Python and Object Oriented Programming

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python

Contents

1 Introduction

python

- clear syntax
- introspection
- intuitive object orientation
- natural expression of procedural code
- modularity
- batteries included

python resources

- Python `help` function
- Python documentation `http://docs.python.org/`
- Code examples `http://sandbox.mc.edu/~bennet/python/code/`
- Useless Python `http://www.uselesspython.com/`
- Python recipes at Activestate `http://code.activestate.com/recipes/langs/python/`

starting python

- Interactive mode (Command line interface)

```
$ python
Python 2.6.3 (r263:75183, Oct  4 2009, 09:36:16)
[GCC 4.2.1 (Apple Inc. build 5646)] on darwin
Type "help", "copyright", "credits" or "license"
for more information.
>>> print "Hello World!"
Hello World!
>>>
```

- From a file

```
$ python helloworld.py
Hello World!
$
```

- From an IDE (IDLE)

2 python syntax

data Types

```
>>> a = 3.1415
>>> b = 10
>>> c = 3 + 4j
>>> d = 'Hey!'
>>> e = ['eggs', 'spam', 15, [2, 3]]
>>> f = ('eggs', 'spam', 15, [2, 3])
>>> g = {'USD':0.6745, 'GBP':1.1189, 'JPY':0.0075}
```

names (instead of variables)

```
>>> a = 'Hello World'
>>> print a
 Hello World
>>> a = 3
>>> print a
 3
>>> print pow(2, 10)
 1024
>>> a = pow
>>> print a(2,10)
 1024
```

2.1 strings

strings

```
>>> a = 'Hello World'
>>> print a[1:6]
 ello
>>> b = a.upper()
>>> print b
 HELLO WORLD
>>> c = a.replace('e', 'a')
>>> print c
 Hallo World
```

```
>>> print len(a)
 11
>>> print a.count('o')
 2
```

2.2 introspection

introspection

```
>>> a = 'Hello World'
>>> dir(a)
 ...
 'join', 'ljust', 'lower', 'lstrip', 'partition', 'replace',
 'rfind', 'rindex', 'rjust', 'rpartition', 'rsplit', 'rstrip',
 'split', 'splitlines', 'startswith', 'strip', 'swapcase',
 'title', 'translate', 'upper', 'zfill']
>>> help(range)
range([start,] stop[, step]) -> list of integers

Return a list containing an arithmetic progression of integers.
range(i, j) returns [i, i+1, i+2, ..., j-1]; start (!) defaults to 0.
When step is given, it specifies the increment (or decrement).
...
```

2.3 conditional statements

conditional statements

```
>>> i = 12
>>> if i % 3 == 0:
>>>     # some code here
>>>     pass
>>> elif i % 2:
>>>     # some other code here
>>>     pass
>>> else:
>>>     # code for the default case
>>>     pass
```

2.4 loops

for loops

```
>>> x = 1
>>> for i in range(4, 8):
>>>     x *= 3
>>>     print "3 to the", i , "is", x
 3 to the 4 is 3
 3 to the 5 is 9
 3 to the 6 is 27
 3 to the 7 is 81
```

while loops

```
>>> n = 1
>>> x = 0
>>> while x < 0.99:
>>>     x = x + 0.5**n
```

```
>>>     n = n + 1
>>>     print n, x
```

```
2 0.5
3 0.75
4 0.875
5 0.9375
6 0.96875
7 0.984375
8 0.9921875
```

2.5 lists

lists

lists are *ordered sets* of objects

```
>>> A = ['Hannibal', 'B.A. Baracus', 'Faceman']
>>> print A[0], A[-1]
```

```
Hannibal Faceman
```

```
>>> print A[1:3]
```

```
['B.A. Baracus', 'Faceman']
```

```
>>> print len(A)
```

```
3
```

```
>>> A[1] = 'Mr. T'
>>> print A
```

```
['Hannibal', 'Mr. T', 'Faceman']
```

lists

```
>>> A = ['Hannibal', 'B.A. Baracus', 'Faceman']
>>> A.append('Murdock')
>>> A.append('Murdock')
>>> print A.count('Murdock')
```

```
2
```

```
>>> for a in A:
>>>     print a
```

```
Hannibal
B.A. Baracus
Faceman
Murdock
Murdock
```

lists comprehensions

```
>>> a = [x**2 for x in range(5)]
```

```
>>> print a
```

```
[0, 1, 4, 9, 16]
```

```
>>> noprimes = [j for i in range(2, 8) \
>>> for j in range(i*2, 50, i)]
>>> primes = [x for x in range(2, 50) if x not in noprimes]
>>> print primes
```

```
[2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47]
```

