PYTHON

PYTHON PROGRAMMING

By
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Introducing Myself

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Boring Stuff about me:

- 14+ years of experience in development and training
- Started with Java, moved to Android and now working on Big Data Technologies

Interesting Things about me:

- Actually Nothing !

Getting to know you

Show of hands please!

- Any freshers in this group?
- What is the general development experience of this group
  - 0-2 years, 0-5 years, 5 and above
- What programming area are you currently working on?
  - Java, Web Stack, Analytics, Big data, any other
- Why are you learning python programming?
  - Sys admin, Web development, Data Analytics, IoT, any other

Agenda

- Python programming
- Advanced Python
- Object Oriented Programming in Python

Course Objectives

- At ease with python programming
- Pythonic way of coding
- Learn OOP in python

Chapter: Introduction

Python

High Level
Interpreted
Dynamic Programming language
Multi-paradigm language
- OO
- Functional
- Procedural
- Imperative

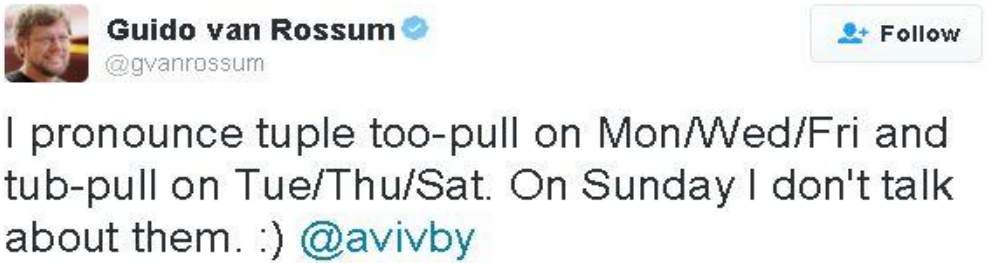
The idea of Python started in 1980 and the implementation began by 1990
- Author: Guido Von Rossum

Guido van Rossum

Python 's
Benevolent Dictator For Life (BDFL)

In Guido van Rossum's words

Over six years ago, in December 1989, I was looking for a "hobby" programming project that would keep me occupied during the week around Christmas. My office ... would be closed, but I had a home computer, and not much else on my hands. I decided to write an interpreter for the new scripting language I had been thinking about lately: a descendant of ABC that would appeal to Unix/C hackers. I chose Python as a working title for the project, being in a slightly irreverent mood (and a big fan of Monty Python's Flying Circus).



A funny Guy : Check his answer on asking how to pronounce "tuple" – a data structure in Python

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Zen of Python

A set of 20 aphorisms. My favs below

- Beautiful is better than ugly.
- Simple is better than complex.
- Complex is better than complicated.
- Readability counts.
- Errors should never pass silently.
- In the face of ambiguity, refuse the temptation to guess.
- If the implementation is hard to explain, it's a bad idea.
- If the implementation is easy to explain, it may be a good idea.

--Tim Peters

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Why should I love python?

Python is very concise

```
public class HelloWorld
{
        public static void main
(String[] args)        {

        System.out.println(“Hello
world!”);
        }
}
```

```
print “Hello world!”
```

Why should I love python?

Python is as readable as a pseudo code.
Readability is very important because very often code is read more than its written

```
fileHandle = open(“somefile.txt”, “r”)

for line in fileHandle:
    print line
```

Why should I love python?

Eliminates a lot of syntax overheads.

- No dreaded semi-colon at the end ";"
- No flower brackets "}" for blocks

```
var1 = 100

if var1>100:
    print "Not a century"
    print var1
else:
    print "It's a century"
    print var1

print "Bye!"
```

Why should I love python?

Follows duck typing

- Lot less coding.
- Forces a clean understanding of code before using it.
- Can be dangerous too, depending on what kind of a programmer you are!

```
def f(someobj):
    someobj.quack()
```

```
If a equals 10:
   f(b)

#suppose b cannot quack and a is
#very rarely 10. you will not see
#an error as long as a is never 10
```

Why should I love python?

Python comes with batteries included.

Python Standard Library

Simply put, Python has a large standard library. Some examples

- HTTP Protocols
- Database access
- IPC
- File system access

Python Package Index

- Python Package Index is a repository for python libraries
- Currently has over 89000 packages
- These can be installed through pip

Version of Python for this course

- We will be using version 2.7.12
- The latest version is 3.7
- Python 3 and Python 2 are radically different at a many places.
  - Implies all the libraries have to be ported to Python 3
  - Due the compatibility issues Python 2 versions continue to find favour
  - In a couple of years time, we would see everything in Python 3
- Incremental learning from 2.x to 3.x is not very difficult

Chapter: Setup

Python setup or installation

Step 1	• Download from https://www.python.org/downloads/
Step 2	• Run the installer and click through
Step 3	• Run IDLE and the python shell should come up

Check the installation guide provided (You will not need this)

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Chapter: Basic data types

The proverbial “hello world” program

```
>>> print “Hello World!"
Hello World!

>>> print 'Hello World!'
Hello World!

>>> print '''Hello World!'''
Hello World!

>>> print """Hello World!"""
Hello World!
```

```
>>> print “Hello \
World!"
Hello World!

>>> print ‘’’Hello
World!'''
Hello
World
```

Variables

```
>>> a = 10
>>> b = 10.2
>>> c = True
>>> d = 'Hello'
>>> print a , b, c, d
10 10.2 True Hello
```

```
>>> type(a)
<type 'int'>

>>> type(b)
<type 'float'>

>>> type(c)
<type 'bool'>

>>> type(d)
<type 'str'>
```

Python Errors

```
>>> a = 10/0

Traceback (most recent call last):
  File "<pyshell#67>", line 1, in
<module>
    a = 10/0
ZeroDivisionError: integer
division or modulo by zero
```

```
>>> hello

Traceback (most recent call last):
  File "<pyshell#65>", line 1, in
<module>
    hello
NameError: name 'hello' is not
defined
```

Python Integers and Floats

```
>>> a = 10 + 4
>>> a
14

>>> a = a*a
>>> a
169

>>> a = 2**10
>>> a
1024
```

```
>>> a= 1.0
>>> type(a)
<type 'float'>
```

Python type conversions

```
>>> a= 10
>>> b = True
>>> a + b
11
>>> a = 10.0
>>> b = True
>>> a + b
11.0
>>> a = True + True
>>> a
2
>>> a = 3
>>> b = 4
>>> a/b
0
```

```
>>> a = 3
>>> b=4.0
>>> a/b
0.75
>>> b/a
1.3333333333333333
>>> a = 5 + '5‘
Traceback (most recent call last):
  File "<pyshell#144>", line 1, in
<module>
    a = 5 + '5'
TypeError: unsupported operand
type(s) for +: 'int' and 'str'
```

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Python type conversions

```
>>> a = 5 + int('5')
>>> a
10

>>> a = 5 + float(1)
>>> a
6.0

>>> a = 3
>>> b = 4
>>> a / float(b)
0.75
```

```
>>> a = 3
>>> b=4.0
>>> a/b
0.75
>>> b/a
1.3333333333333333
>>> a = 5 + '5‘
Traceback (most recent call last):
  File "<pyshell#144>", line 1, in
<module>
    a = 5 + '5'
TypeError: unsupported operand
type(s) for +: 'int' and 'str'
```

Strings

Our Hello World program actually dealt with a lot of strings
Consider strings to be a sequence of ‘char’ s

```
>>> a = "hello"
>>> a
'hello'
>>> a = "Hello" + " World"
>>> a
'Hello World'
>>> a += " Again"
>>> a
'Hello World Again'
```

```
# convert with str
>>> a = str(3) + 's'
>>> a
'3s'

# now try a = a * 5
>>> a = a * 5
>>> a
'3s3s3s3s3s'
```

