

Introduction to Python

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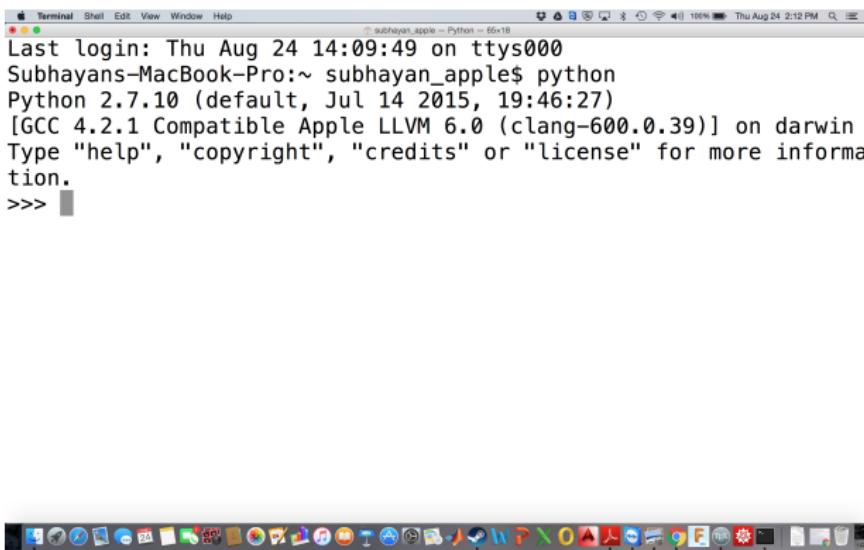
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CE 408: Risk Analysis in Civil Engineering
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Installation

- ▶ Download Python: <https://www.python.org/downloads/>
- ▶ **Mac and Linux users:** you already have some version of the Python compiler in your computer.
- ▶ Open Terminal and type 'python' without the quotes
- ▶ You should see something like the following screenshot:
- ▶ Install Pip (Package manager for Python) by typing
sudo easy_install pip



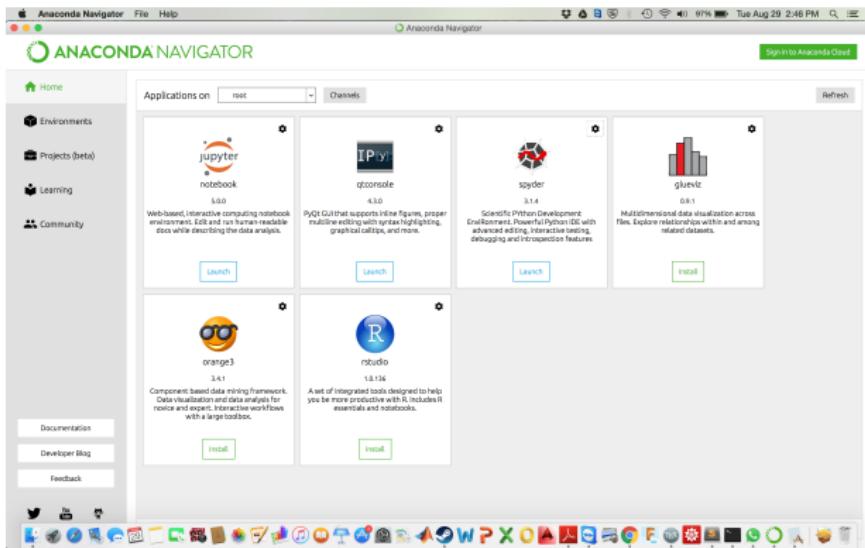
A screenshot of a Mac OS X Terminal window titled "subhayan.apple - Python - 65x18". The window shows the following text output:

```
Last login: Thu Aug 24 14:09:49 on ttys000
Subhayans-MacBook-Pro:~ subhayan_apple$ python
Python 2.7.10 (default, Jul 14 2015, 19:46:27)
[GCC 4.2.1 Compatible Apple LLVM 6.0 (clang-600.0.39)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> 
```

The terminal window has a standard OS X look with a title bar, menu bar, and a scroll bar on the right. The bottom of the screen shows the Dock with various application icons.

