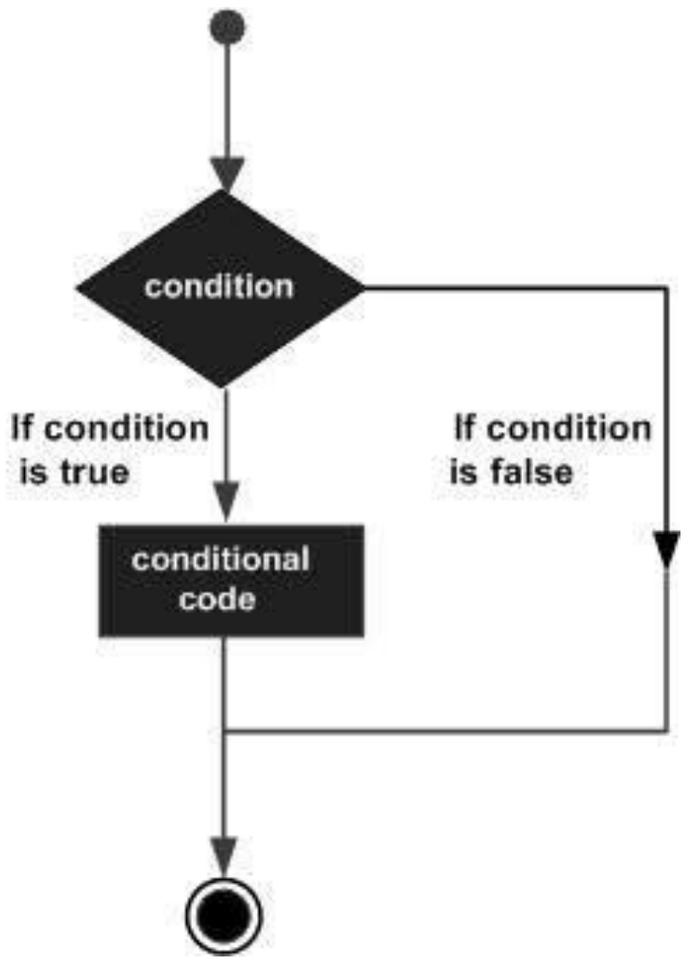
# Exercise # 4

- 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.

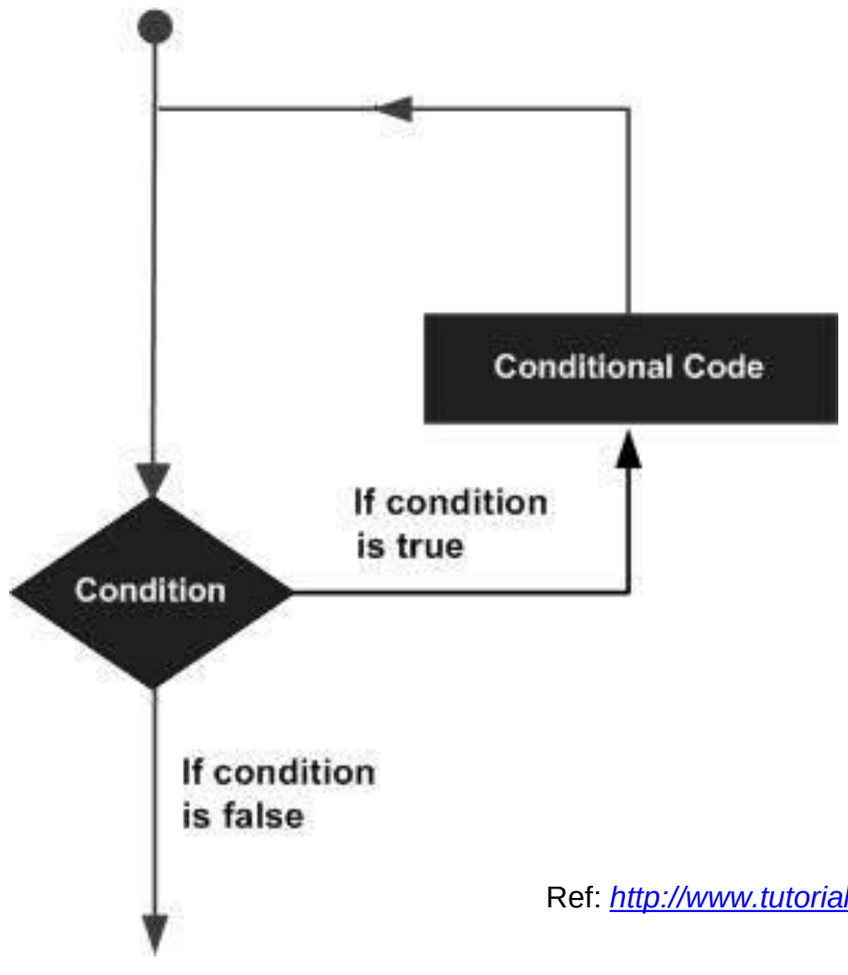
# Beyond Sequential Execution: Control Flow Tools

- 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***