Strings – access through index

Consider strings to be a sequence of ‘char’ s
Can we extract characters?

```
>>> a = "Hello Bangalore"
>>> a[1]
'e'
>>> a[20]
Traceback (most recent call last):
  File "<pyshell#202>", line 1, in
<module>
    a[20]
IndexError: string index out of
range
```

```
>>> a[-2]
'r'
>>> a[-1]
'e'
>>> a[0]
'H'
>>> len(a)
15

# try changing the char at index 0
a[0]="h"
```

Strings - Slicing

- Slicing a String with a start, end and step
  - To extract a substring
  - [start:end:step]
  - If a is a string then a[0:3] gives a substring
    - which contains a[0], a[1], a[2] characters
    - It is a lot forgiving in terms of index checks. Try with “out of bound” indices

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Strings

```
>>> a='0123456789'
>>> a[0:9]
'012345678'
>>> a[0:10]
'0123456789'
>>> a[0:100]
'0123456789'
>>> a[-3:-1]
'78'
>>> a[-1:3]
''
```

```
>>> a[-1:3:1]
''
>>> a[-1:3:-1]
'987654'
>>> a[-1:-8:-1]
'9876543'
```

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Strings

```
>>> a='0123456789'
>>> a[0:9]
'012345678'
>>> a[0:10]
'0123456789'
>>> a[0:100]
'0123456789'
>>> a[-3:-1]
'78'
>>> a[-1:3]
''
```

```
>>> a[-1:3:1]
''
>>> a[-1:3:-1]
'987654'
>>> a[-1:-8:-1]
'9876543'
```

Strings – summarizing slice movement

String	a	b	c	d	e	f	g	h	i	j
+ve index	0	1	2	3	4	5	6	7	8	9
-ve index	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1

```
>>> a[-1:3]
''
>>> a[-1:3:-1]
'jihge'
```

Strings - challenge

```
>>> a='0123456789'
# Challenge 1 : Print the reverse of the string using slice
# Challenge 2 : Print only the even number indices
# Duration : 3 minutes
```

Lab work

Lab 1

- Attempt Lab work questions #1 – #8 (can skip #2)
- Duration : Approx 12 minutes

Strings – lots of string functions

```
a.startwith('0')
a.endswith('9')
a.find('a')
# funny thing with "find". Returns -1 to say it did not find
a.count('0')
a.isalnum()
a = "the discovery of india"
a.title()
a.capitalize()
a.lower()
a.upper()
```

Strings – now check this

```
>>> a ="the discovery of india"
>>> a.split()
['the', 'discovery', 'of', 'india']
>>> a.split(" ")
['the', 'discovery', 'of', 'india']

# any guesses which movie has this star cast?

>>> b = 'Samuel Jackson, John Trovolta, Bruce Wills, Uma Thurman'
>>> b.split(',')
['Samuel Jackson', ' John Trovolta', ' Bruce Wills', ' Uma Thurman']
```

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Chapter: Lists

Lists

- Data structure to hold a list of items
- These items can be of different data types too
- Can access items of the list using index
- The same slicing operations work well on lists too but at a list item level
  - [start:end:step]
  - [:end:step]
  - [::]
  - [::step]
  - [:end]
  - [:]
- List can contain lists too
- Can be as deeply nested as you want

Lists - creation

```
>>> a = []
>>> a = list()
>>> a
[]
>>> a = []
>>> a
[]
>>> a = list('cat')
>>> a
['c', 'a', 't']
>>> a= 'India,Japan,China,UK,USA'.split(',')
>>> a
['India', 'Japan', 'China', 'UK', 'USA']
```

Lists – accessing list element using index

```
>>> a = ['India', 'Japan', 'China', 'UK', 'USA']
>>> a[1]
'Japan'
>>> a[-1]
'USA'
>>> a[100]

Traceback (most recent call last):
  File "<pyshell#317>", line 1, in <module>
    a[100]
IndexError: list index out of range
```

Lists – slice

```
>>> a = ['India', 'Japan', 'China', 'UK', 'USA']
>>> a[1:3]
['Japan', 'China']
>>> a[-1:]
['USA']
>>> a[-1::-1]
['USA', 'UK', 'China', 'Japan', 'India']
```

Lists – Modifying Lists

```
>>> a
['India', 'Japan', 'China', 'UK',
'USA']
>>> a[3]='Burma'
>>> a
['India', 'Japan', 'China',
'Burma', 'USA']
>>> id(a)
59350280L
>>> a[3]='Russia'
>>> id(a)
59350280L
```

```
>>> b='hello'
>>> b.replace('h','d')
'dello'
>>> b
'hello'
>>> id(b)
59545200L
>>> b = b.replace('h','d')
>>> b
'dello'
>>> id(b)
56578616L
```

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Lists – Modifying Lists

```
>>> a.append('UK')
>>> a
['India', 'Japan', 'China',
'Russia', 'USA', 'UK'] >>> b =
['Sri Lanka','Thailand','Nigeria']
>>> a + b
['India', 'Japan', 'China',
'Russia', 'USA', 'UK', 'Sri
Lanka', 'Thailand', 'Nigeria']
>>> a+=b
>>> a
['India', 'Japan', 'China',
'Russia', 'USA', 'UK', 'Sri
Lanka', 'Thailand', 'Nigeria']
```

```
>>> a = ['India', 'Japan',
'China', 'Russia', 'USA']
>>> a.extend(b)
>>> a
['India', 'Japan', 'China',
'Russia', 'USA', 'Sri Lanka',
'Thailand', 'Nigeria']
>>> a = ['India', 'Japan',
'China', 'Russia', 'USA']
>>> a.append(b)
>>> a
['India', 'Japan', 'China',
'Russia', 'USA', ['Sri Lanka',
'Thailand', 'Nigeria']]
```

Lists – Modifying Lists

```
>>> a = ['India', 'Japan',
'China', 'Russia', 'USA']
>>> a.insert(3,'Ukraine')
>>> a
['India', 'Japan', 'China',
'Ukraine', 'Russia', 'USA']

>>> a.insert(200, 'Bangkok')
>>> a
['India', 'Japan', 'China',
'Ukraine', 'Russia', 'USA',
'Bangkok']
```

```
>>> a.insert(-1, 'Indonesia')
>>> a
['India', 'Japan', 'China',
'Ukraine', 'Russia', 'USA',
'Indonesia', 'Bangkok']

>>> a.insert(-200, 'New York')
>>> a
['New York', 'India', 'Japan',
'China', 'Ukraine', 'Russia',
'USA', 'Indonesia', 'Bangkok']
```

Lists – Deleting

```
>>> a.remove('Bangkok')
>>> a
['New York', 'India', 'Japan', 'China', 'Ukraine', 'Russia', 'USA',
'Indonesia']

>>> del a[0]
>>> a
['India', 'Japan', 'China', 'Ukraine', 'Russia', 'USA', 'Indonesia']

>>> a.pop()
'Indonesia'
>>> a
['India', 'Japan', 'China', 'Ukraine', 'Russia', 'USA']
```

Lists – Test for a value

Pythonic way of coding

```
>>> a = ['India', 'Japan', 'China', 'UK', 'USA']
>>> 'India' in a
True
>>> country = 'India'
>>> country in a
True
```

A little digression

Pythonic way of coding

When a veteran Python developer (a “Pythonista”) calls portions of code not “Pythonic”, they usually mean that these lines of code do not follow the common guidelines and fail to express its intent in what is considered the best (hear: most readable) way.

```
#Pythonic way
>>> a = ['India', 'Japan',
'China', 'UK', 'USA']
>>> 'Japan' in a
True
```

```
# non Pythonic way
>>> a.index('Japan')
1
# then compare the index if its
positive or if it gave an error
and then confirm whether 'Japan'
exists or not
```

