

Python Tutorial 1

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In this course we are using on Python 3. You can download it from:

<https://www.python.org/downloads/>

1.1 Python Syntax

Basic Syntax

- simple data structure: `,` `[]`
- `print`
- simple algebraic operator: `+`, `-`, `*`, `/`, `%`, `**`
- Logical operator: `and`, `or`, `not`
- If statement, Loop Statement, and Indentation.

```
def Example1(a,b):
    c = a + b + 4    # use "#" for comments
    c = "test"      # Python is weak typing programming language
    if c == "test":
        d = 10      # a local variable ,
                    # use INDENTATION to indicate this statement is inside "if"
    c = 1 # not inside "if"
    while (c < 10):
        c +=1 # Note: python does not support ++
    print(c)        # Question: What values are printed?
    for i in range (10):
        print(i) # Question: What values are printed?
    for i in range (5,20,3):
        print(i) # Question: What values are printed?
    return c
```

File IO

- `open()`
- `read()`
- `readlines()`
- `write()`

```
def Example2(Input, Output):
    Fout = open(Output, 'w')
    with open(Input) as f:
        lines = f.readlines() # lines stores strings from Input line by line
        for l in lines: #iterate through all lines
            words = l.split() # split stirngs by space
            Fout.write(words[-1]) #wrtie the last word to Fout
            Fout.write('\n')
```

Simple Object-Oriented Programming:

```
class GradStudent:
    advisor = None
    school = None
    courseList = []
    def __init__(self, advisor, school):
        self.advisor = advisor
        self.school = school
        self.courseList = []

    def switchAdvisor(self, advisor):
        self.advisor = advisor

    def takeCourse(self, course):
        self.courseList.append(course)
```

1.2 Useful Libraries

- SciPy <https://www.scipy.org>
- NumPy <https://www.numpy.org>
- MatPlot <http://matplotlib.org>

1.2.1 Numpy

Tutorial: <https://docs.scipy.org/doc/numpy-dev/user/quickstart.html>

One of Numpy's main object is the homogeneous multidimensional array. It is a table of elements (usually numbers), all of the same type, indexed by a tuple of positive integers. In NumPy dimensions are called axes. The number of axes is rank.

ndarray: The numpy's array class is called ndarray, it's not the same as the standard array.array, which only handles one-dienional arrays and offers less functionality.

- `ndim()`: The number of axes of array.
- `shape()`: The dimensions of the array.
- `size()`: total number of elements

- `array()`: creating array

```
import numpy as np
def Example3():
    a = np.arange(15).reshape(3,5)
    print(a)
    print(a.shape)
    print(a.ndim)
    a = np.array([2,3,4])
```

1.2.2 SciPy

Tutorial: <https://docs.scipy.org/doc/scipy/reference/tutorial/>

SciPy is a collection of mathematical algorithms and convenience functions built on the Numpy extension of Python. You can use SciPy to solve the following problems:

1. Integration
2. Optimization
3. Interpolation
4. Fourier Transforms
5. Singal Processing
6. Linear Algebra
7. Statistics
8. Image Processing
9. File IO
10. Spatial data structures and algorithms

```
import numpy as np
def Example4():
    for i in range(20):
        noise = np.random.laplace(scale = 5)
        print(noise)
```

1.2.3 MatPlot

Tutorial: <http://matplotlib.org/users/tutorials.html>

Matplotlib is a Python 2D plotting library which produces publication quality figures in a variety of hardcopy formats and interactive environments across platforms.

Bar chart Sample Code: https://matplotlib.org/examples/api/barchart_demo.html