Python Advance Course via Astronomy street

python

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Python Advance Course via Astronomy street

Advance Course Outline:

- Lesson 1: Python basics (T)
- Lesson 2: Python with Numpy and Matplotlib (T)
- Lesson 3: Science modules (Scipy) (T)

Python Advance Course via Astronomy street

Lesson 1: Python basics

- Starting Python
- Syntax & Basic data types
- Input and Output - Files
- Scripting & Modules
- Common Syntax Structures
- Standard Libraries

python

Starting Python

Python:

type python in terminal...

```
sousasag@asusg51jx: ~
sousasag@asusg51jx:~$ python
Python 2.7.4 (default, Apr 19 2013, 18:28:01)
[GCC 4.7.3] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

IPython:

type ipython in terminal...

```
sousasag@asusg51jx: ~
sousasag@asusg51jx:~$ ipython
Python 2.7.4 (default, Apr 19 2013, 18:28:01)
Type "copyright", "credits" or "license" for more information.

IPython 0.13.2 -- An enhanced Interactive Python.
?         -> Introduction and overview of IPython's features.
%quickref -> Quick reference.
help      -> Python's own help system.
object?   -> Details about 'object', use 'object??' for extra details.

In [1]:
```

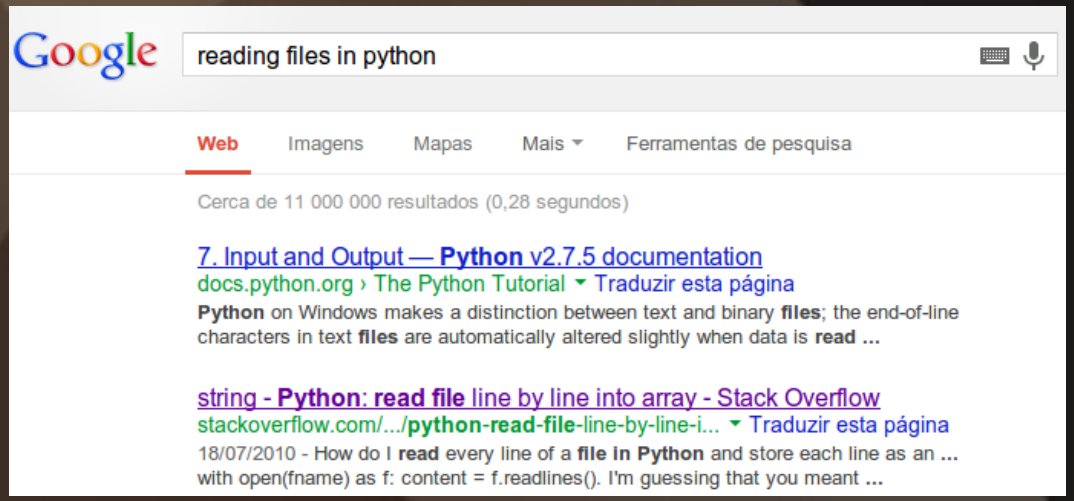
Python finding help

The geeky way:

Interactive Help in Python Shell

help()	Invoke interactive help
help(*m*)	Display help for module *m*
help(*f*)	Display help for function *f*
dir(*m*)	Display names in module *m*

The easy way:



IPython way:

```
In [1]: range?
Type:       builtin_function_or_method
String Form:<built-in function range>
Namespace:  Python builtin
Docstring:
range(stop) -> list of integers
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).
For example, range(4) returns [0, 1, 2, 3].  The end point is omitted!
These are exactly the valid indices for a list of 4 elements.
```

Python importing modules

Module Import

import *module_name*

from *module_name* import *name* , ...

from *module_name* import *

CAUTION

Interactive Help in Python Shell

help()	Invoke interactive help
help(*m*)	Display help for module *m*
help(*f*)	Display help for function *f*
dir(*m*)	Display names in module *m*

Python Sintaxe and Basic Types
Python as a calculator

Using Python as a Calculator

Common Data Types

Type	Description	Literal Ex
int	32-bit Integer	3, -4
long	Integer > 32 bits	101L
float	Floating point number	3.0, -6.55
complex	Complex number	1.2J

