Python Tutorial

A Python Tutorial focused for Data Mining

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Data Mining Training Session

About the Facilitator

- Background
  - BS Electronics and Communications Engineering
  - *MS Industrial Engineering (Information Systems)
  - Licensed Electronics Engineer
- Work
  - Nokia Technology Philippines Inc.
    - Software Engineer for Base Stations
    - Scrum Master
    - Nokia Insider
    - 1st Placer IoE Hackathon
  - Big Data Project
    - Systems Developer
    - Webscraped supermarket and real estate prices
    - Analytics Platform
    - Consultant for Big Data Integration
  - DTI Inventory Management System
    - Lead Developer
    - Inventory Management System
    - Monitoring and consolidat
  - ISU ODeSSee
    - Information Systems Analyst
    - Data Trends for both Typhoon-related disasters and Covid-19 Trends
    - ETL for geospatial analysis
  - PGH Ivermectin Study
    - Project Development Officer
    - Clinical Trial Electronic Data Capture
  - iCity: Digital Business Locator
    - Information Systems Analyst
    - Data Cleaning, Processing, Concept
- Others
  - *I was able to deliver these projects using only Python*
  - **Self-pledged pythonista**

Gauging the Baseline

https://www.mentimeter.com/app Go to menti.com

About the session

- Learn basic python
- Introduction to python tools for data mining
- Regression Analysis

Python installation:

- Install Jupyter-Notebook on Windows
- Install Jupyter-Notebook on Mac

Online Python Notebooks:

- JupyterLite
  - for basic python demo
- Google Colaboratory
  - more advance installed libraries available
  - a bit slow

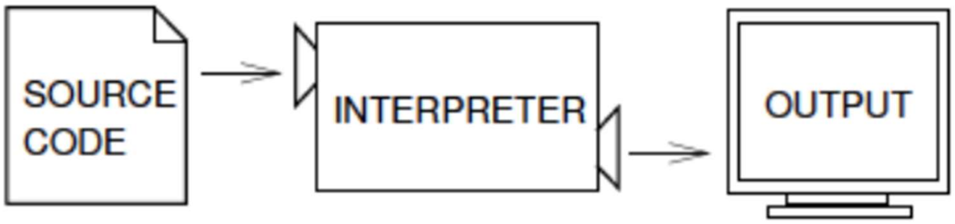
Objectives

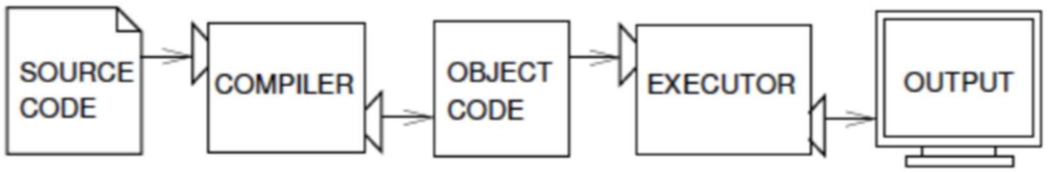
- Learn and apply basic and core python
- Be Introduced in python tools
- Learn and apply essential Data Science libraries used for data exploration, processing and transformation for further analysis
- Apply python for data mining applications
- Brief introduction for different data mining libraries

Obj: Learn and apply basic and advanced programming skills in core python

What is Python?

- Python is an example of a high-level language
- Low-level languages(assembly languages or machine languages) are the ones computer only understands.
- Thus, a high-level language has to be processed; taking some time.
- Advantages of a high-level language: easier to code, portability
- Low-level languages are only used for a few specialized applications.
- Kinds of program process high-level languages into low-level languages: interpreter and compiler





- Python is considered as interpreted language because Python programs are executed by an interpreter.
- Two ways to use interpreter
  - command line
  - script mode
  - * notebook - just command line

Program

A program is a sequence of instructions that specifies how to perform a computation. The computation might be something mathematical, such as solving a system of equations or finding the roots of a polynomial, but it can also be a symbolic computation, such as searching and replacing text in a document or (strangely enough) compiling a program.

Terms: * **input**: Get data from the keyboard, a file, or some other device. * **output**: Display data on the screen or send data to a file or other device. * **math**: Perform basic mathematical operations like addition and multiplication. * **conditional execution**: Check for certain conditions and execute the appropriate sequence of statements. * **repetition**: Perform some action repeatedly, usually with some variation.

Programming is a complex process, and because it is done by human beings, it often leads to errors. For whimsical reasons, programming errors are called bugs and the process of tracking them down and correcting them is called debugging .