Lists – Copying

```
>>> a = ['India', 'Japan',
'China', 'UK', 'USA']
>>> b = a
>>> b
['India', 'Japan', 'China', 'UK',
'USA']
>>> a[1] = 'Nigeria'
>>> a
['India', 'Nigeria', 'China',
'UK', 'USA']
>>> b
['India', 'Nigeria', 'China',
'UK', 'USA']
```

```
>>> b = list(a)
>>> c = a[:]
```

Tuples

- Similar to lists
- Uses “(“ and “)” for being and end
- Tuples are Immutable. So they lack
  - append(), insert(), pop() etc

Tuples

```
>>> a_tuple= ()
>>> a_tuple = ('batman','spiderman','superman','ironman')
>>> a_tuple = 'batman','spiderman','superman','ironman'
>>> a_tuple
('batman', 'spiderman', 'superman', 'ironman')
>>> type(a_tuple)
<type 'tuple'>
```

Tuples - unpacking

```
>>> sh1, sh2, sh3, sh4 = a_tuple
>>> print sh1, sh2, sh3, sh4
batman spiderman superman ironman

>>> sh1, sh2 = a_tuple

Traceback (most recent call last):
  File "<pyshell#497>", line 1, in <module>
    sh1, sh2 = a_tuple
ValueError: too many values to unpack
```

Tuples – Slicing is same as in lists

```
>>> a_tuple[1:2]
('spiderman',)
>>> a_tuple[1:]
('spiderman', 'superman', 'ironman')
>>> a_tuple[1:100]
('spiderman', 'superman', 'ironman')
>>> a_tuple[1::2]
('spiderman', 'ironman')
```

Tuple Vs Lists

- Uses lesser space
- Immutable and hence cannot change by mistake
- Function arguments are passed as tuples

Dictionaries

- Uses key value pairs instead of index
- Similar to associative array (PHP), hash maps (Java) of other languages
- Mutable data structure => can change its values
- Uses “{“ and “}” to define its being and end

Dictionary

```
>>> a_d = {1:'January', 2:'February', 3:'March'}
>>> a_d
{1: 'January', 2: 'February', 3: 'March'}
>>> type(a_d)
<type 'dict'>
>>> a = [1,2,3,4,5,6,7]
>>> dict(a)

Traceback (most recent call last):
  File "<pyshell#525>", line 1, in <module>
    dict(a)
TypeError: cannot convert dictionary update sequence element #0 to a
sequence
>>> a = [[1,2],[3,4],[5,6]]
>>> dict(a)
{1: 2, 3: 4, 5: 6}
```

Dictionary – accessing elements

```
>>> a_d = {'name': 'Aditya', 'email' : 'sp.aditya@gmail.com'}
>>> len(a_d)
2
>>> a_d['name']
'Aditya'
>>> keystr = 'name'
>>> a_d[keystr]
'Aditya'
>>> a_d[keystr]="Aditya Prabhakara"
>>> a_d
{'name': 'Aditya Prabhakara', 'email': 'sp.aditya@gmail.com'}
>>> a_d['city'] = "Bangalore"
>>> a_d
{'city': 'Bangalore', 'name': 'Aditya Prabhakara', 'email':
'sp.aditya@gmail.com'}
```

Dictionary – combine dictionaries

```
>>> a_d = {'name': 'Aditya Prabhakara', 'email': 'sp.aditya@gmail.com'}
>>> update_d = {'name' : 'Aditya S P', 'city' : 'Bangalore'}
>>> a_d.update(update_d)
>>> a_d
{'city': 'Bangalore', 'name': 'Aditya S P', 'email':
'sp.aditya@gmail.com'}
```

Dictionary – Working with keys

```
>>> a_d
{'city': 'Bangalore', 'name': 'Aditya S P', 'email':
'sp.aditya@gmail.com'}
>>> 'city' in a_d
True
>>> a_d.keys()
['city', 'name', 'email']
>>> a_d.values()
['Bangalore', 'Aditya S P', 'sp.aditya@gmail.com']
```

Lab work

Lab 2

- Attempt Lab work questions #9 – #16
- Duration : Approx 10 minutes

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Chapter: Conditionals

Conditional – if elif else

- The syntax might feel a bit strange
- Whitespaces matter – forced indentation
- Leads to indented formatted code
- I personally was not a huge fan of this in the beginning and then it grew on me and now it feels “so obvious”

Conditional – if elif else

```
>>> a = True
>>> type(a)
<type 'bool'>
>>> if a:
        print "Truthful"

Truthful
```

Conditional – if elif else

```
>>> a = 100
>>> if a<10 :
        print "Single Digit"
else:
        print "May be double digit"


May be double digit
```

Conditional – if elif else

```
>>> a = 100
>>> if a<10 :
        print "Single Digit"
elif a < 100:
        print "Double Digit"
else :
        print "2+ digits"

2+ digits
```

Conditionals

Description	Operator
Equality	==
Inequality	!=
less than	<
Less than or equal	<=
Greater than	>
Greater than or equal	>=
Membership	in

Conditional operators

```
>>> x = 5
>>> y = 10
>>> x < y
True
>>> x < 5 and y < 20
False
>>> x < 6 and y < 20
True
>>> x < 5 or y < 20
True
>>> x < 5 and not y < 6
False
>>> x < 6 and not y < 6
True
```

Conditional operators – Cool & readable

```
>>> x = 5
>>> y = 10
>>> 3 < x < 10
True
>>> 3 < x < y < 20
True
>>> if x > 3 and x < y and y < 20 :
        print "Truthful"


Truthful
```

Loops – while loop

```
>>> a = ['KA','TN','DL','AP','KL','PY']
>>> while count < len(a):
        print a[count]
        count+=1

KA
TN
DL
AP
KL
PY
```

Loops – for loop

A better Pythonic way of previous while loop

```
>>> a = ['KA','TN','DL','AP','KL','PY']
>>> for itr in a:
        print itr


KA
TN
DL
AP
KL
PY
```

Loops – break and continue

```
>>> a =
['KA','TN','DL','AP','KL','PY']
>>> for itr in a:
        if itr == 'UP':
                break
else:
        print 'did not find code'


did not find code
```

```
# not Pythonic. Sake of example
>>> found = False
>>> for itr in a:
        if itr == 'UP':
                found = True
>>> if not found:
        print "Did not find what I
was looking for“

Did not find what I was looking
for
```

Lab work

Lab 2

- Attempt Lab work questions #17 – #18
- Duration : Approx 5 minutes

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Chapter: Functions

Functions – defining and calling

```
>>> def sayhi():
        print "Hi"

>>> type(sayhi)
<type 'function'>
>>> sayhi()
Hi
```

```
>>> def sayhi():
        ''' this is a function
that says hi '''
        print "Hi"


>>> sayhi()
Hi
>>> sayhi.__doc__
' this is a function that says hi
'
```

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Functions

```
>>> def is_even(num):
        if num%2 == 0:
                return True
        else:
                return False
>>> if is_even(2):
        print "This is even"
else:
        print "This is odd"


This is even
```

```
if is_even(3):
        print "This is even"
else:
        print "This is odd"


This is odd
```

Functions – Parameters (key word)

```
>>> def full_name(fname, lname):
        print fname + " " + lname


>>> full_name('Aditya', 'Prabhakara')
Aditya Prabhakara
>>> full_name (lname='Prabhakara', fname='Aditya')
Aditya Prabhakara
```

Functions – Parameters (default args)

```
>>> def full_name(fname, lname, title="Mr"):
        print title + " " + fname + " " + lname


>>> full_name (lname='Prabhakara', fname='Aditya')
Mr Aditya Prabhakara
>>> full_name(lname='Prabhakara')

Traceback (most recent call last):
  File "<pyshell#785>", line 1, in <module>
    full_name(lname='Prabhakara')
TypeError: full_name() takes at least 2 arguments (1 given)
```

Functions – any number of args -1

```
>>> def any_args(*args):
        print args


>>> any_args('a',1,2,'c')
('a', 1, 2, 'c')
>>> def any_args(*args):
        print args
        print type(args)


>>> any_args('a',1,2,'c')
('a', 1, 2, 'c')
<type 'tuple'>
```

Functions – any number of args - 2

```
>>> def any_args(**kwargs):
        print kwargs

>>> any_args(what=2, where=3)
{'what': 2, 'where': 3}

>>> def any_args(*args, **kwargs):
        print args, kwargs


>>> any_args(1, 2, 3,a=4, b = 5, c = 6)
(1, 2, 3) {'a': 4, 'c': 6, 'b': 5}
```

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Understand Namespace or scope

```
>>> a=10
>>> def finda():
        print a


>>> finda()
10
>>> a=30
>>> finda()
30
```

```
>>> def finda():
        a=100
        print a


>>> a=20
>>> finda()
100
```

Understand Namespace or scope

```
>>> def finda():
        global a
        a = 100
        print a


>>> a = 200
>>> finda()
100
>>> a
100
```

Lab work

Lab 3

- Attempt Lab work question #19, #20
- Duration : Approx 5 minutes

Functions

- We have only treated functions as just that.