Installation: Anaconda

- ▶ Another good option is Anaconda: Python data science platform (<https://www.anaconda.com/what-is-anaconda/>)
- ▶ Download from here:
<https://www.anaconda.com/download/#download>
- ▶ After installing you will find this in your applications folder:
Anaconda-Navigator



Installation: Windows users

- ▶ 3 options:

Opt. 1 Install Python compiler and Pip by following the steps available at:

<https://github.com/BurntSushi/nfldb/wiki/Python-&-pip-Windows-installation>

Opt. 2 Install WinPython (<http://winpython.github.io/>) or Anaconda (<https://www.anaconda.com/what-is-anaconda/>)

Opt. 3 Use a virtual machine (e.g., Oracle VM VirtualBox) with Linux Ubuntu and follow the steps on the previous slide.

Build the codes

- ▶ You can use the terminal to run the Python codes:

- ▶ Type the following lines in the terminal:

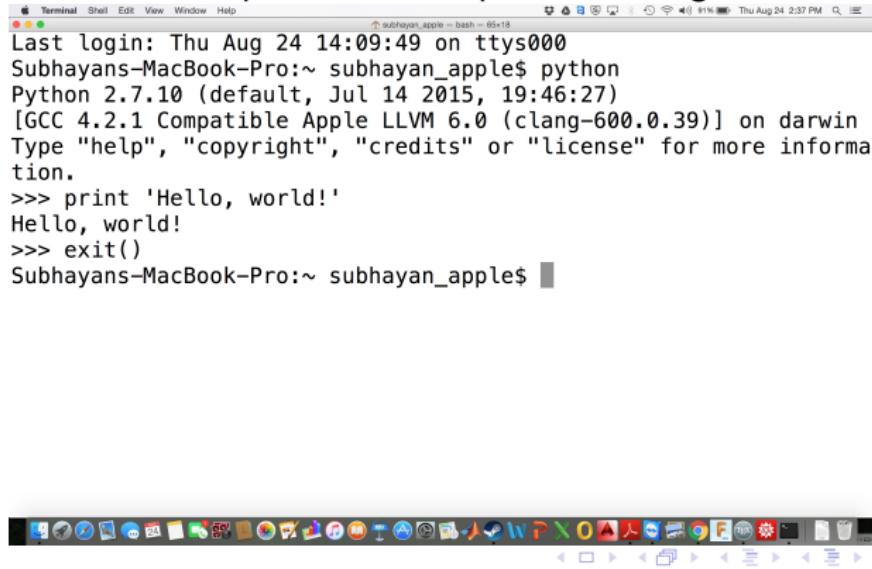
```
python
```

```
print 'Hello, world!'
```

```
Python 3.6 users: python
```

```
print ('Hello, world!')
```

This should produce an output like the figure here



The screenshot shows a Mac OS X Terminal window. The title bar reads "subhayan_apple ~ bash - 0x18". The window contains the following text:

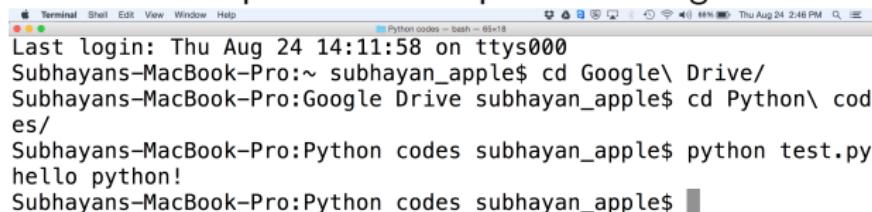
```
Last login: Thu Aug 24 14:09:49 on ttys000
Subhayans-MacBook-Pro:~ subhayan_apple$ python
Python 2.7.10 (default, Jul 14 2015, 19:46:27)
[GCC 4.2.1 Compatible Apple LLVM 6.0 (clang-600.0.39)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> print 'Hello, world!'
Hello, world!
>>> exit()
Subhayans-MacBook-Pro:~ subhayan_apple$
```

The window has a standard OS X look with a dark grey header and a white body. The menu bar at the top includes "Terminal", "Shell", "Edit", "View", "Window", and "Help". The status bar at the bottom shows the date and time: "Thu Aug 24 2:37 PM". The dock at the very bottom of the screen contains icons for various applications like Finder, Mail, Safari, and others.