```
>>> 2 + 5
7
>>> 2.1*(2**3-1/2.3)
15.886956521739132
>>>
```

**	Exponentiation
*, /, %	Multiply, divide, mod
+, -	Add, subtract

Python Sintaxe and Basic Types
Python as a calculator
Using Python as an advanced Calculator

Common Data Types

Type	Description	Literal Ex
int	32-bit Integer	3, -4
long	Integer > 32 bits	101L
float	Floating point number	3.0, -6.55
complex	Complex number	1.2J

**	Exponentiation
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```
Python 2.7.4 (default, Apr 19 2013, 18:28:01)
[GCC 4.7.3] on linux2
Type "help", "copyright", "credits" or "license" for mo
re information.
>>> from math import *
>>> dir()
['__builtins__', '__doc__', '__name__', '__package__',
'acos', 'acosh', 'asin', 'asinh', 'atan', 'atan2', 'ata
nh', 'ceil', 'copysign', 'cos', 'cosh', 'degrees', 'e',
 'erf', 'erfc', 'exp', 'expm1', 'fabs', 'factorial', 'f
loor', 'fmod', 'frexp', 'fsum', 'gamma', 'hypot', 'isin
f', 'isnan', 'ldexp', 'lgamma', 'log', 'log10', 'log1p'
, 'modf', 'pi', 'pow', 'radians', 'sin', 'sinh', 'sqrt'
, 'tan', 'tanh', 'trunc']
>>> cos(radians(60))**2+sin(radians(60))**2
1.0
```

Common Math Module Functions

Function	Returns (all float)
ceil(*x*)	Smallest whole nbr >= *x*
cos(*x*)	Cosine of *x* radians
degrees(*x*)	*x* radians in degrees
radians(*x*)	*x* degrees in radians
exp(*x*)	e ** *x*
floor(*x*)	Largest whole nbr <= *x*
hypot(*x*, *y*)	sqrt(*x* * *x* + *y* * *y*)
log(*x* [, *base*])	Log of *x* to *base* or natural log if *base* not given
pow(*x*, *y*)	x ** y
sin(*x*)	Sine of *x* radians
sqrt(*x*)	Positive square root of *x*
tan(*x*)	Tangent of *x* radians
pi	Math constant pi to 15 sig figs
e	Math constant e to 15 sig figs

Python Sintaxe and Basic Types

Small Operator Precedence Table

func_name(*args*, ...)	Function call
x[*index* : *index*]	Slicing
x[*index*]	Indexing
x.attribute	Attribute reference
**	Exponentiation
*, /, %	Multiply, divide, mod
+, -	Add, subtract
>, <, <=, >=, !=, ==	Comparison
in, not in	Membership tests
not, and, or	Boolean operators NOT, AND, OR

Python Sintaxe and Basic Types

Common Data Types

Type	Description	Literal Ex
int	32-bit Integer	3, -4
long	Integer > 32 bits	101L
float	Floating point number	3.0, -6.55
complex	Complex number	1.2J
bool	Boolean	True, False
str	Character sequence	“Python”
tuple	Immutable sequence	(2, 4, 7)
list	Mutable sequence	[2, x, 3.1]
dict	Mapping	{ x:2, y:5 }

Special Note: 32bit vs 64bit systems have different variable sizes:

max int for 32bit: 2**31-1 for 64bit: 2**63-1

you can check this with sys.maxint

Python Sintaxe and Basic Types
Strings

And more:

- **strip()** - Return a copy of the string s with leading and trailing whitespace removed.

Other useful functions:

- **atof(s)** - Return the floating point number represented by the string s.
- **atoi(s)** - Return the int number represented by the string s.
- **atol(s)** - Return the long number represented by the string s.