Wait till we start treating them as first class citizens.

We can pass functions around as variables
We can make a function return a function
We can have nested functions
We can have anonymous functions
It gets exciting

PYTHON

Chapter: Functions as First class citizens

Functions (Contd)

- Functions are first class citizens
- Which basically means
  - They are treated like objects (as in Python everything is an object)
  - They can be passed around like other variables
  - Assigned to other variables

Function as variables

```
>>> def sayhi():
        print "Hi"


>>> sayhi()
Hi
>>> type(sayhi)
<type 'function'>
>>> a = sayhi
>>> type(a)
<type 'function'>
>>> id(a)
59704264L
>>> id(sayhi)
59704264L
```

```
>>> a()
Hi
>>> def someotherhi(func):
        func()


>>> someotherhi(a)
Hi
>>>
```

Inner functions

```
>>> def add(*args):
        def inneradd(*args):
                return sum(*args)
        print inneradd(*args)


>>> add([1,2])
3
>>> add([1,2,3,4])
10
>>> sum.__doc__
"sum(sequence[, start]) -> value\n\nReturn the sum of a sequence of
numbers (NOT strings) plus the value\nof parameter 'start' (which
defaults to 0).  When the sequence is\nempty, return start."
```

Closure – it gets crazy here!

```
>>> def bill(*args):
        def withtax(x):
                return sum(args)+x*sum(args)
        return withtax

>>> newbill = bill(10,15,20,50)
>>> newbill(.145)
108.775
>>> newbill(.20)
114.0
>>> newbill2 = bill(2)
>>> newbill2(.145)
2.29
>>> newbill2(.2)
2.4
```

Decorators – it gets crazier

```
def deco(func):
        def new_func(*args, **kwargs):
                print 'in mydeco'
                result=func(*args, **kwargs)
                return result
        return new_func

def addthem(*args):
        return sum(args)

>>> decoratedadd = deco(addthem(3,4))
>>> decoratedadd(3,4)
>>> @deco
def addthem(*args):
        return sum(args)
```

Chapter: Comprehension

range

```
>>> range(10)
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
>>> for i in range(10):
        print i
```

Comprehension

- Comprehension is a compact way of creating a Python data structure
- Leads to more readable code
- List comprehension is a compact way of creating lists
- A generic syntax of comprehension is as follows

```
[expression for item in iterable]
```

- What qualifies as iterable?
  - Lists
  - Range
  - Generators

  … and a lot more

List comprehension

```
>>> a = [x for x in range(5)]
>>> a
[0, 1, 2, 3, 4]
>>> a = [x*x for x in range(5)]
>>> a
[0, 1, 4, 9, 16]
>>> b = 'abcdefghijklmnopqrstuvwxyz'
>>> a = [x*2 for x in b]
>>> def sqit(x):
        return x*x

>>> a = [sqit(x) for x in range(5)]
>>> a
[0, 1, 4, 9, 16]
```

List comprehension – advanced

```
[expression for item in iterable if expression]
```

```
>>> a = [x for x in range(5) if x%2 == 0]
>>> a
[0, 2, 4]

>>> a = [x for x in range(5) if is_even(x)]
>>> a
[0, 2, 4]
```

Dict comprehension

```
{keyexpr:valueexpr for item in iterable if expression}
```

```
>>> a = {x:x*x for x in range(5)}
>>> a
{0: 0, 1: 1, 2: 4, 3: 9, 4: 16}

# comprehend and deliberate on what is happening below

>>> a = 'the quick brown fox jumps over the lazy dog'
>>> a={x:a.count(x) for x in a}
```

Generator

- A python sequence creation object
- Are source of data for iterators
- Range is generator which creates a sequence of integers
- A generic syntax of comprehension is as follows
- Special key work yield

Generator

```
>>> def my_range(first=0, num=10, step=1):
        current_range = first
        count = 0
        while count < 10:
                yield current_range
                current_range += step
                count +=1

>>> for i in my_range():
        print i
```

Lab work

Lab 5

- Attempt Lab work question #23, #24
- Duration : Approx 20 minutes

Chapter: Lambda

Lambda

- Anonymous functions
- Expressed as a single statement
- Use it instead of a normal tiny functions
- Can be used as closures

Lambda

- Import only what you like
- Some hate it. Some love it. But you can't ignore it ☺

```
>>> def f(x):
        return x%2==0

>>> f(1)
False
>>> f(2)
True
>>> d = lambda x:x%2==0
>>> d(5)
False
>>> d(4)
True
```

Map

- Takes a function and applies it to every item in the list

```
>>> raceinkm =[5,10,21,42]
>>> def kmtomi(x):
        return x*0.621

>>> map(kmtomi, raceinkm)
[3.105, 6.21, 13.041, 26.082]
>>> map(lambda x:x*0.621, raceinkm)
[3.105, 6.21, 13.041, 26.082]
>>> salary =[1.4,0.8,2.6,5.8]
>>> bonus=[0.2,.10,.40,.01]
>>> map(lambda x,y:x*y, salary, bonus)
[0.27999999999999997, 0.08000000000000002, 1.04, 0.05799999999999996]
>>> map(lambda x,y:x*y + x, salary, bonus)
[1.68, 0.8800000000000001, 3.64, 5.858]
```

Filter

- Takes a boolean function and applies it to every item in the list

```
>>> agelist=[12,23,78,95,22,36,71,22,20]
>>> filter(lambda x:18<x<50, agelist)
[23, 22, 36, 22, 20]

>>> allnum =list(range(10))
>>> filter(lambda x:x%2==0, allnum)
[0, 2, 4, 6, 8]
```

Reduce

- Takes the first two numbers
- Applies a reduction
- Takes the next number

```
>>> a = list(range(10))
>>> reduce(lambda x,y:x+y, a)
45
```

Chapter: Set

Sets

- Similar to dictionary but with no values
- => unique, order does not matter

```
>>> a = set()
>>> a
set([])
>>> a = set('letters')
>>> a
set(['s', 'r', 'e', 'l', 't'])
```

```
>>> a = set()
>>> a
set([])
```

PYTHON

Sets – combination operations

```
>>> a = set('letters')
>>> a
set(['s', 'r', 'e', 'l', 't'])
>>> b = set('postman')
>>> b
set(['a', 'm', 'o', 'n', 'p', 's',
't'])
# intersection
>>> a & b
set(['s', 't'])
# union
>>> a | b
set(['a', 'e', 'm', 'l', 'o', 'n',
'p', 's', 'r', 't'])
```

```
# in a but not in b
>>> a -b
set(['r', 'e', 'l'])
# in b but not in a
>>> b-a
set(['a', 'p', 'm', 'o', 'n'])
# exclusive – either in a or in b
but not in both
>>> a ^ b
set(['a', 'p', 'r', 'e', 'm', 'l',
'o', 'n'])
```