Build the codes

- ▶ You can also use the terminal to run the Python codes using a Python script:
 - ▶ Type *print 'hello python!'* in a file using a text editor and save it as *test.py*
 - ▶ Python 3.6 users: type *print ('hello python!')*
 - ▶ Type the following lines in Terminal:
python test.py

This should produce an output like the figure here



A screenshot of a Mac OS X Terminal window. The window title is "Python codes - bash - 65x18". The status bar at the bottom shows "Thu Aug 24 2:46 PM". The terminal history is as follows:

```
Last login: Thu Aug 24 14:11:58 on ttys000
Subhayans-MacBook-Pro:~ subhayan_apple$ cd Google\ Drive/
Subhayans-MacBook-Pro:Google Drive subhayan_apple$ cd Python\ cod
es/
Subhayans-MacBook-Pro:Python codes subhayan_apple$ python test.py
hello python!
Subhayans-MacBook-Pro:Python codes subhayan_apple$
```

Using an IDE: Sublime Text

- ▶ You can also use any IDE (integrated development environment) – e.g., Sublime Text, Jupyter, Spyder.



A screenshot of the Sublime Text interface. The menu bar includes File, Edit, Selection, Find, View, Goto, Tools, Project, Window, Help. The status bar shows 'This Aug 24 2:50 PM' and 'UNREGISTERED'. A tab labeled 'test.py' is open, containing the code: 1 print 'hello python!'

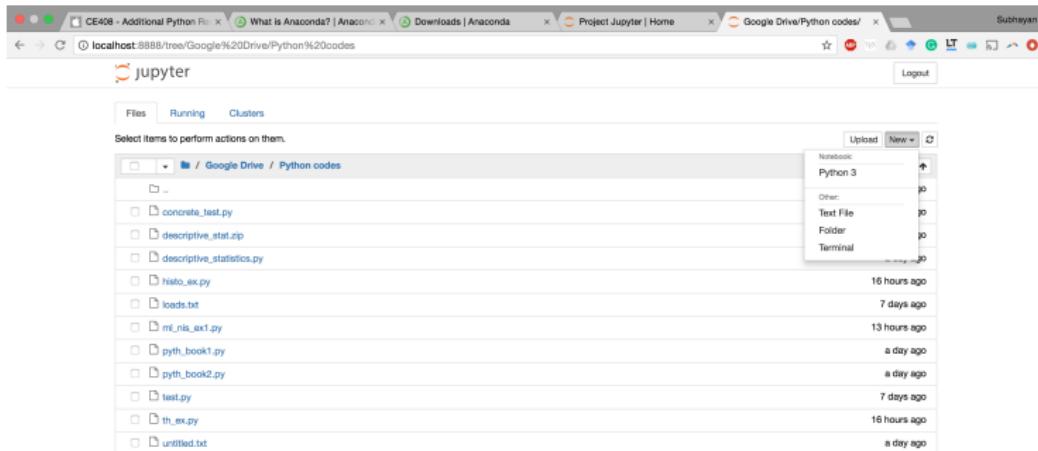
```
hello python!
[Finished in 0.1s]
```



- ▶ Goto Tools and in the Build system select Python.
- ▶ Build the code in Sublime text using Ctrl+B or Cmd+B.
- ▶ If you are having trouble building from Sublime Text:
<https://www.youtube.com/watch?v=6ZpuwW-9T54>
(thanks to Mr. Elezar Kenig)

