A short introduction on the Python

Using Python Console in Pycharm

- Open Pycharm
- Menu Tools==> Python Console

The Python Interpreter

EVOLVE
MACHINE LEARNERS

- Python is an interpreted language
- The interpreter provides an interactive environment to play with the language
- Results of expressions are printed on the screen

```
>>> 3 + 7
10
>>> 3 < 15
True
>>> 'print me'
'print me'
>>> print ('print me')
print me
>>>
```

The print Statement

EVOLVE
MACHINE LEARNERS

- Elements separated by commas print with a space between them
- A comma at the end of the statement (print ‘hello’,) will not print a newline character

```
>>> print ('hello')
hello
>>> print ('hello', 'there')
hello there
```

Documentation

EVOLVE
MACHINE LEARNERS

The ‘#’ starts a line comment

```
>>> 'this will print'
'this will print'
>>> #'this will not'
>>>
```

Everything is an object

EVOLVE
MACHINE LEARNERS

- Everything means everything, including functions and classes (more on this later!)
- Data type is a property of the object and not of the variable

```
>>> x = 7
>>> x
7
>>> x = 'hello'
>>> x
'hello'
>>>
```

Numbers: Floating Point

EVOLVE
MACHINE LEARNERS

- int(x) converts x to an integer
- float(x) converts x to a floating point
- The interpreter shows a lot of digits

```
>>> 1.23232
1.2323200000000001
>>> print 1.23232
1.23232
>>> 1.3E7
13000000.0
>>> int(2.0)
2
>>> float(2)
2.0
```

String Literals

- Strings are *immutable*
- There is no char type like in C++ or Java
- + is overloaded to do concatenation

```
>>> x = 'hello'
>>> x = x + ' there'
>>> x
'hello there'
```

String Literals: Many Kinds

EVOLVE
MACHINE LEARNERS

- Can use single or double quotes, and three double quotes for a multi-line string

```
>>> 'I am a string'
'I am a string'
>>> "So am I!"
'So am I!'
>>> s = """And me too!
though I am much longer
than the others :)"""
'And me too!\nthough I am much longer\nthan the others :)‘
>>> print s
And me too!
though I am much longer
than the others :)‘
```

Substrings and Methods

EVOLVE
MACHINE LEARNERS

```
>>> s = '012345'
>>> s[3]
'3'
>>> s[1:4]
'123'
>>> s[2:]
'2345'
>>> s[:4]
'0123'
>>> s[-2]
'4'
```

- **len**(String) – returns the number of characters in the String

- **str**(Object) – returns a String representation of the Object

```
>>> len(x)
6
>>> str(10.3)
'10.3'
```

Lists

- Ordered collection of data
- Data can be of different types
- Lists are *mutable*
- Issues with shared references and mutability
- Same subset operations as Strings

```
>>> x = [1,'hello', (3 + 2j)]
>>> x
[1, 'hello', (3+2j)]
>>> x[2]
(3+2j)
>>> x[0:2]
[1, 'hello']
```

Lists: Modifying Content

EVOLVE
MACHINE LEARNERS

- **x[i] = a** reassigns the ith element to the value a
- Since x and y point to the same list object, *both* are changed
- The method **append** also modifies the list

```
>>> x = [1,2,3]
>>> y = x
>>> x[1] = 15
>>> x
[1, 15, 3]
>>> y
[1, 15, 3]
>>> x.append(12)
>>> y
[1, 15, 3, 12]
```

Lists: Modifying Contents

EVOLVE
MACHINE LEARNERS

- The method **append** modifies the list and returns **None**
- List addition (+) returns a new list

```
>>> x = [1,2,3]
>>> y = x
>>> z = x.append(12)
>>> z == None
True
>>> y
[1, 2, 3, 12]
>>> x = x + [9,10]
>>> x
[1, 2, 3, 12, 9, 10]
>>> y
[1, 2, 3, 12]
>>>
```

Tuples

- Tuples are *immutable* versions of lists
- One strange point is the format to make a tuple with one element:

  ‘,’ is needed to differentiate from the mathematical expression (2)

```
>>> x = (1,2,3)
>>> x[1:]
(2, 3)
>>> y = (2,)
>>> y
(2,)
>>>
```

Dictionaries

EVOLVE
MACHINE LEARNERS

- A set of key-value pairs
- Dictionaries are *mutable*

```
>>> d = {1 : 'hello', 'two' : 42, 'blah' : [1,2,3]}
>>> d
{1: 'hello', 'two': 42, 'blah': [1, 2, 3]}
>>> d['blah']
[1, 2, 3]
```

Dictionaries: Add/Modify

EVOLVE
MACHINE LEARNERS

- Entries can be changed by assigning to that entry

```
>>> d
{1: 'hello', 'two': 42, 'blah': [1, 2, 3]}
>>> d['two'] = 99
>>> d
{1: 'hello', 'two': 99, 'blah': [1, 2, 3]}
```

- Assigning to a key that does not exist adds an entry

```
>>> d[7] = 'new entry'
>>> d
{1: 'hello', 7: 'new entry', 'two': 99, 'blah': [1, 2, 3]}
```

Dictionaries: Deleting Elements

- The **del** method deletes an element from a dictionary

```
>>> d
{1: 'hello', 2: 'there', 10: 'world'}
>>> del(d[2])
>>> d
{1: 'hello', 10: 'world'}
```