Errors

Three kinds of errors can occur in a program:

syntax errors - not follow the syntax of the program

runtime errors - occurs once your program runs

semantic errors - the program you wrote is not the program you wanted to write

Debugging

Experimental debugging is like detective work. You are confronted with clues, and you have to infer the processes and events that led to the results you see.

Variables

One of the most powerful features of a programming language is the ability to manipulate **variables**. A variable is a name that refers to a value.

Variable Rules * Variable names can be arbitrarily long. * They can contain both letters and numbers, but they have to begin with a letter. * Although it is legal to use uppercase letters, by convention we don’t. If you do, remember that case matters. `Bruce` and `bruce` are different variables. * You include underscore character

Expressions

If an expression is given as a command, it is evaluated, printed and the value is lost

Assignments

The **assignment statement** creates new variables and gives them values:

```
# variable = value
message = "What’s up, Doc?"
n = 17
pi = 3.14159
```

Statements

an instruction that the Python interpreter can execute.

```
#%% Expressions, Assignments and Statements
print(2+1)

2+5

r=5
print(r)

s=r+10
print(s)

my_income = 1000
tax_rate=0.12
my_taxes=my_income*tax_rate
print(my_taxes)
```

Operators and Operands

Operators are special symbols that represent computations like addition and multiplication. The values the operator uses are called operands.

- addition: +
- subtraction: -
- multiplication: *
- division: /
- power: **
- modulo: %
- greater than: >
- greater than equal to : >=
- less than equal to: <=
- equal: ==
- not equal: !=

Formatted Printing

```
food = "pizza"

print(f'My favorite food is {food}')

_str = "mathematics"
_float = 0.78
_int = 78

print('In %s, we can convert %d percent as %f in decimal' % (_str, _int,
_float))
print('%f can be rounded up to %.1f' % (_float, _float))

print('%d %d %d %d' % (1,2,3,4))

print('%s %s %s %s' % ('one', 'two', 'three', 'four'))

formatter = '%r %r %r %r'

print(formatter % (1,2,3,4))

print(formatter % ('one', 'two', 'three', 'four'))

print('Print statements use single quotes')

print("But you can also use double quotes")

print("It's easier to use double quotes when statements have contractions or
possessions")

print('And single quotes when you need to say something like "hi"')

print('But it\'s still okay to use single quotes as long as you place a
backslash')

print("The same goes for double quotes(\")")

_str = "string"
print('I can also concat ', _str)
```

Data Types

There are different kinds of datatypes in python:

- integer

```
x = 1
```

- float

```
pi = 3.14159
half = 1/2
```

- string

```
str1 = 'Hello'
str2 = "World"

# accessing a character
print(str1[0]) #'H'

# accessing 3rd to 4th character
print(str1[2:4]) # ll

# accessing 1st to 3rd
print(str1[:3]) # Hel

# accessing 3rd to last
print(str1[2:]) # llo

# print string twice
print(str1*2) # HelloHello

# concatenate string
print(str1+"WORLD") # HelloWORLD

# what happens?
print(str1[-1])
```

- list:

```
hairs = ['brown', 'blond', 'red']
weights = [1,2,3,4]

#it can be heterogenous
info = ['Bob', 23, 'Male']

# accessing an element
print(hairs[1]) # 'blond'

# adding element/s
hairs.append('black')
print(hairs) #['brown', 'blond', 'red', 'black']

hairs.extend(hairs)
print(hairs) #['brown', 'blond', 'red', 'black', 'brown', 'blond', 'red',
'black']

hairs.insert(1, 'violet')
print(hairs) #['brown', 'violet', 'blond', 'red', 'black', 'brown', 'blond',
'red', 'black']

# removing element
hairs.remove('brown')
print(hairs)

# sorting
hairs.sort()
print(hairs) #['black', 'black', 'blond', 'blond', 'brown', 'red', 'red',
'violet']

hairs.reverse()
print(hairs) #['violet', 'red', 'red', 'brown', 'blond', 'blond', 'black',
'black']

# taking element/s
print(hairs.pop(1)) #red
print(hairs) #['violet', 'red', 'brown', 'blond', 'blond', 'black', 'black']

print(hairs.pop()) #black (last one)
print(hairs) #['violet', 'red', 'brown', 'blond', 'blond', 'black']
```

- tuple
  - the same with `list` BUT it is enclosed with parentheses `()`

```
_tuple = ('abcd', 786 , 2.23, 'john', 70.2)
tinytuple = (123, 'john')

# Prints complete list
print(_tuple)

# Prints first element of the list
print(_tuple[0])

# Prints elements starting from 2nd till 3rd
print(_tuple[1:3])

# Prints elements starting from 3rd element
print(_tuple[2:])

# Prints list two times
print(tinytuple * 2)

# Prints concatenated lists
print(_tuple + tinytuple)
```