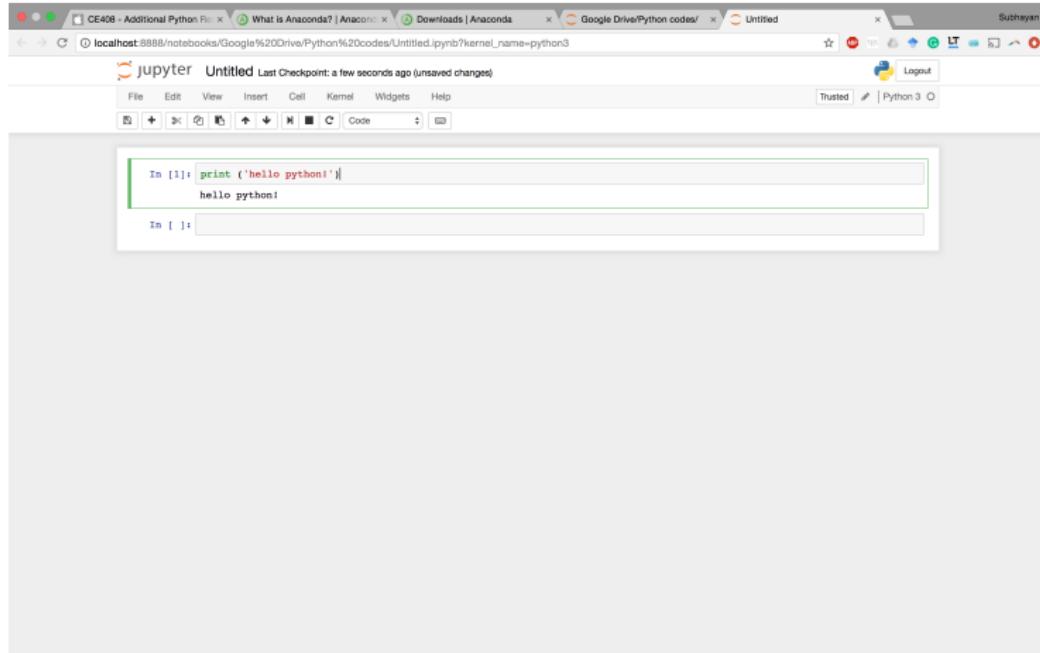
Using an IDE: Jupyter

- ▶ The Jupyter Notebook is an open-source web application that can contain live code, equations, visualizations and explanatory text.
- ▶ On top right click on the New button and select *Python 3* or *Python 2* depending on the python compiler version you have installed.



Using an IDE: Jupyter

- ▶ Type `print ('hello python')` and click on the next button.



The screenshot shows a Jupyter Notebook interface running in a web browser. The title bar indicates the browser tabs include "CE408 - Additional Python Resources", "What Is Anaconda?", "Downloads | Anaconda", "Google Drive|Python codes/", and "Untitled". The main window title is "jupyter Untitled Last Checkpoint: a few seconds ago (unsaved changes)". The menu bar includes File, Edit, View, Insert, Cell, Kernel, Widgets, Help, and a toolbar with icons for New, Open, Save, Run, Cell, Kernel, Help, and Code. A status bar at the bottom shows navigation icons and the text "Suhmayan". The notebook content area contains a single code cell with the following content:

```
In [1]: print ('hello python!')  
hello python!
```

The output of the code cell is displayed in a green-bordered box below the input cell. Below the output box is an empty input cell labeled "In []:".

Using an IDE: Spyder

- Type `print ('hello python')` in a new file and save it as `test.py` and press F5

The screenshot shows the Spyder Python IDE interface. In the top-left corner, there's a toolbar with various icons for file operations like Open, Save, and Run. Below the toolbar is a menu bar with options like File, Edit, Search, Source, Run, Debug, Consoles, Projects, Tools, View, Help, and a specific Spyder (Python 3.6) entry. The main window has tabs for Editor, Source, Console, and Object. The Editor tab is active, displaying the code `print ('hello python!')`. To the right of the Editor is a large blue box labeled "Usage" which contains the text: "Here you can get help of any object by pressing Cmd+I in front of it, either on the Editor or the". Below the Editor is a "Console 1/A" tab, which is currently selected. It shows the output of running the script: `In [1]: runfile('/Users/subhayan_apple/Google Drive/Python codes/test.py', wdir='/Users/subhayan_apple/Google Drive/Python codes')` followed by `hello python!`. Below this, there's another line starting with `In [2]:`. At the bottom of the screen, there's a dock with various application icons, and at the very bottom, a Mac OS X-style menu bar with items like "File", "Edit", "View", "Project", "Run", "Tools", "Help", and "About Spyder".

```
1print ('hello python!')
```