Chapter: File handling

File handling

- Before we can read or write to a file we need to obtain a handle to the file

```
filehandler = open(filename, mode)
```

- *filehandler* is the reference that open() call returned
- *filename* is the filepath mentioned as a string
- *mode* is a string which indicates the file type and what we want to do on it
  - First character of mode : r for read, w for write, x write iff file does not exist, a means append

Lastly we need to close the file handle after we are done with some read or write

```
filehandler.close()
```

Writing to a file

```
>>> stringtowrite = '''I changed my password to \"incorrect\" so when
ever I
enter a wrong password it reminds me saying your password is
incorrect'''
>>> fh= open('trialfile.txt', 'wt')
>>> fh.write(stringtowrite)
>>> fh.close()
>>> fh= open('C:/users/aditya/desktop/trialfile.txt', 'wt')
>>> fh.write(stringtowrite)
>>> fh.close()
```

Reading from a file

```
>>> filehandle = open('trialfile.txt', 'rt')
>>> for line in filehandle:
        print line
>>> filehandle.close()
>>> filehandle = open('trialfile.txt', 'rt')
>>> alllines = filehandle.readlines()
>>> alllines
```

Reading from a file – chunked reading

```
>>> fh = open('C:/users/aditya/desktop/trialfile.txt','r')
>>> chunk=3
>>> while True:
        mytext=fh.read(chunk)
        if not mytext:
                break
        print mytext
```

seeking

Continuing from previous example

```
>>> for line in filehandle:
        print line
>>> filehandle.seek(0)
>>> for line in filehandle:
        print line
```

Lab work

Lab 3

- Attempt Lab work question #22
- Duration : Approx 5 minutes

Chapter: Error handling

Errors

- We have already encountered a lot of errors or exceptions
  - ZeroDivisionError
  - NameError
  - IndexError
  - ValueError
  - TypeError

Handle Exception

```
>>> a=list('abcdefghij')
>>> try:
        a[11]
except:
        print "Position out of bound"


Position out of bound
>>> try:
        a[9]
except:
        print "Position out of bound"


'j'
```

Handle multiple exception

```
>>> try:
        a[11]
        a=a/0
except IndexError as err:
        print err
except Exception as err:
        print err
```

```
list index out of range
```

```
>>> try:
        a[7]
        a=10/0
except IndexError as err:
        print err
except Exception as err:
        print err
```

```
'h'
integer division or modulo by zero
```

PYTHON

Chapter: Modules

Modules

- Modules are files containing Python definitions and statements (ex. *mymodule*.py)

```
import mymodule
```

- If my mymodule.py has a function by name myfunc. Then you can call that using

```
mymodule.myfunc()
```

- Modules can call their own modules

Lab work

Lab 5

- Attempt Lab work question #21
- Duration : Approx 15 minutes

Class work

- Create two .py files
- Import one in the other
- Run it

Modules

- Import only what you like

```
from greeting import sayhi
```

- If my mymodule.py has a function by name myfunc. Then you can call that using

```
mymodule.myfunc()
```

- Modules can call their own modules

Chapter: OO

What is an object

- Which occupies space
- Which may have data
- Which may have behavior

- For e.g. In real world “Car” is an object which has a “name” (data) and which can drive (behavior)

What is an Class

- Objects of similar type will have similar attributes and similar behaviour
- All objects of car have a name, can drive
- Or in other words if we somehow create a type then we can use that as a template/blueprint to create objects from that
- Such a template or blueprint is called as class

- For eg.
- a=10;b=20;c=30 are all “objects” of the “class” int

- For eg.
- We are all “objects” of “class” called “human beings”

Create a class in python

- A pretty useless car. No data No behaviour

```
>>> class Car():
        pass
>>> b = Car()
```

Create an object in python

- Oh a little better at least it has a name

```
>>> class Account():
        def __init__(self,holdername, acctype="Savings"):
                self.balance = 1000.00
                self.acctype=acctype
                self.holdername = holdername


>>> ac = Account('Aditya')
```

Pretty print an object

```
>>> class Account():
        def __init__(self,holdername, acctype="Savings"):
                self.minbalance = 1000.00
                self.acctype=acctype
                self.holdername = holdername
        def __repr__(self):
                return '{}, {}'.format(self.holdername, self.acctype)
        def __str__(self):
                return 'Account Holder : {}, Acc Type :
{}'.format(self.holdername, self.acctype)
```

Object of an account

- So now an Object of account has data (balance, holdername, acctype)
- So now an Object of account has behaviour (print)

- In other words we can now say that the object has encapsulated data and behaviour

Encapsulation

Add more behaviour

```
def credit(self, amount=0):
    self.balance += num
    return self.balance
def debit(self, amount=0):
    if(self.balance - amount < 0):
       # raise an exception
    else
       return self.balance -= amount
```

Raising an exception

```
def debit(self, amount=0):
    self.balance += num
    return self.balance
def credit(self, amount=0):
    if(self.balance - amount < 0):
       # raise an exception
    else
       return self.balance -= amount
```

Living Being – Human Being inherits

```
>>> class LivingBeing():
        def breathe():
                print "I can
breathe, therefore I am a
LivingBeing"
```

```
>>> class HumanBeing(LivingBeing):
        pass
```

Living Being – Human Being inherits

```
>>> class LivingBeing():
        def breathe(self):
                print "I can
breathe, therefore I am a
LivingBeing”
```

```
>>> class HumanBeing(LivingBeing):
        def breathe(self):
                print "breathe
through lungs. O2 in CO2 out"
```

Getters and Setters

```
class Shape():
        def __init__(self,shapename):
                self.name = shapename
        def get_shapename(self):
                print "In getter"
                return self.name
        def set_shapename(self,shapename):
                print "In setter"
                self.name=shapename
```

Getters and Setters - private names

```
class Shape():
        def __init__(self,shapename):
                self.__name = shapename
        def get_shapename(self):
                print "In getter"
                return self.__name
        def set_shapename(self,shapename):
                print "In setter"
                self.__name=shapename
        name = property(get_shapename, set_shapename)
```

Class Methods

```
>>> class Shape():
        counter = 0
        def __init__(self):
                print "In init"
                Shape.counter += 1
        @classmethod
        def objscreated(cls):
                print "Shape has ",Shape.counter, " Objects created!"
```

Static Methods

```
>>> class Shape():
        counter = 0
        def __init__(self):
                print "In init"
                Shape.counter += 1
        @classmethod
        def objscreated(cls):
                print "Shape has ",Shape.counter, " Objects created!"
        @staticmethod
        def somestaticnoise():
                print "I am a shape!"


>>> Shape.somestaticnoise()
I am a shape!
```

Equality?

```
>>> class Student():
        def __init__(self, stud_id, stud_name):
                self.stud_id = stud_id
                self.stud_name = stud_name


>>> b = Student(1, 'John Doe')
>>> c = Student(1, 'John Doe')
>>> b == c
False
```

Equality?

```
class Student():
        def __init__(self, stud_id, stud_name):
                self.stud_id = stud_id
                self.stud_name = stud_name
        def __eq__(self, stud2):
                return self.stud_id == stud2.stud_id

>>> b = Student(1, 'John Doe')
>>> c = Student(1, 'John Doe')
>>> b == c
True
```

Methods for comparision

```
__lt__(self, other)
__le__(self, other)
__eq__(self, other)
__ne__(self, other)
__gt__(self, other)
__ge__(self, other)
```

Methods for Math

```
__add__(self, other)
__sub__(self, other)
__mul__(self, other)
__mod__(self, other)
__pow__(self, other)
```

Other

```
__str__(self)
__repr__(self)
__len__(self)
```

List Sorting

```
>>> sorted(student_objects, key=lambda student: student.age)
```

Classes - Challenge

```
Create a class to represent complex numbers (for eg. 5 + i6)
c = Complex(5,7)
d = Complex(3,7)
c + d should give 8 + i14
```