- cannot be updated; no assignment operations

```
# try
_tuple.insert(1)
```

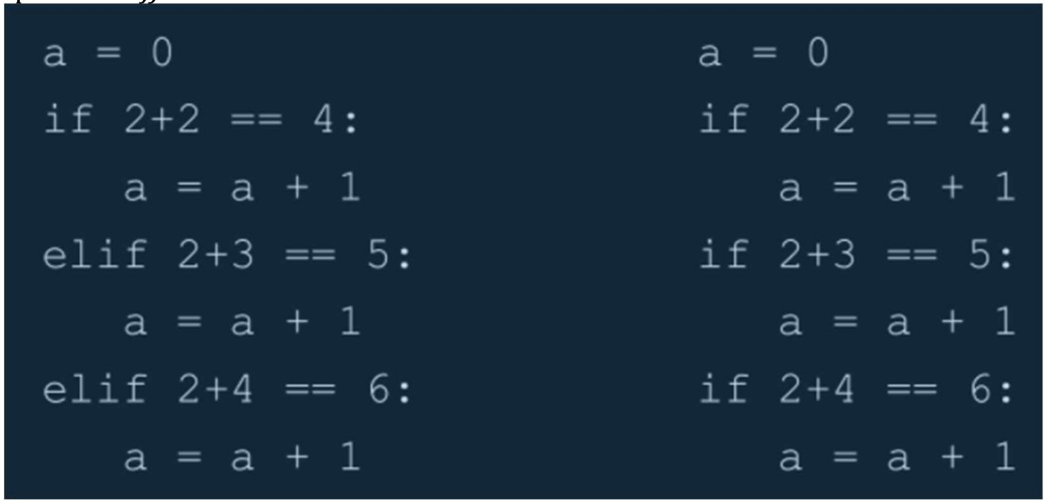
- dictionary
  - kind of hash table type
  - key-value pair. key can be any data type but usually numbers and strings

```
dictio = {}

dictio['one'] = 'This is one'
dictio[2] = 'This is two'

tinydictio = {'name': 'john', 'code':6734, 'dept': 'sales'}

print(dictio['one']) #'This is one'

print(dictio[2]) #'This is two'

# Prints complete dictionary
print(tinydictio)

# Prints dictionary items
print(tinydictio.items())

# Prints all the keys
print(tinydictio.keys())

# Prints all the values
print(tinydictio.values())
```

Conditional Statements

```
a = -1
if a > 0:
    print("positive")
elif a == 0:
    print("zero")
else:
    print("negative")
```

spot the difference



```
a = 0
if 2+2 == 4:
    a = a + 1
elif 2+3 == 5:
    a = a + 1
elif 2+4 == 6:
    a = a + 1
```

```
a = 0
if 2+2 == 4:
    a = a + 1
if 2+3 == 5:
    a = a + 1
if 2+4 == 6:
    a = a + 1
```

Nested Conditions

```
a = 0
if 2+2 == 4:
    if 2+3 == 5:
        if 2+4 == 6:
            a = a + 1
        else:
            a = a + 3
else:
    a = a + 4
# what is a?
print(a)
```

Looping Statements

- For Loop

```
hairs = ['brown', 'blond', 'red']
for hair in hairs:
    print("Color: %s" % hair)

print('first loop')
x = 10
for a in range(x):
    print(a)
    # prints from 0 to x - 1

print('second loop')
y=20
for b in range(x,y):
    print(b)
    # prints from x to y - 1

print('third loop')
step=2
for c in range(x,y,step):
    print(c)
    # prints from x to y - 1 with step as addend
```

- While Loop

```
i = 0
numbers = []

while i < 6:
    print("At the top i is %d" % i)
    numbers.append(i)
    i = i + 1
    print("Numbers now: ", numbers)
    print("At the bottom i is %d:" % i)
```

- Continue

```
for a in range(10):
    if a % 2 == 0:
        continue
    print(a)
```

- Break

```
for a in range(10)
    if a == 5:
        break
    print(a)
```

Functions

```python
def print_two(*args):
    arg1, arg2 = args
    print(args) # *args pass arguments as tuples
    print("arg1: %r, arg2: %r" % (arg1, arg2))

def print_two_again(arg1, arg2):
    print("arg1: %r, arg2: %r" % (arg1, arg2))

def print_one(arg1):
    print("arg1: %r" % arg1)

def print_none():
    print("I got nothin'.")

print_two("Bob", "Alice")
print_two_again("Bob", "Alice")
print_one("First!")
print_none()

def print_kw(**kwargs):
    print(kwargs) #**kwargs pass arguments as dictionaries

print_kw(name="Bearbrand", milk="Nay")
#{'name': 'Bearbrand', 'milk': 'Nay'}
```