<u>Alternatively you can use casting of variables:</u>

```
>>> from string import *
>>> s='1.23'
>>> df=atof(s)
>>> type(df)
<type 'float'>
>>> df2=float(s)
>>> type(df2)
<type 'float'>
>>> print df,df2
1.23 1.23
```

Common String Methods

S.method()	Returns (str unless noted)
capitalize	*S* with first char uppercase
center(*w*)	*S* centered in str *w* chars wide
count(*sub*)	int nbr of non-overlapping occurrences of *sub* in *S*
find(*sub*)	int index of first occurrence of *sub* in *S* or -1 if not found
isdigit()	bool True if *S* is all digit chars, False otherwise
islower() isupper()	bool True if *S* is all lower/upper case chars, False otherwise
join(*seq*)	All items in *seq* concatenated into a str, delimited by *S*
lower() upper()	Lower/upper case copy of *S*
lstrip() rstrip()	Copy of *S* with leading/ trailing whitespace removed, or both
split([*sep*])	List of tokens in *S*, delimited by *sep*; if *sep* not given, delimiter is any whitespace

Python Sintaxe and Basic Types
Strings – Formating numbers

```
>>> x=123;y=456.789
>>> s='%6d' % x
>>> s
'   123'
>>> '%06d' % x
'000123'
>>> '%8.2f' % y
'  456.79'
>>> '%8.2e' % y
'4.57e+02'
```

Formatting Numbers as Strings

Syntax: *"format_spec" % numeric_exp*
***format_spec* syntax:** *% width.precision type*

- *width* (optional): align in number of colums specified; negative to left-align, precede with 0 to zero-fill
- *precision* (optional): show specified digits of precision for floats; 6 is default
- *type* (required): d (decimal int), f (float), s (string), e (float – exponential notation)
- Examples for x = 123, y = 456.789
  "%6d" % x -> . . . 123
  "%06d" % x -> 000123
  "%8.2f % y -> . . 456.79
  "8.2e" % y -> 4.57e+02
  "-8s" % "Hello" -> Hello . . .

Python Sintaxe and Basic Types
Lists

list	Mutable sequence	[2, x, 3.1]

```
>>> list = [1,2,3,4,5,6,7]
>>> list[1]
2
>>> list [-1]
7
>>> list[3:5]
[4, 5]
>>> list[4:]
[5, 6, 7]
>>> list [:-3]
[1, 2, 3, 4]
```

```
>>> a
['Primeiro', 'a']
>>> a=[1,'a',2L]
>>> a.insert(0,'Primeiro')
>>> a
['Primeiro', 1, 'a', 2L]
>>> ele=a.pop()
>>> ele
2L
>>> a
['Primeiro', 1, 'a']
>>> a.reverse()
>>> a
['a', 1, 'Primeiro']
>>> a.sort()
>>> a
[1, 'Primeiro', 'a']
>>> a.pop(0)
1
>>> a
['Primeiro', 'a']
```

```
>>> a=['Helton','Jackson','Moutinho','Iturbe']
>>> a.sort()
>>> a
['Helton', 'Iturbe', 'Jackson', 'Moutinho']
>>> a.sort(reverse=True)
>>> a
['Moutinho', 'Jackson', 'Iturbe', 'Helton']
```

Common List Methods

***L*.method()**	**Result/Returns**
append(*obj*)	Append *obj* to end of *L*
count(*obj*)	Returns int nbr of occurrences of *obj* in *L*
index(*obj*)	Returns index of first occurrence of *obj* in *L*; raises ValueError if *obj* not in *L*
pop([*index*])	Returns item at specified *index* or item at end of L if *index* not given; raises IndexError if *L* is empty or *index* is out of range
remove(*obj*)	Removes first occurrence of *obj* from *L*; raises ValueError if *obj* is not in *L*
reverse()	Reverses *L* in place
sort()	Sorts *L* in place

Python Sintaxe and Basic Types
Tuples

tuple	Immutable sequence	(2, 4, 7)

Common Tuple Methods

***T*.method()**	**Returns**
count(*obj*)	Returns nbr of occurrences of *obj* in *T*
index(*obj*)	Returns index of first occurrence of *obj* in *T*; raises ValueError if *obj* is not in *T*

Tuples vs. Lists

Tuples are immutable, what you define you cannot change it.

Lists is a dynamic data structure, you can add, remove, change elements.