Object Composition

- One Object containing multiple objects
- For eg. Car containing tyres, body, engine, seats
- For eg. Pizaa containing cheese, capsicum, onion

Super

- “B” inherits from “A”. But why doesn’t it contain ‘a’?

```
>>> class A(object):
    def __init__(self):
        self.a = 'a'

>>> class B(A):
    def __init__(self):
        self.b = 'b'
```

```
>>> b = B()
>>> b.a

Traceback (most recent call last):
  File "<pyshell#758>", line 1, in
   <module>
    b.a
AttributeError: 'B' object has no
   attribute 'a'
```

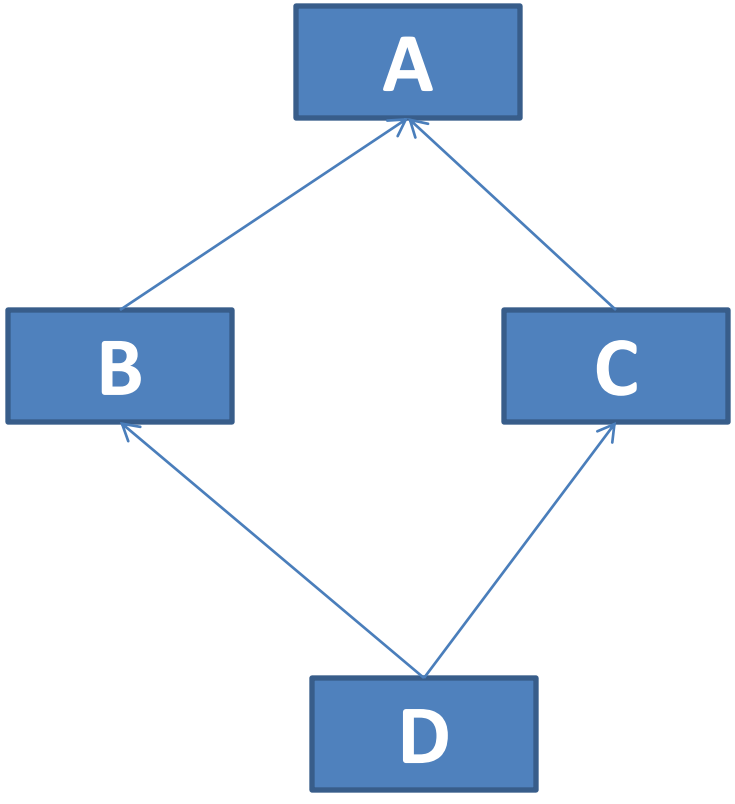
Super - contd...

- Use super to execute the init of A

```
>>> class A(object):
    def __init__(self):
        self.a = 'a'

>>> class B(A):
    def __init__(self):
        self.b = 'b'
        super(B,self).__init__()
```

```
>>> b = B()
>>> b.a
'a'
```


A
B
C
D

Multiple Inheritance

- "B" inherits from "A". But why doesn't it contain 'a'?

```
>>> class A(object):
    def __init__(self):
        self.a = 'a'

>>> class B(A):
    def __init__(self):
        self.b = 'b'
        super(B,self).__init__()
```

```
>>> class C(A):
    def __init__(self):
        self.c='c'
        super(C, self).__init__()


>>> class D(B, C):
    def __init__(self):
        self.d='d'
```

Method Resolution Order (MRO)

- To resolve a method , Python searches
  - First in the current class
  - If not found
    - Search continues into parent class
      - Depth First
      - Left to Right
  - This order is called as Linearization of Multi Derived Classes
  - The rules to find this order is called MRO

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Method Resolution Order (MRO)

```
>>>D.__mro__
(<class '__main__.D'>, <class '__main__.B'>, <class '__main__.C'>,
   <class '__main__.A'>, <type 'object'>)

#OR you can also execute

>>> D.mro()
[<class '__main__.D'>, <class '__main__.B'>, <class '__main__.C'>,
   <class '__main__.A'>, <type 'object'>]
```

custom classes or objects Vs Module?

- When you require multiple instances of the same behaviour but different attributes
- Inheritance leads to code reuse. Not possible with modules

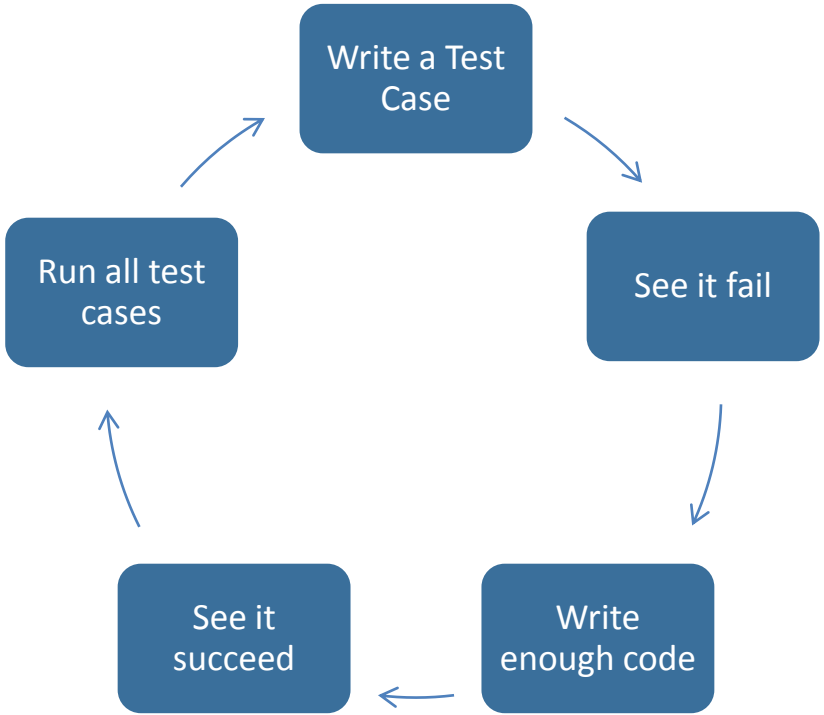
Chapter: PyUnit

Test Driven Development

Test-driven development (**TDD**) is a software development process that relies on the repetition of a very short development cycle: requirements are turned into very specific test cases, then the software is improved to pass the new tests, only. This is opposed to software development that allows software to be added that is not proven to meet requirements.
Kent Beck, who is credited with having developed or 'rediscovered‘ the technique, stated in 2003 that TDD encourages simple designs and inspires confidence.

-- Wikipedia

Test Driven Development - Process



Requires a good Testing Framework

- PyUnit -> Pythons Unit Testing framework
- Pythons version of Java's JUnit
- Which in turn is a version of Small Talks testing framework

- PyUnit is consider an automatic choice for Python's unit testing

PyUnit

- Object oriented in nature
- PyUnit is a part of Pythons standard library
- The name of the module is “unittest”
- unittest is commonly called as PyUnit loosely based on its java counterpart JUnit

```
import unittest
```

Creating our unit tests

- Terminology :
  - Test Case - Single scenario that must be setup and checked for correctness
    - For eg. Create an object of Account and it should have a default acctype of “Savings”
  - Test Suite – Collection of Test Cases
  - Assert : An expression to raise an AsssertError

```
>>> a = 1
>>> assert a==0, 'A was expected to be zero. How did it change?'

Traceback (most recent call last):
  File "<pyshell#796>", line 1, in <module>
    assert a==0, 'A was expected to be zero. How did it change?'
AssertionError: A was expected to be zero. How did it change?
```

Creating our unit tests

- Asserts Available

assertEqual(a, b)	a == b
assertNotEqual(a, b)	a != b
assertTrue(x)	bool(x) is True
assertFalse(x)	bool(x) is False
assertIs(a, b)	a is b
assertIsNot(a, b)	a is not b
assertIsNone(x)	x is None
assertIsNotNone(x)	x is not None
assertIn(a, b)	a in b
assertNotIn(a, b)	a not in b
assertIsInstance(a, b)	isinstance(a, b)
assertNotIsInstance(a, b)	not isinstance(a, b)