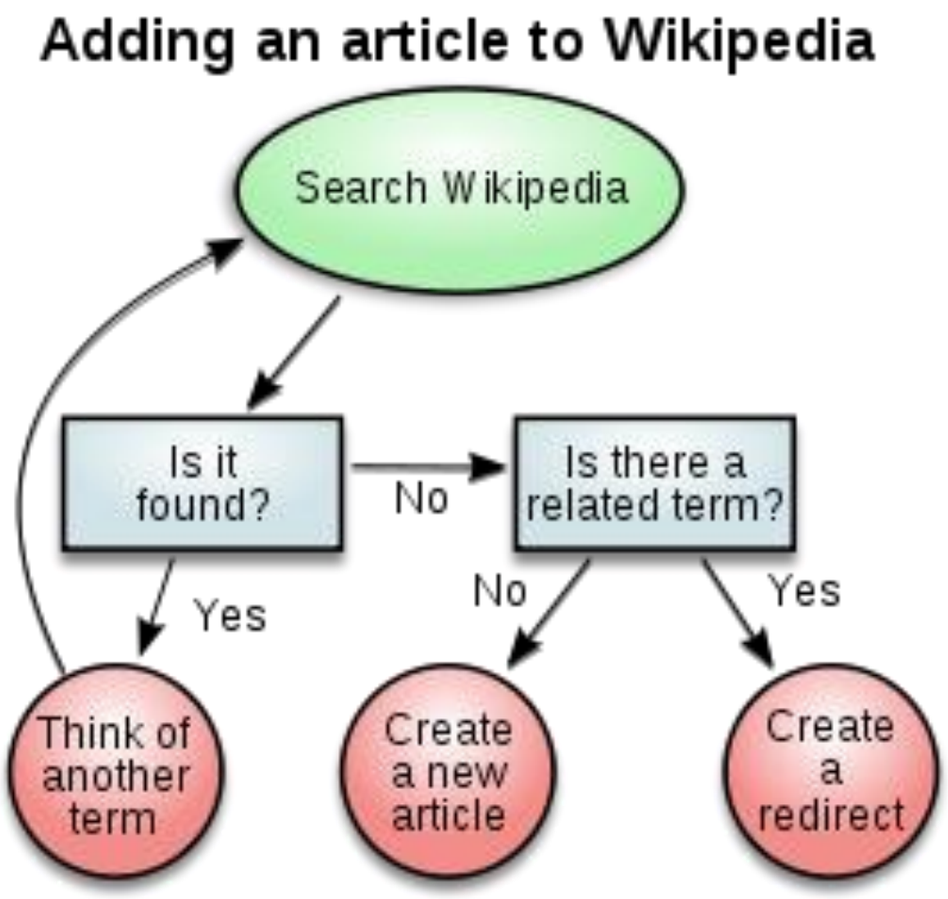

***Loop***




Ref: [http://www.tutorialspoint.com/](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:

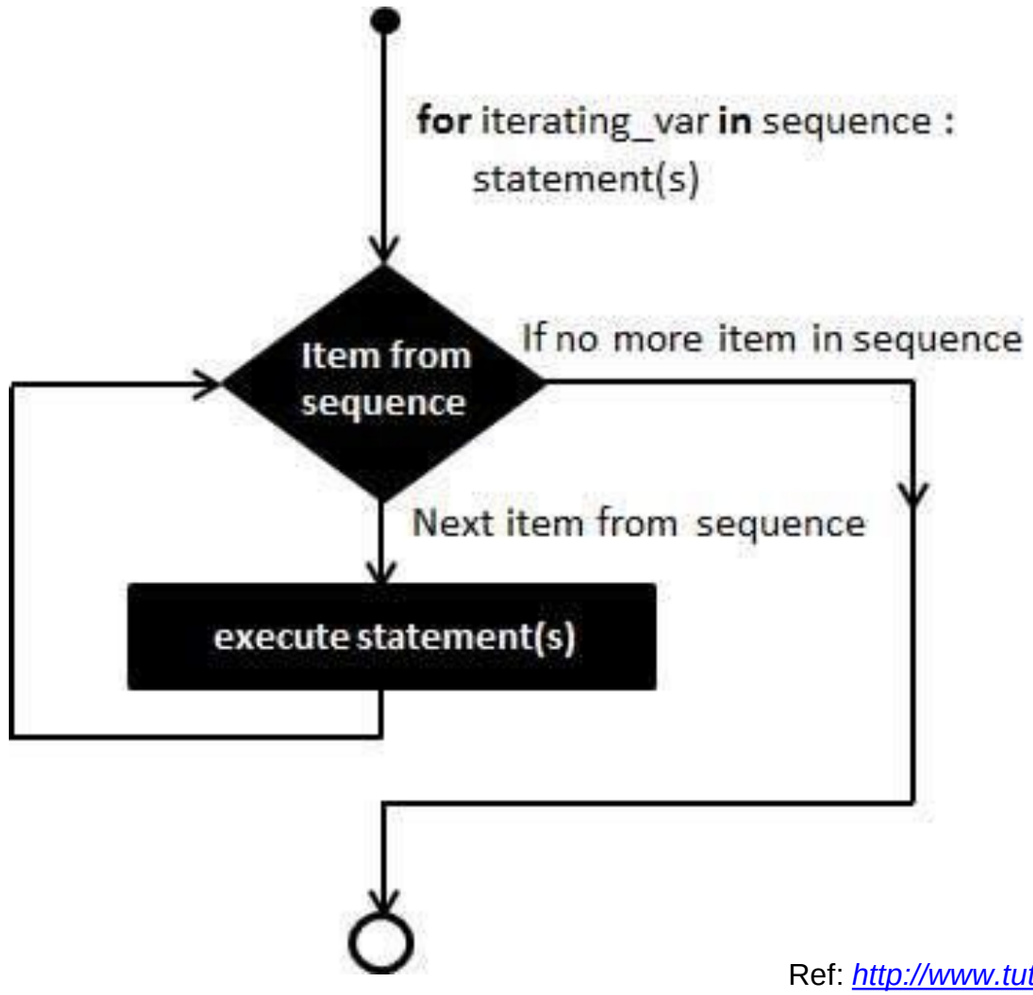
```
>>> x = int(raw_input("Please enter an integer: "))
Please enter an integer: 42
>>> if x < 0:
...     x = 0
...     print 'Negative changed to zero'
... elif x == 0:
...     print 'Zero'
... elif x == 1:
...     print 'Single'
... else:
...     print 'More'
...