2.6 tuples

tuples (inmutable data type)

```
>>> printerIP = (147,83,94,16,9100)
>>> print printerIP[3]
```

```
16
```

```
>>> try:
>>>     printerIP[3] = 12
>>> except TypeError, err:
>>>     print 'There was an error:'
>>>     print err
```

```
There was an error:
'tuple' object does not support item assignment
```

```
>>> oct1, oct1, oct2, oct3, port = printerIP
>>> print port
```

```
9100
```

2.7 dictionaries

dictionaries

- dictionaries map keys to values (one-to-one relationships)
- order is not conserved

```
>>> d = {'a':1, 'name':'James', 'grades':['A', 'A', 'C']}

>>> print d.keys()
```

```
['a', 'grades', 'name']
```

```
>>> print d.values()
```

```
[1, ['A', 'A', 'C'], 'James']
```

```
>>> print d['a']
```

```
1
```

```
>>> d['grades'] = ['C', 'C', 'C']

>>> print d.has_key('name')
```

```
True
```

```
>>> print 'grades' in d
```

```
True
```

zipping, combining dictionaries

```
>>> seq1 = ('a','b','c','d')
>>> seq2 = [1,2,3,4]
>>> d = dict(zip(seq1,seq2))
>>> print d
```

```
{'a': 1, 'c': 3, 'b': 2, 'd': 4}
```

```
>>> d1 = {'apples': 3, 'oranges': 2}
>>> d2 = {'pears': 4, 'grapes': 1}
>>> d1.update(d2)
>>> print d1
```

```
{'grapes': 1, 'pears': 4, 'apples': 3, 'oranges': 2}
```

looping, deleting dictionaries

```
>>> eur = {'USD':0.6745, 'GBP':1.1189, 'JPY':0.0075}
>>>
>>> for k, v in eur.items():
>>>     print "EUR 1 = %s %g" % (k, v)
```

```
EUR 1 = JPY 0.0075
EUR 1 = USD 0.6745
EUR 1 = GBP 1.1189
```

```
>>> del eur['JPY']
>>> print eur
```

```
{'USD': 0.67449999999999999, 'GBP': 1.1189}
```

2.8 string formatting

string formatting

```
>>> template = 'All %s and no %s makes %s a %s.'
>>> tuple1 = ('sun', 'snow', 'Hawaii', 'funny place')
>>> # a list is also ok
>>> phrase1 = template % tuple1
>>> print phrase1
```

```
All sun and no snow makes Hawaii a funny place.
```

```
>>> tuple2 = ('work', 'play', 'Jack', 'dull boy')
>>> phrase2 = template % tuple2
>>> print phrase2
```

```
All work and no play makes Jack a dull boy.
```

string formatting with dictionaries

```
>>> format = 'results_epsilon%(eps).3fk_%(k).2f_N%(N)d.txt'
>>> params = {'eps':0.125,'k':2.35, 'N':200}
>>> filename = format % params
>>> print filename
```

```
results_epsilon0.125k_2.35_N200.txt
```

```
>>> params['k'] = 2.40
>>> filename = format % params
>>> print filename
```

```
results_epsilon0.125k_2.40_N200.txt
```

2.9 functions

functions

```
>>> def myFunction(a, b):
>>>     '''
>>>     Returns the result of two times 'a' plus 'b'
>>>     '''
>>>     c = 2*a + b
>>>     return c
>>>
>>> print myFunction(2, 3)
```

```
7
```

```
>>> print myFunction('Hey ', 'Ho ')
```

```
Hey Hey Ho
```

positional vs keyword arguments

```
>>> def printArguments(a, b):
>>>     print 'First arg. '  + a + ', second arg. '  + b
>>>
>>> # Positional arguments
>>> printArguments('1', '2')
```

```
First arg. 1, second arg. 2
```

```
>>> # Keyword arguments
>>> printArguments(b='1', a='2')
```

```
First arg. 2, second arg. 1
```

positional arguments

```
>>> def myFunction(*args):
>>>     ''' Here 'args' is a list of values '''
>>>     return args
>>>
>>> print myFunction(2, 'A', ['Random', 3.15])
```

```
(2, 'A', ['Random', 3.1499999999999999])
```

```
>>> def computeMean(*args):
>>>     t = 0
>>>     for arg in args: t += arg
>>>     return t/len(args)
>>>
>>> print 'The mean is %.2f' % computeMean(1,2,3,4,5,6,7)
```

```
The mean is 4.00
```

keyword arguments

```
>>> def myFunction(**kwargs):
>>>     ''' In this case 'kwargs' is a dictionary'''
>>>     for k,v in kwargs.items():
>>>         print k, '=', v
>>>
>>> myFunction(dt=0.1, c='RungeKutta', epsilon=0.05)
```

```
epsilon = 0.05
dt = 0.1
c = RungeKutta
```

```
>>> dict = {'USD':0.6745, 'GBP':1.1189, 'JPY':0.0075}
>>> myFunction(**dict)
```

```
JPY = 0.0075
USD = 0.6745
GBP = 1.1189
```