Tuples are faster than Lists

Python Sintaxe and Basic Types
Dictionary

dict	Mapping	{ x:2, y:5 }

```
>>> dict={'Helton':1,'Jackson':9,'Lucho':3}
>>> dict.keys()
['Helton', 'Lucho', 'Jackson']
>>> dict.values()
[1, 3, 9]
>>> for key in dict:
...   print key,dict[key]
...
Helton 1
Lucho 3
Jackson 9
```

Common Dictionary Methods

***D*.method()**	**Result/Returns**
clear()	Remove all items from *D*
get(*k* [,*val*])	Return *D*[*k*] if *k* in *D*, else *val*
has_key(*k*)	Return True if *k* in *D*, else False
items()	Return list of key-value pairs in *D*; each list item is 2-item tuple
keys()	Return list of *D*'s keys
pop(*k*, [*val*])	Remove key *k*, return mapped value or *val* if *k* not in *D*
values()	Return list of *D*'s values

Python Sintaxe and Basic Types
Common Built-in Functions

```
>>> list=range(0,8,2)
>>> list
[0, 2, 4, 6]
>>> len(list)
4
>>> max(list)
6
>>> min(list)
0
>>> sum(list)
12
>>> type(list)
<type 'list'>
>>> str='1.234'
>>> num=float(str)
>>> num
1.234
>>> round(num,2)
1.23
```

Common Built-in Functions

Function	Returns
abs(*x*)	Absolute value of *x*
dict()	Empty dictionary, eg: d = dict()
float(*x*)	int or string *x* as float
id(*obj*)	memory addr of *obj*
int (*x*)	float or string *x* as int
len(*s*)	Number of items in sequence *s*
list()	Empty list, eg: m = list()
max(*s*)	Maximum value of items in *s*
min(*s*)	Minimum value of items in *s*
open(*f*)	Open filename *f* for input
ord(*c*)	ASCII code of *c*
pow(*x*,*y*)	x ** y
range(*x*)	A list of x ints 0 to *x* - 1
round(*x*,*n*)	float *x* rounded to *n* places
str(*obj*)	str representation of *obj*
sum(*s*)	Sum of numeric sequence *s*
tuple(*items*)	tuple of *items*
type(*obj*)	Data type of *obj*

Input – Output - Files

```
open(...)
    open(name[, mode[, buffering]]) -> file object
```

```
>>> file = open('file.tmp','r')
>>> lines_list=file.readlines()
>>> lines_list
['line 1\n', 'before an empty line\n', '\n', 'final line\n']
>>> file.close()
>>> fileout = open('output.file','w')
>>> fileout.write("First Line to fine\n")
>>> fileout.write("Last Line to file\n")
>>> fileout.close()
>>> fileap = open('file.tmp', 'a')
>>> fileap.write("Extra line to file\n")
>>> fileap.close()
>>>
sousasag@asusg51jx:~$ more file.tmp
line 1
before an empty line

final line
Extra line to file
sousasag@asusg51jx:~$
```

File modes

- Read-only: `r`
- Write-only: `w`
  - Note: Create a new file or *overwrite* existing file.
- Append a file: `a`
- Read and Write: `r+`
- Binary mode: `b`
  - Note: Use for binary files, especially on Windows.

Common File Methods

F.method()	Result/Returns
read([*n*])	Return str of next *n* chars from *F*, or up to EOF if *n* not given
readline([*n*])	Return str up to next newline, or at most *n* chars if specified
readlines()	Return list of all lines in *F*, where each item is a line
write(*s*)	Write str *s* to *F*
writelines(*L*)	Write all str in seq *L* to *F*
close()	Closes the file

Scripting in Python

simple_script.txt (~/Dropbox/Python/AdvancedCour

```
1 print 'hello world'
```

Plain Text · Tab Width: 24 · Ln 1, Col 20 · INS

simple_script.py (~/Dropbox/Python/AdvancedCours

```
1 print 'hello world'
```

Python · Tab Width: 24 · Ln 1, Col 20 · INS

better_script.py (~/Dropbox/Python/AdvancedCours

```
1 #!/usr/bin/python
2
3 print 'hello world'
```

Python · Tab Width: 24 · Ln 3, Col 20 · INS

Template_Python.py (~/Dropbox/Python/Advance

```
1 #!/usr/bin/python
2 ## My first python code
3
4 ##imports:
5
6
7
8 ## My functions:
9
10
11
12 ### Main program:
13 def main():
14   print "Hello"
15
16
17 if __name__ == "__main__":
18     main()
19
```

Python · Tab Width: 24 · Ln 9, Col 1 · INS

To run the script/program:

- python filename

- ./filename (given exec permission)

Python Sintaxe
Common Syntax Structures

Assignment Statement

var = *exp*

Console Input/Output

var = input([*prompt*])
var = raw_input([*prompt*])
print *exp*[,] ...