More
```

  - 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:

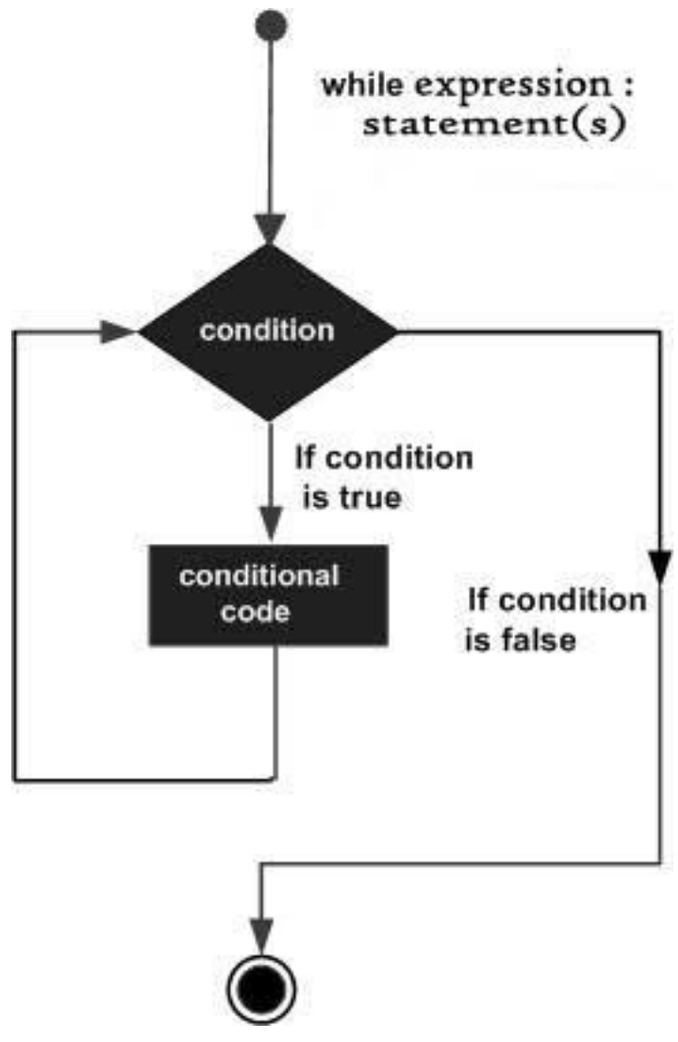
```
>>> # Measure some strings:
... a = ['cat', 'window', 'defenestrate']
>>> for x in a:
...     print x, len(x)
...
cat 3
window 6
defenestrate 12
```

  - 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!"
```

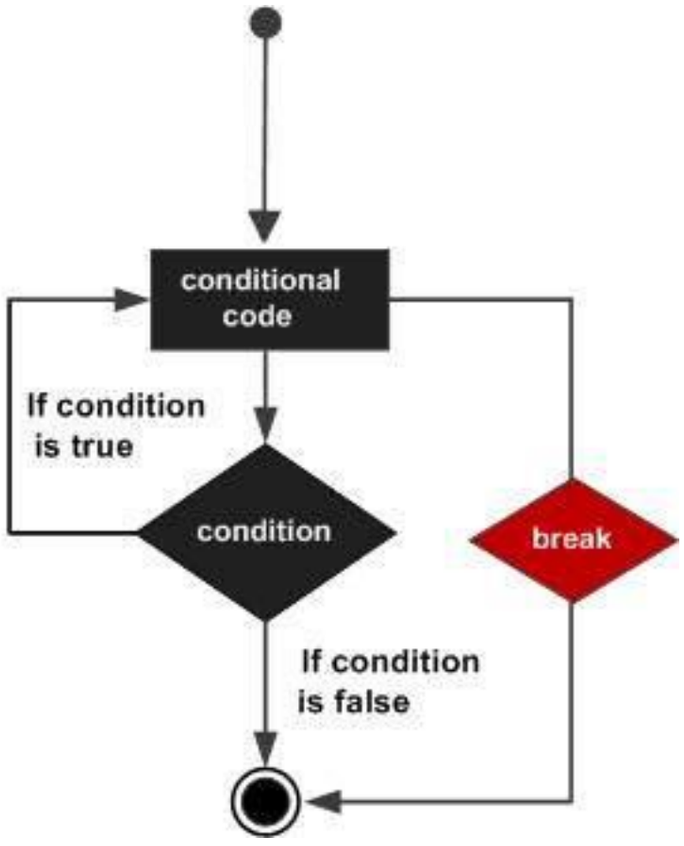
```
The count is: 0
The count is: 1
The count is: 2
The count is: 3
The count is: 4
The count is: 5
The count is: 6
The count is: 7
The count is: 8
Good bye!