Usage

Here you can get help of any object by pressing **Cmd+I** in front of it, either on the Editor or the

```
In [1]: runfile('/Users/subhayan_apple/Google Drive/Python codes/test.py', wdir='/Users/subhayan_apple/Google Drive/Python codes')
hello python!
```

```
In [2]:
```

Install Python libraries

- ▶ Using pip install numPy, SciPy, and matplotlib (libraries for the Python programming language) by typing the following in the terminal (Linux and Mac users):

python -m pip install –upgrade pip

*pip install –user numpy scipy matplotlib ipython jupyter
pandas sympy nose*

- ▶ Anaconda users: already has these libraries installed
- ▶ Windows users: (Note: WinPython already has these libraries)
- ▶ Download .whl files from here:
http://www.lfd.uci.edu/~gohlke/pythonlibs/
- ▶ Then type similar to the following in the command prompt for each of these packages:
pip install scipy-0.18.1-cp27-cp27m-win_amd64.whl
- ▶ Detailed instructions are available here:
https://scipy.org/install.html

Arithmetic operations

```
# Arithmetic operations
```

```
a = 5
```

```
b = 10
```

```
c = a + b
```

```
d = a - b
```

```
e = a * b
```

```
f = a/b
```

```
g = b ** a
```

```
print('a + b =', c, 'a - b =', d, 'a * b =', e, 'a / b =', f, 'b ** a =', g)
```

Loop statements: for

The screenshot shows a Jupyter Notebook environment with the following components:

- Editor Tab:** Displays Python code in test2.py. The code calculates the mean of a list [1, 2, 3, 4].
- Variable explorer:** A table showing variables and their properties.
- Console Tab:** Displays the output of running the code in the notebook.

Code in Editor:

```
1#!/usr/bin/env python3
2# -*- coding: utf-8 -*-
3"""
4Created on Tue Aug 29 15:46:13 2017
5
6@author: subhayan_apple
7"""
8
9import numpy as np
10x=np.array ([1, 2, 3, 4])
11sum1 = 0
12for i in range(len(x)):
13    sum1+=x[i]
14Mean = sum1/len(x)
15print ('Mean = ',Mean)
```

Variable explorer:

Name	Type	Size	Value
Mean	float64	1	2.5
i	int	1	3
sum1	int64	1	10
x	int64	(4,)	[1, 2, 3, 4]

Console Tab Output:

```
help      -> Python's own help system.
object?   -> Details about 'object', use 'object??' for extra details.

In [1]: runfile('/Users/subhayan_apple/Google Drive/Python codes/test2.py', wdir='/Users/subhayan_apple/Google Drive/Python codes')
Mean = 2.5
```

Bottom status bar: Permissions: RW, End-of-lines: LF, Encoding: UTF-8, Line: 8, Column: 1, Memory: 73 %

Loop statements: if

The screenshot shows a Jupyter Notebook interface with the following components:

- Editor Tab:** Contains Python code demonstrating loops and conditionals.
- Variable explorer Tab:** Shows a table of variables with their names, types, sizes, and values.
- Console Tab:** Displays the output of running the code in the editor.
- Bottom Status Bar:** Provides system information like permissions, encoding, line number, and memory usage.