Copying Dictionaries and Lists

EVOLVE
MACHINE LEARNERS

- The built-in **list** function will copy a list
- The dictionary has a method called **copy**

```
>>> l1 = [1]
>>> l2 = list(l1)
>>> l1[0] = 22
>>> l1
[22]
>>> l2
[1]
```

```
>>> d = {1 : 10}
>>> d2 = d.copy()
>>> d[1] = 22
>>> d
{1: 22}
>>> d2
{1: 10}
```

Moving to Files

- The interpreter is a good place to try out some code, but what you type is not reusable
- Python code files can be read into the interpreter using the **import** statement

Moving to Files

- In order to be able to find a module called myscripts.py, the interpreter scans the list sys.path of directory names.
- The module must be in one of those directories.

```
>>> import sys
>>> sys.path
['C:\\Python26\\Lib\\idlelib', 'C:\\WINDOWS\\system32\\python26.zip',
'C:\\Python26\\DLLs', 'C:\\Python26\\lib', 'C:\\Python26\\lib\\plat-win',
'C:\\Python26\\lib\\lib-tk', 'C:\\Python26', 'C:\\Python26\\lib\\site-packages']
>>> import myscripts
Traceback (most recent call last):
  File "<pyshell#2>", line 1, in <module>
    import myscripts.py
ImportError: No module named myscripts.py
```

Moving to Files

- The interpreter is a good place to try out some code, but what you type is not reusable
- Python code files can be read into the interpreter using the **import** statement

No Braces

- Python uses ***indentation*** instead of braces to determine the scope of expressions
- All lines must be indented the same amount to be part of the scope (or indented more if part of an inner scope)
- This **forces** the programmer to use proper indentation since the indenting is part of the program!

If Statements

EVOLVE
MACHINE LEARNERS

```
import math
x = 30
if x <= 15 :
    y = x + 15
elif x <= 30  :
    y = x + 30
else :
    y = x
print ‘y = ‘,
print math.sin(y)
```

In file ifstatement.py

```
>>> import ifstatement
y =  0.999911860107
>>>
```

In interpreter

While Loops

EVOLVE
MACHINE LEARNERS

```
x = 1
while x < 10 :
    print x
    x = x + 1
```

In whileloop.py

```
>>> import whileloop
1
2
3
4
5
6
7
8
9
>>>
```

In interpreter

Loop Control Statements

EVOLVE
MACHINE LEARNERS

break	Jumps out of the closest enclosing loop
continue	Jumps to the top of the closest enclosing loop
pass	Does nothing, empty statement placeholder

The Loop Else Clause

EVOLVE
MACHINE LEARNERS

- The optional **else** clause runs only if the loop exits normally (not by break)

```
x = 1

while x < 3 :
    print x
    x = x + 1
else:
    print 'hello'
```

In whileelse.py

```
~: python whileelse.py
1
2
hello
```

Run from the command line

The Loop Else Clause

EVOLVE
MACHINE LEARNERS

```
x = 1
while x < 5 :
    print x
    x = x + 1
    break
else :
    print 'i got here'
```

whileelse2.py

```
~: python whileelse2.py
1
```

For Loops

- Similar to perl for loops, iterating through a list of values

forloop1.py

```
for x in [1,7,13,2] :
    print x
```

```
~: python forloop1.py
1
7
13
2
```

For Loops

- Similar to perl for loops, iterating through a list of values

forloop2.py

```
for x in range(5) :
    print x
```

```
~: python forloop2.py
0
1
2
3
4
```

For Loops

EVOLVE
MACHINE LEARNERS

- **For** loops also may have the optional **else** clause

```
for x in range(5):
    print x
    break
else :
    print 'i got here'
```

elseforloop.py

Function Basics

EVOLVE
MACHINE LEARNERS

```
def max(x,y) :
    if x < y :
        return x
    else :
        return y
```

functionbasics.py

```
>>> import functionbasics
>>> max(3,5)
5
>>> max('hello', 'there')
'there'
>>> max(3, 'hello')
'hello'
```

Functions as Parameters

EVOLVE
MACHINE LEARNERS

```
def foo(f, a) :
    return f(a)

def bar(x) :
    return x * x
```

funcasparam.py

```
>>> from funcasparam import *
>>> foo(bar, 3)
9
```

Note that the function foo takes two parameters and applies the first as a function with the second as its parameter

Higher-Order Functions

EVOLVE
MACHINE LEARNERS

map(func,seq) – for all i, applies func(seq[i]) and returns the corresponding sequence of the calculated results.

```
def double(x):
    return 2*x
```

highorder.py

```
>>> from highorder import *
>>> lst = range(10)
>>> lst
[0,1,2,3,4,5,6,7,8,9]
>>> map(double,lst)
[0,2,4,6,8,10,12,14,16,18]
```

Higher-Order Functions

EVOLVE
MACHINE LEARNERS

filter(boolfunc,seq) – returns a sequence containing all those items in seq for which boolfunc is True.

```
def even(x):
    return ((x%2 == 0)
```

highorder.py

```
>>> from highorder import *
>>> lst = range(10)
>>> lst
[0,1,2,3,4,5,6,7,8,9]
>>> filter(even,lst)
[0,2,4,6,8]
```

Class example

- bag.py

```
class Bag:
  def __init__(self):
    self.data = []
  def add(self, x):
    self.data.append(x)
  def addtwice(self,x):
    self.add(x)
    self.add(x)
```

Class example

- invoke:

```
>>> from bag import *
>>> l = Bag()
>>> l.add('first')
>>> l.add('second')
>>> l.addtwice('three’)
>>> l.data
['first', 'second', ‘three’, ‘three’]
```