```

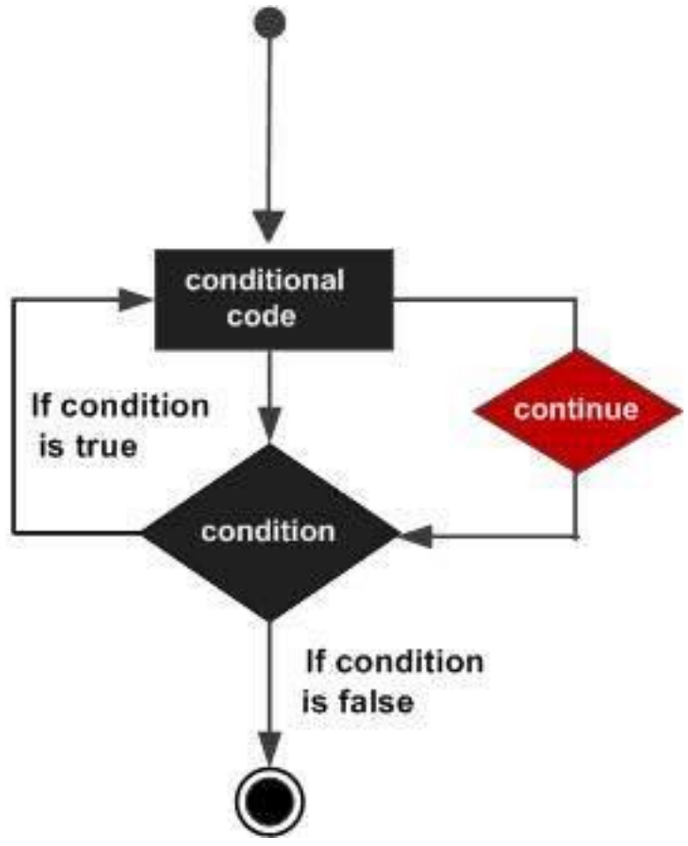
Ref: *http://www.tutorialspoint.com/*

  - 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/*



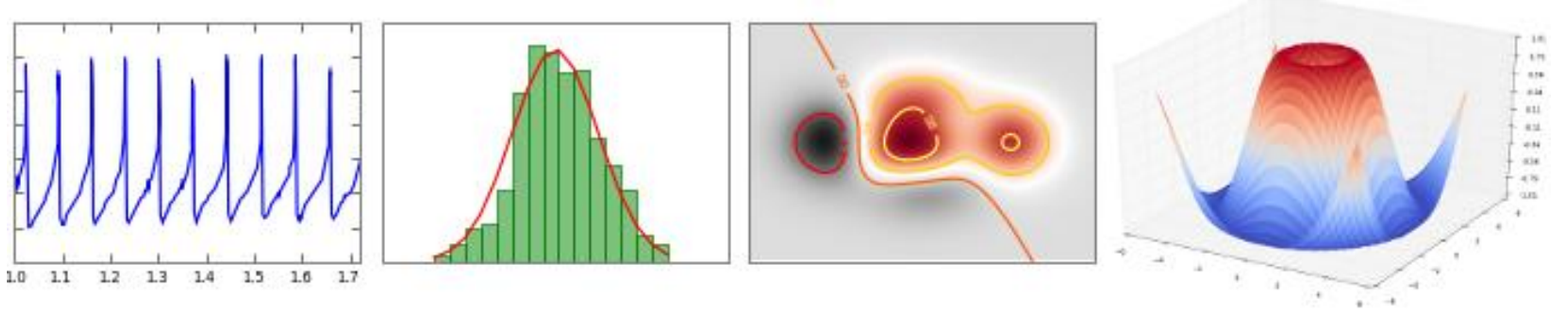
# Interacting with the External World
## *(Users, Files, Computers on the Internet …)*

- Reading from Web Servers using url lib module

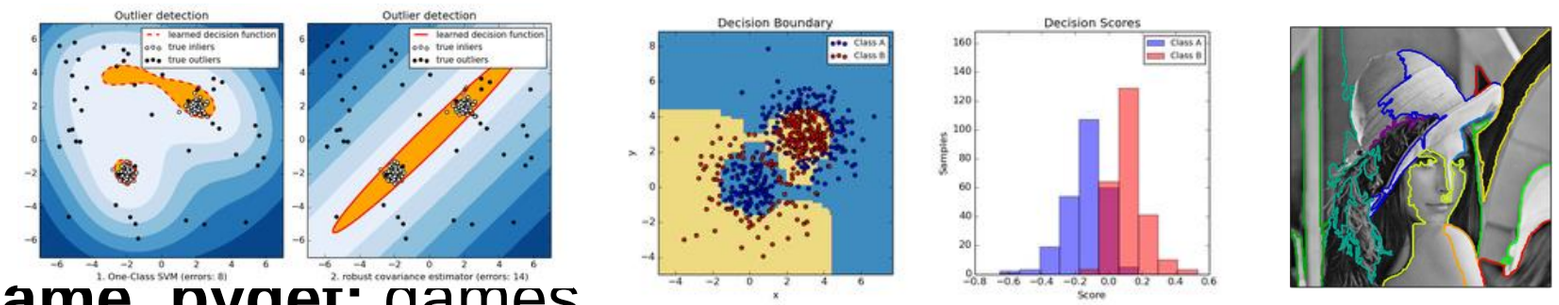
```
def wget(url):
  try:
    ufile = urllib.urlopen(url)
    if ufile.info().gettype() == 'text/html':
      print ufile.read()
  except IOError:
    print 'problem reading url:', url
```

