Python language: Functions, modules and objects

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26 September, 2010
Day 2, Session 4

Outline

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1 Functions

- Default arguments
- Keyword arguments
- Built-in functions
- Exercises

2 Modules

3 Objects

Outline

Functions: default arguments

```
In []: greet = 'hello world'

In []: greet.split()
Out[]: ['hello', 'world']

In []: line = 'Rossum, Guido, 54, 46, 55'

In []: line.split(',')
Out[]: ['Rossum', ' Guido', ' 54',
                       ' 46', ' 55']
```

Functions: default arguments . . .

```
In []: def welcome(greet, name="World"):
  ....     print greet, name

In []: welcome("Hello")
Hello World

In []: welcome("Hi", "Guido")
Hi Guido
```

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Functions: Keyword arguments

We have seen the following

```
legend(['sin(2y)'], loc = 'center')

plot(y, sin(y), 'g', linewidth = 2)

annotate('local max', xy = (1.5, 1))

pie(science.values(),
            labels = science.keys())
```

Basic Python

Functions: keyword arguments . . .

```
In []: def welcome(greet, name="World"):
 ....     print greet, name

In []: welcome("Hello", "James")
Hello James

In []: welcome("Hi", name="Guido")
Hi Guido

In []: welcome(name="Guido", greet="Hey")
Hey Guido
```

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Before writing a function

- Variety of built-in functions are available
- **abs, any, all, len, max, min**
- **pow, range, sum, type**
- Refer here: `http://docs.python.org/library/functions.html`

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Problem set 3: Problem 3.1

Write a function to return the gcd of two numbers.

Problem 3.2

Write a program to print all primitive pythagorean triads
(a, b, c) where a, b are in the range 1—100
A pythagorean triad (a, b, c) has the property
$a^2 + b^2 = c^2$.
By primitive we mean triads that do not 'depend' on
others. For example, (4,3,5) is a variant of (3,4,5) and
hence is not primitive. And (10,24,26) is easily derived
from (5,12,13) and is also not primitive.

Problem 3.3

Write a program that generates a list of all four digit numbers that have all their digits even and are perfect squares.

For example, the output should include 6400 but not 8100 (one digit is odd) or 4248 (not a perfect square).

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`from...import` magic

from **scipy.integrate** **import** **odeint**

from **scipy.optimize** **import** **fsolve**

Above statements import a function to our namespace

Running scripts from command line

- Fire up a terminal

- python four_plot.py

```
Traceback (most recent call last):
  File "four_plot.py", line 1, in <module>
    x = linspace(-5*pi, 5*pi, 500)
NameError: name 'linspace' is not defined
```

Running scripts from command line

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NameError: name 'linspace' is not defined
```

Remedy . . .

`from scipy import *`

Now run python four_plot.py again

Now what?

```
Traceback (most recent call last):
  File "four_plot.py", line 1, in <module
    x = plot(x, x, 'b')
NameError: name 'plot' is not defined
```

Basic Python

Remedy . . .

`from pylab import *`

Now run python four_plot.py again!!

Modules

- The **import** keyword "loads" a module
- One can also use:

```
In []: from scipy import *
In []: from scipy import linspace
```

- What is the difference?
- Use the former only in interactive mode

Package hierarchies

```python
from scipy.integrate import odeint

from scipy.optimize import fsolve
```

`from ... import` - conventional way!

```python
from scipy import linspace, pi, sin
from pylab import plot, legend, annotate
from pylab import xlim, ylim

x = linspace(-5*pi, 5*pi, 500)
plot(x, x, 'b')
plot(x, -x, 'b')
plot(x, sin(x), 'g', linewidth=2)
plot(x, x*sin(x), 'r', linewidth=3)
legend(['x', '-x', 'sin(x)', 'xsin(x)'])
annotate('origin', xy = (0, 0))
xlim(-5*pi, 5*pi)
ylim(-5*pi, 5*pi)
```

`from ... import` - conventional way!

```python
import scipy
import pylab

x = scipy.linspace(-5*scipy.pi, 5*scipy.pi, 500)
pylab.plot(x, x, 'b')
pylab.plot(x, -x, 'b')
pylab.plot(x, scipy.sin(x), 'g', linewidth=2)
pylab.plot(x, x*scipy.sin(x), 'r', linewidth=3)
pylab.legend(['x', '-x', 'sin(x)', 'xsin(x)'])
pylab.annotate('origin', xy = (0, 0))
pylab.xlim(-5*scipy.pi, 5*scipy.pi)
pylab.ylim(-5*scipy.pi, 5*scipy.pi)
```

Modules: Standard library

- Very powerful, "Batteries included"
- Some standard modules:
  - Math: **math**, **random**
  - Internet access: **urllib2**, **smtplib**
  - System, Command line arguments: **sys**
  - Operating system interface: **os**
  - Regular expressions: **re**
  - Compression: **gzip**, **zipfile**, and **tarfile**
  - And a whole lot more!
- Check out the Python Library reference:
  http://docs.python.org/library/

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Modules of special interest

pylab Easy, interactive, 2D plotting

scipy arrays, statistics, optimization, integration, linear algebra, Fourier transforms, signal and image processing, genetic algorithms, ODE solvers, special functions, and more

Mayavi Easy, interactive, 3D plotting

Outline

Basic Python

Everything is an Object!

- **int**
- **float**
- **str**
- **list**
- **tuple**
- **string**
- **dictionary**
- **function**
- User defined class is also an object!

Using Objects

- Creating Objects
  - Initialization

  In []: a = str()

  In []: b = "Hello World"

- Object Manipulation
  - Object methods
  - "." operator

  In []: "Hello World".split()
  Out[]: ['Hello', 'World']

Objects provide consistency

```python
for element in (1, 2, 3):
    print element
for key in {'one':1, 'two':2}:
    print key
for char in "123":
    print char
for line in open("myfile.txt"):
    print line
for line in urllib2.urlopen('http://site.com'):
    print line
```

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What did we learn?

- Functions: Default and Keyword arguments
- Modules
- Objects