Demo

- “Shape” Unit Test cases

```
C:\Users\aditya\Desktop\testing>python TestShape.py
..
----------------------------------------------------------------------
Ran 2 tests in 0.000s

OK
```

Demo

- Command line interface

```
python -m unittest <module1> <module2>
python -m unittest <modulename.testclassname>
python -m unittest <modulename.testclassname.testmethod>
```

Other Testing Frameworks

- PyMock
  - Testing framework built on Mock Objects
  - Created by Jeff Younker
  - Creates mock objects
  - Access to a simulated object / system in test env
  - For eg;
    - Mock Database
    - Mock Payment gateway
    - Mock server etc

Other Testing Frameworks

- Nose
  - Discovers and runs unit test
  - Very much similar to unit test
  - Is more of a runner
  - Can run unittest test case in Nose too
  - Good support for test case organization

Chapter: Database Access

SQLite

- C library
- Light weight disk-based database
- Support SQL like query languagle (A variant of standard SQL spec)
- Module sqlite3 is Compliant with PEP 249
- It’s also possible to prototype an application using SQLite and then port the code to a larger database such as PostgreSQL or Oracle.

Database access steps

Step 1	• Create Connection object
Step 2	• Create a cursor
Step 3	• Execute db statements
Step 4	• Commit
Step 5	• Close Connection

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Creating a Connection

```
>>> import sqlite3
>>> conn = sqlite3.connect('users.db')
>>> conn
<sqlite3.Connection object at 0x0000000003943A28>
```

Creating a Cursor

```
>>> cur = conn.cursor()
>>> cur
<sqlite3.Cursor object at 0x0000000003A7A2D0>
```

Execute statements

Data Definition Language

```
CREATE TABLE `User` (
`name` TEXT,
`salary` REAL
);
```

Data Modification Language

```
INSERT INTO `User`(`name`,`salary`) VALUES
('Aditya',10000000.00);
```

Query

```
Select  * from User
```

Execute statements

```
cur.execute  (‘’’CREATE TABLE User (name TEXT, salary REAL)’’’)
cur.execute  (‘’’INSERT INTO User values(‘Aditya’,10000000.00)’’’)
conn.commit()
conn.close()
```

Execute statements

```
>>> cur.execute('select * from User')
<sqlite3.Cursor object at 0x0000000003A7A2D0>
>>> cur.fetchall()
[(u'Aditya', 10000000.0)]
>>> cur.execute('select * from User where name=?', ('Aditya',))
<sqlite3.Cursor object at 0x0000000003A7A500>
>>> cur.fetchall()
[(u'Aditya', 10000000.0)]
```

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Execute statements

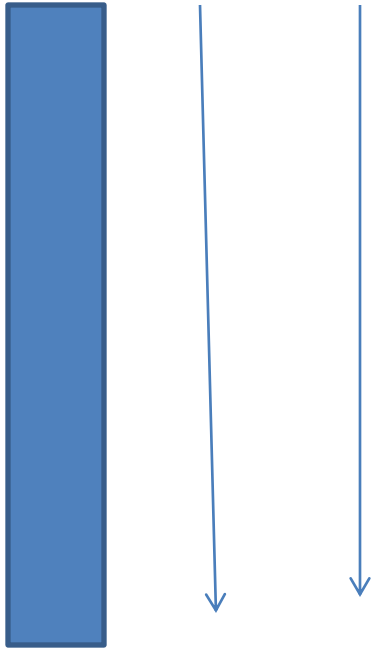
```
>>> users = [('user1',10000),('user2',100023)]
>>> cur.executemany('insert into users values(?,?)', users)
>>> cur.execute('select * from User')
<sqlite3.Cursor object at 0x0000000003A7A500>
>>> cur.fetchall()
[(u'Aditya', 10000000.0), (u'user1', 10000.0), (u'user2', 100023.0)]
```

Execute statements

```
>>> for row in cur.execute('select * from user'):
        print row


(u'Aditya', 10000000.0)
(u'user1', 10000.0)
(u'user2', 100023.0)
```

Chapter: Threading



What are threads?

- Smallest schedulable unit in a computer
- Threads are contained in processes
- Threads share memory and state of the process

- Two kinds of threads
- a. Threads created by the kernel / operating system – Kernel Threads
- b. User threads
- Implemented through Threading Module

Advantages of threads

- Faster Execution
- Let us deliberate on the difference in “return “
- Threads can share memory => threads from a same process have access to the same variables – Both a cause for joy and a cause for worrying

Starting threads

```
import threading
threading.Thread()

(refer program thread1.py)
```

Passing arguments to threads

```
t = threading.Thread(target=somemethod, args=(i,))
```

(refer program thread1.py)

Naming of threads

```
threading.currentThread().getName()


threading.Thread(name = 'myname' + str(i),  target=somemethod,
args=(i,))

(refer program thread3.py)
```

Talk to each other

```
threading.Event()

(refer to program thread4.py)
```

Locking a resource

```
Execute thread2.py
Note that the output is garbled
Execute thread6.py
Note how lock solved the problem
This has made the code “Thread Safe”
```

Chapter: ctypes

ctypes

Loading ctypes
Interface with .dll files on windows and .so files on linux or unix machines

```
from ctypes import *
```

Ctypes - loading

Loading ctypes
Interface with .dll files on windows and .so files on linux or unix machines

```
from ctypes import *
library=cdll.LoadLibrary('libc.so.6')
library=CDD('msvcrt.dll')
library.printf('Hello World')
```

Ctypes - loading

Loading ctypes
Interface with .dll files on windows and .so files on linux or unix machines

```
from ctypes import *
library=cdll.LoadLibrary('libc.so.6')
library=CDD('msvcrt.dll')
```

Ctypes – calling a function

May not work from interpreter.
Run it as a module

```
libc.printf("Hello World")
print libc.time(None)
```

Ctypes – datatypes to interface with C

ctypes type	C type	Python type
c_char	char	1-character string
c_wchar	wchar_t	1-character unicode string
c_byte	char	int/long
c_ubyte	unsigned char	int/long
c_short	short	int/long
c_ushort	unsigned short	int/long
c_int	int	int/long
c_uint	unsigned int	int/long
c_long	long	int/long
c_ulong	unsigned long	int/long
c_longlong	__int64 or long long	int/long
c_ulonglong	unsigned __int64 or unsigned long long	int/long
c_float	float	float
c_double	double	float
c_char_p	char * (NUL terminated)	string or None
c_wchar_p	wchar_t * (NUL terminated)	unicode or None
c_void_p	void *	int/long or None

Ctypes – convert to datatype of C

Only Strings and int automatically convert
For all others we have to explicitly convert

```
libc.printf("Hello World")
libc.printf(“%d“, 42)
libc.printf(“%f“, 20.42)
```

Ctypes – calling our own functions

Calling our own functions

1. Create a linked library
2. Get a handle to the function
3. Set argtypes – optional
4. Set returntypes = optional

```
gcc -o libtest.so -shared -fPIC libtest.c
```

Chapter: pip

pip

Python > 2.7.9 comes with pip but we need to update pip
pip Python Package Manager
PyPi – Python package index – Most of the packages are found here

```
python -m pip install -U pip setuptools

Install a package using

pip install "projectname"

For eg.
pip install "openpyxl"
pip install "poster"
```

PYTHON

Chapter: Handling files
Excel
Json

PYTHON

Excel

```
# from within the scripts directory of Python
pip install openpyxl


# now we can import openpyxl
import openpyxl
```

Excel files - Reading

```
#Step 1 Open the workbook
wb = openpyxl.load_workbook(<path of xls>)

#Step 2 Get a handle to the Sheet
wb.get_sheet_names
sheet = wb.get_sheet_by_name('Sheet1')

#use generators
sheet.rows
sheet.columns

for i in sheet.rows:
        for cell in i:
                print cell.value
```