2.10 moularity

everything can be put in a module

```
>>> # This is the conversor.py module
>>>
>>> def c2f(Tf):
>>>     '''    Converts Farenheit to Celsius '''
>>>     return (5.0/9.0)*(Tf-32.0)
```

```
>>> import conversor
>>> print conversor.c2f.__doc__
```

```
    Converts Farenheit to Celsius
```

```
>>> Tc = conversor.c2f(66)
>>> print Tc

 18.8888888889
```

2.11 classes

Classes

```
>>> class Stack():
>>>     ''' Aqui definim la classe '''
>>>     def __init__(self):
>>>         self.items = []
>>>
>>>     def push(self, item):
>>>         self.items.append(item)
>>>
>>>     def pop(self):
>>>         item = self.items[-1]
>>>         self.items = self.items[0:-1]
>>>         return item
```

BioSequence Example

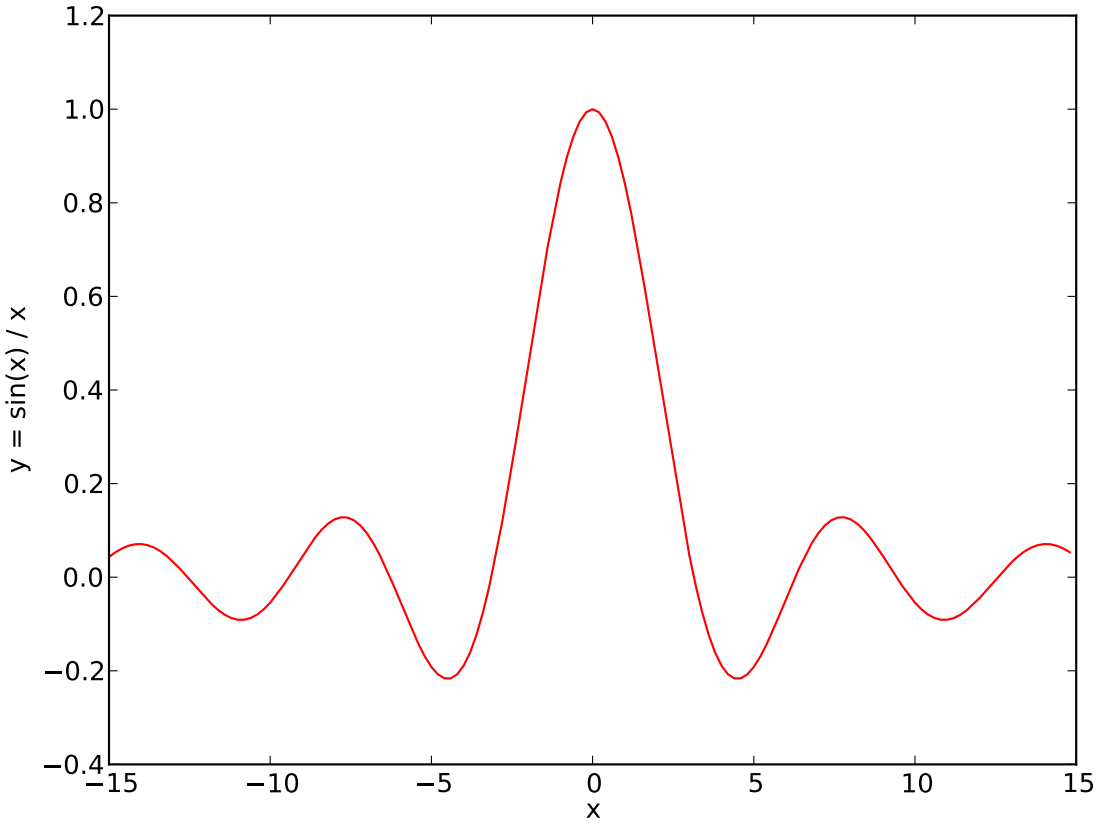
2.12 external modules

external modules

```
>>> from pylab import *
>>> A = array([[1, 2, 3], [4, 5, 6]])
>>> print 2*A

 [[ 2  4  6]
  [ 8 10 12]]

>>> print A*A

 [[ 1  4  9]
  [16 25 36]]

>>> print dot(A.T, A)

 [[17 22 27]
  [22 29 36]
  [27 36 45]]
```

external modules

```
>>> from pylab import *
>>>
>>> x = arange(-15, 15, 0.2)
>>> y = sin(x) / x
>>> plot(x, y, 'r-')
>>> xlabel('x')
>>> ylabel('y = sin(x) / x')
>>> savefig('sinc.pdf')
>>> close()
```



3 Hands on

Hands on