# 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, pyget:** 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.

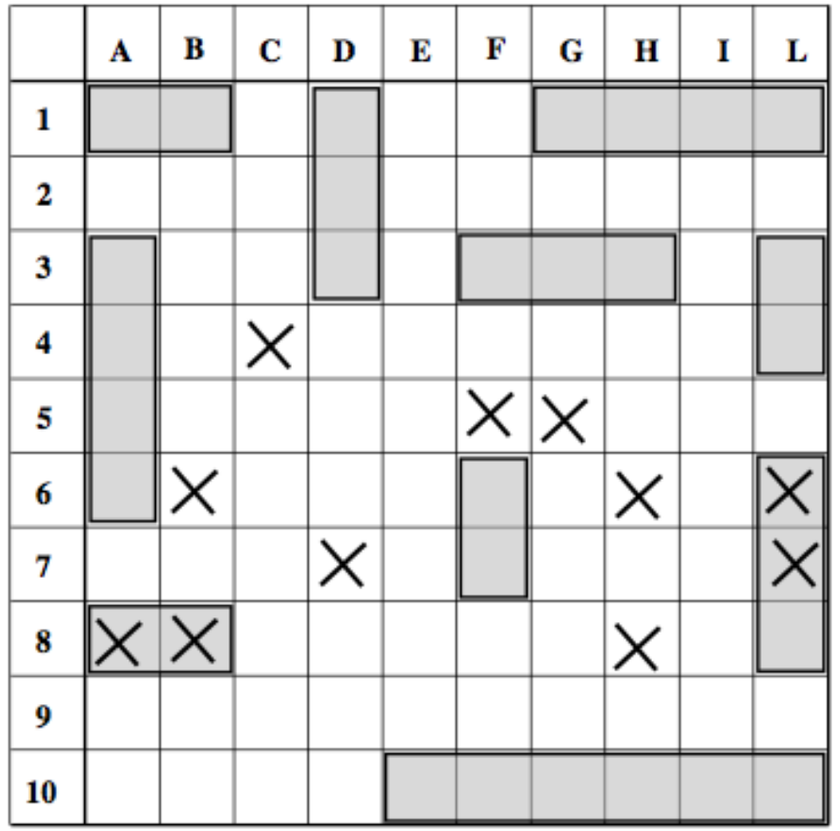
- Write a program in **Assignment 2** section in jupyter notebook, which when run will prompt the user with the phrase “Enter a URL:”, analyze the text at the URL, and then output a sorted (highest to lowest) listing of different English (a-z, A-Z) and numeric (0-9) characters and their respective fraction 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: Networked Battleship Game

- You'll be given:
  - Network functions to talk to opponent
  - File **net.py** at https://www.dropbox.com/s/buix5t7o5xjcsy3/net.py?dl=0
- You must implement:
  - Ship placement
  - Hit detection
  - Game flow
  - In file **battleship.py** (to be submitted)
- Advanced assignment
  - Automated playing
  - AI player
    - Ship placement
    - Shooting strategy




- Game details: http://en.wikipedia.org/wiki/Battleship_%28game%29

# 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