Function Return

```python
def add(a, b):
    return a + b

result = add(3, 4)
print(result)
```

Input Method

```
x = input()
print(f"You've input x={x}")
y = input("Please enter a number")
print(f"You've input y={y}")

# Notice that input will always force input as...
print(type(x))
print(type(y))
```

Input Method Scripts

- create a file `input_method.py` in our working directory

```
from sys import argv
script, b, c, d = argv

print(argv)
print("script: ", script)
print("second input: ", b)
print("third input: ", c)
print("fourth input: ", d)
```

Writing Files

- create a file `writing_files.py` in our working directory

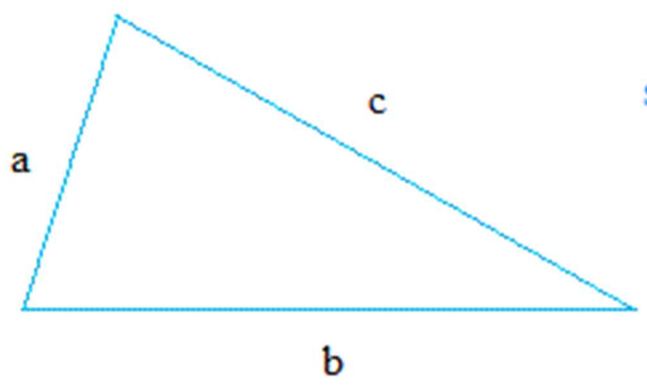
```
from sys import argv
from os.path import exists

script, from_file, to_file = argv

input = open(from_file)
indata = input.read()

if not exists(to_file):
    output = open(to_file, 'w')
    output.write(indata)
    output.close()
else:
    print("already_exists")

input.close()
```

Exercise 1

Using the concepts presented in the previous secion, evaluate how to answer the following problems:

- Given the side length of a triangle a = 122, b = 22, c = 120, assign to variables `area` and perimeter `s` the following computation based on the Heron's formula and print the results for the following variables.

Heron's Formula : $$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$



$$s = \frac{a+b+c}{2}$$

```
a = 122
b = 22
c = 120
#...
# Answer
s = 132
area = 1320
```

- Given arguments P, Y, R, calculate the monthly payments you would have to make over Y years to pay off P dollar loan at R percent interest compounded monthly. The formula is shown below:

$$Payment = \frac{Pr}{1-(1+r)^{-n}}$$

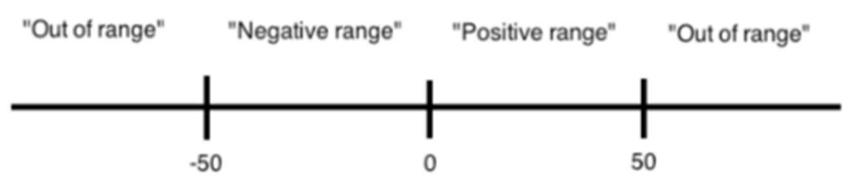
where $n = 12 * Y, r = R/(12 * 100)$

```
P = 122
Y = 22
R = 120
#...
# Answer
Payment = 41.98862770388198
```

- Write a function that adds one to all even numbers on this list

```
x_list = [11, 6, 5, 7, 10]
# ...
print(x_list)
# 11, 7, 5, 7, 11

# hint: try running code below
value_list = ['a', 'b', 'c']
for counter, value in enumerate(value_list):
    print(counter, value)
```

- Write a function that checks all values in list and then prints out the string relative to its value as indicated in the figure below. Note, if it touches the border, it should print "Border"



```
_list = [-25, 50, 25, 100]
# ...
# -25 Negative range
# 50 Border
# 25 Positive range
# 100 Out of range
```

- Write a program `arithmetic.py`
  - takes two inputs a, b in the command line
  - calls a function to compute sum
  - calls a function to compute difference
  - calls a function to compute product
  - calls a function to compute quotient
  - calls a function to print results of previous functions

```
# Test
a = 1
b = 2
#...
sum = 3
difference = -1
product = 2
quotient = 0.50
```

- Write a program `grades.py` that prints the equivalent grade in letters.
  - >= 90 is A
  - [80, 90) is B
  - [70, 80) is C
  - [60, 70) is D
  - < 60 is E
- Write a program `consonants.py`
  - reads a file via command line
  - returns only the consonants of the file and sorted them alphabetically *bonus: remove repeating characters*
  - create a `test.txt` file in the working directory

```
the quick brown fox jumps over the lazy dog
```