Code in Editor:

```
3 """
4 Created on Thu Aug 31 14:41:25 2017
5
6 @author: subhayan_apple
7 """
8
9 import numpy as np
10 x=np.array ([1, 2, 3, 4])
11 sum1 = 0
12
13 # for loop
14 for i in range(len(x)):
15     sum1+=x[i]
16 Mean = sum1/len(x)
17 print ('Mean = ',Mean)
18
19 # use numpy.mean() to calculate the mean
20 Mean2=np.mean(x)
21
22 # if loop
23 if Mean==Mean2:
24     print('My code is correct!')
```

Variable explorer:

Name	Type	Size	Value
Mean	float64	1	2.5
Mean2	float64	1	2.5
i	int	1	3
sum1	int64	1	10
x	int64	(4,)	[1, 2, 3, 4]

Console Output:

```
In [6]: runfile('/Users/subhayan_apple/Google Drive/Python codes/test_if_loop.py', wdir='/Users/subhayan_apple/Google Drive/Python codes')
Mean = 2.5
My code is correct!
```

In [7]:

Loop statements: *while*

The screenshot shows a Jupyter Notebook interface with the following components:

- Editor Tab:** Contains the Python code for calculating the mean of a list of numbers using a `while` loop.
- Variable explorer Tab:** Shows a table of variables with their types, sizes, and values.
- Console Tab:** Displays the output of running the code in the current notebook.
- Bottom Status Bar:** Provides information about permissions, encoding, line, column, and memory usage.

Code in Editor:

```
1#!/usr/bin/env python3
2# -*- coding: utf-8 -*-
3"""
4Created on Thu Aug 31 14:45:54 2017
5
6@author: subhayan_apple
7"""
8
9import numpy as np
10x=np.array ([1, 2, 3, 4])
11sum1 = 0
12i=0
13
14# for loop
15while i<len(x):
16    sum1+=x[i]
17    i+=1
18Mean = sum1/len(x)
19print ('Mean = ',Mean)
```

Variable explorer:

Name	Type	Size	Value
Mean	float64	1	2.5
Mean2	float64	1	2.5
i	int	1	4
sum1	int64	1	10
x	int64	(4,)	[1, 2, 3, 4]

Console Output:

```
In [7]: runfile('/Users/subhayan_apple/Google Drive/Python codes/test_while_loop.py', wdir='/Users/subhayan_apple/Google Drive/Python codes')
Mean =  2.5

In [8]:
```

Permissions: RW End-of-lines: LF Encoding: UTF-8 Line: 17 Column: 9 Memory: 77%

Define a function

The screenshot shows a Jupyter Notebook interface with several panes:

- Editor:** Displays Python code for calculating the mean of a list of numbers. The code includes imports, a function definition, and a print statement.
- Variable explorer:** Shows a table of variables with their names, types, sizes, and values. It includes variables like Mean (float64), i (int), sum1 (int64), and x (int64).
- Console:** Displays the output of running the code. It shows the definition of the function, its execution, and the resulting mean value.
- Python console:** Shows the command runfile and its output, indicating the code was run in the Python console.

```
1#!/usr/bin/env python3
2# -*- coding: utf-8 -*-
3"""
4Created on Tue Aug 29 15:54:29 2017
5
6@author: subhayan_apple
7"""
8
9import numpy as np
10
11def my_mean_fun(data):
12    sum1 = 0
13    for i in range(len(data)):
14        sum1+=data[i]
15    Mean = sum1/len(data)
16    return (Mean)
17
18x=np.array ([1, 2, 3, 4])
19Mean = my_mean_fun(x)
20print ('Mean = ',Mean)
```

Name	Type	Size	Value
Mean	float64	1	2.5
i	int	1	3
sum1	int64	1	10
x	int64	(4,)	[1, 2, 3, 4]

```
In [1]: Python codes/test2.py, wdir='/Users/subhayan_apple/Google Drive/Python codes'
In [1]: Mean = 2.5
In [2]: runfile('/Users/subhayan_apple/Google Drive/Python codes/test3.py', wdir='/Users/subhayan_apple/Google Drive/Python codes')
In [2]: Mean = 2.5
In [3]:
```

Permissions: RW End-of-lines: LF Encoding: UTF-8 Line: 7 Column: 1 Memory: 73 %

Codes and Tutorials

- ▶ You can find the codes and notes used during the discussion sessions on my website: www.subhayande.com under the Tutorials tab.
- ▶ Office hours: M 2-4 pm, W 4-6 pm (KAP 115).

THANK YOU