PYTHON

Excel files - Writing

```
#Step 1 Open the workbook
wb = openpyxl.Workbook()

#Step 2 Get a handle to the Sheet
wb.get_sheet_names
sheet = wb.get_sheet_by_name('Sheet')

# Can create sheets
wb.create_sheet('Sheet2')

#write values
wb.get_sheet_by_name('Sheet')['A1'] = "First Created Value"

#Save
wb.save(<filename>)
```

Json

Introduced in 2.6 and a part of the standard lib => no third party lib required
loads()
dumps()

```
import json

#read json data
>>> fh = open('jsondata.txt','r')
>>> data = json.loads(fh.read())
>>> fh.close()

#write json data
>>> fh = open('jsondata.txt','w')
>>> fh.write(json.dumps(data))
>>> fh.close()
```

Chapter: Consuming a Webservice

requests - package

```
pip install requests

>>> import requests
>>> r = requests.get('http://www.omdbapi.com/?s=batman')
>>> r.text


>>> r = requests.post('http://httpbin.org/post', data={'key':'value'})

>>> files_dict = {'file': open('trial.xlsx', 'rb')}
>>> r = requests.post('http://localhost/upload.php', files=files_dict)
>>> r.text
```

Chapter: RE

Regular Expression

Text matching patterns
Analogous to wild cards like *
Has a formal syntax with almost global acceptance
Almost all programming languages have regular expression support
Short hand – regex or regexp

re module of Python

regexp support provided through the “re” module

```
>>> import re
>>> pattern = "text"
>>> sometext = "Is this found here"
>>> if re.search(pattern, sometext):
        print "Found a match"
else:
        print "Not Found“
```

Return value of re.search

In the previous example what object did re.search return ? – match object
match object is a storehouse of information

```
>>> print match.re.pattern
this
>>> print match.string
Is this found here
>>> print match.start()
3
>>> print match.end()
7
```

Pre-compiling patterns (regexp object)

Compiled patterns lead to faster searches
Repeated patterns can be cached. In the previous case caching is limited

```
>>> reo = re.compile(pattern)
>>> m = reo.search(sometext)
>>> m.start(), m.end()
(3, 7)
```

Multiple matches

findall instead of search

```
>>> pattern = 'xy'
>>> string = 'xxyyxyxyxyxy'
>>> re.findall(pattern, string)
['xy', 'xy', 'xy', 'xy', 'xy']
>>> for m in re.finditer(pattern, string):
        print "found at", m.start()


found at 1
found at 4
found at 6
found at 8
found at 10
```

More complex patterns

Pattern syntax = metacharacters + literal text

Repetition

Complete list of metacharacters

. ^ $ * + ? { } [ ] \ | ( )

Some special sequences

\d \D \s \S \w \W

Literal repetition

a followed by zero or more b
'ab*'

a followed by one or more b
'ab+‘

a followed by zero or one b
'ab?‘

a followed by three b
'ab{3}‘

a followed by two to three b
'ab{2,3}'

Literal repetition

```
>>> re.findall('xy*', string)
['x', 'xyy', 'xy', 'xy', 'xy', 'xy']

>>> re.findall('xy+', string)
['xyy', 'xy', 'xy', 'xy', 'xy']

>>> re.findall('xy?', string)
['x', 'xy', 'xy', 'xy', 'xy', 'xy']

>>> re.findall('xy{3}', string)
[]

>>> re.findall('xy{1,2}', string)
['xyy', 'xy', 'xy', 'xy', 'xy']
```

Character set

either a or b
'[ab]'

followed by one or more a or b
'a[ab]+‘

a followed by one or more a or b, not greedy
a 'a[ab]+?’

Character Set

```
>>> re.findall('[xy]', string)
['x', 'x', 'y', 'y', 'x', 'y', 'x', 'y', 'x', 'y', 'x', 'y']

>>> re.findall('x[xy]+', string)
['xxyyxyxyxyxy']

>>> re.findall('x[xy]+?', string)
['xx', 'xy', 'xy', 'xy', 'xy']
```

Positioning

start of string, or line
^

end of string, or line
$

start of string
\A

end of string
\Z

Examples 1

```
>>> re.findall('^[0-9]', '0abs')
['0']
>>> re.findall('^[0-9]+', '0abs')
['0']
>>> re.findall('^[0-9]+', 'what')
[]
>>> re.findall('[0-9]$', 'abs0')
['0']
>>> re.findall('[0-9]$', 'abs')
[]
```

Grouping

‘a' followed by literal 'ab'
'a(ab)‘

'a' followed by 0-n 'a' and 0-n 'b'
'a(a*b*)‘

‘a' followed by 0-n 'ab'
'a(ab)*‘

‘a' followed by 1-n 'ab’
'a(ab)+'

Common regex

```
# username
^[a-z0-9_-]{3,16}$

#color hex code
^#?([a-f0-9]{6}|[a-f0-9]{3})$

#email
^([a-z0-9_\.-]+)@([\da-z\.-]+)\.([a-z\.]{2,6})$
```

Examples 1

```
>>> re.findall('^[0-9]', '0abs')
['0']
>>> re.findall('^[0-9]+', '0abs')
['0']
>>> re.findall('^[0-9]+', 'what')
[]
>>> re.findall('[0-9]$', 'abs0')
['0']
>>> re.findall('[0-9]$', 'abs')
[]
```

Chapter: Pythonic Coding

Pythonic coding -1

- PEP -8 https://www.python.org/dev/peps/pep-0008/
- Written by Rossum

#Naming Style – there is much more to pep-0008

joined_lower for functions, methods, attributes
joined_lower or ALL_CAPS for constants
StudlyCaps for classes
camelCase **only** to conform to pre-existing conventions

Pythonic coding -2

- Compound statements – decreases readablity

GOOD

```
a=10
b=10
c=fun(1)
```

BAD

```
a=10;b=10;c=fun(1)
```

Pythonic coding -3

- Strings
- The algorithm of join does only a single pass through the list to arrive at allcountries
- Bad memory usage with loops as at every step an object is discarded

GOOD

```
>>>countries =['IN','KA','RU','BN','PK]
>>>allcountries = " ".join(countries)
```

BAD

```
>>>allcountries = ''
>>> for i in countries:
                allcountries +=I
```

Pythonic coding -4

- Testing for truth values

GOOD

```
>>> if a:
        …do something here
```

BAD

```
>>>if a == 'True':
        … do something here
```

Pythonic coding -5

- Use list comprehension and sum

GOOD

```
>>> total = sum([num * num for num in range(1, 101)])
```

BAD

```
>>> total = 0
>>>for num in range(1, 101):
        total += num * num
```

Pythonic coding -6

- Wild card import

GOOD

reference names through their module (fully qualified identifiers),

import a long module using a shorter name (alias; recommended),

or explicitly import just the names you need.

BAD

```
>>>from module import *
```

Pythonic coding -7

- Many other languages
- int a = 10 means it creates space for int called “a” and then stores value 10 in it

- In Python
- It creates an object with value of 10 and then assigns a name called “a” to it

Pythonic coding -8

- Use dictionaries get

GOOD

```
>>>somedict.get('what','Not Available')
```

BAD

```
>>> somedict['what']
```

Pythonic coding – Many more at

http://python.net/~goodger/projects/pycon/2007/idiomatic/handout.html

Summary

- Basics Python programming
  - int, str, bool, list, set, tuple, dict, functions, conditionals, loops, file handling, error handling, modules and packages
- Advanced Python
  - Comprehensions, filter, map, reduce, closures, lambda, higher order functions, generators
- Object Oriented Programming in Python
  - Data encapsulation, inheritance, polymorphism, private members, MRO, super,
- Unit Testing in Python
  - PyUnit – demo , TDD using PyUnit, Mock, Nose