Selection

if (*boolean_exp*):
  stmt ...
[elif (*boolean_exp*):
  stmt ...] ...
[else:
  stmt ...]

Repetition

while (*boolean_exp*):
  stmt ...

Traversal

for *var* in *traversal_object*:
  stmt ...

for i in range(init,end,step):

  stmt ...

Identation define the blocks
(no brackets needed)

Function Call

function_name(*arguments*)

Class Definition

class *Class_name* [(*super_class*)]:
  [*class variables*]
  def *method_name*(self, *parameters*):
    stmt

Comprehension Lists sintaxe:

new_list = [expression(i) for i in old_list if filter(i)]

```
>>> list = [1,2,3,4,-1,2,-3,-4.3]
>>> list
[1, 2, 3, 4, -1, 2, -3, -4.3]
>>> listnegatives = [ val for val in list if val < 0 ]
>>> listnegatives
[-1, -3, -4.3]
```

Standard Libraries

os - Miscellaneous operating system interfaces

dir(os) or http://docs.python.org/2/library/os

Some examples:

```
>>> import os
>>> os.getcwd()
'/home/sousasag/Dropbox/Python/AdvancedCourse/examples'
>>> os.listdir(os.curdir)
['Template_Python.py', 'simple_script.py', 'better_script.py', 'simple_script.txt', 'tmpdir']
>>> os.mkdir('junkdir')
>>> os.rename('junkdir','tmpdir2')
>>> os.listdir(os.curdir)
['Template_Python.py', 'simple_script.py', 'tmpdir2', 'better_script.py', 'simple_script.txt', 'tmpdir']
>>> 'file.tmp' in os.listdir(os.curdir)
False
>>> a = os.path.abspath('simple_script.py')
>>> a
'/home/sousasag/Dropbox/Python/AdvancedCourse/examples/simple_script.py'
>>> os.path.split(a)
('/home/sousasag/Dropbox/Python/AdvancedCourse/examples', 'simple_script.py')
>>> os.path.dirname(a)
'/home/sousasag/Dropbox/Python/AdvancedCourse/examples'
>>> os.path.basename(a)
'simple_script.py'
>>> os.path.isfile(a)
True
>>> os.path.isfile(os.path.basename(a))
True
>>> os.path.isfile(tmpdir)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'tmpdir' is not defined
>>> os.path.isfile('tmpdir')
False
```

Standard Libraries

glob - Filename globbing utility

dir(glob) or http://docs.python.org/library/glob

```
>>> import glob
>>> glob.glob('*.py')
['Template_Python.py', 'simple_script.py', 'better_script.py']
```

sys – System information

dir(sys) - http://docs.python.org/library/sys

sys_script.py (~/Dropbox/Python/AdvancedCourse

Open Save Undo

sys_script.py

```
1 #!/usr/bin/python
2 import sys
3 print sys.argv
```

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```
>>> sys.maxint
9223372036854775807
>>> sys.platform
'linux2'
>>> sys.version
'2.7.4 (default, Apr 19 2013, 18:28:01) \n[GCC 4.7.3]'
```

```
sousasag@asusg51jx:~/Dropbox/Python/AdvancedCourse/examples$ ./sys_script.py
['./sys_script.py']
sousasag@asusg51jx:~/Dropbox/Python/AdvancedCourse/examples$ ./sys_script.py a b 2 3.42
['./sys_script.py', 'a', 'b', '2', '3.42']
```

Standard Libraries

pickle - Create portable serialized representations of Python objects.
(similar to IDL save and restore)

dir(pickle)
or
http://docs.python.org/library/pickle

Some examples:

```
import pickle
pickle.dump(obj,file)
obj=pickle.load(file)
```

```
sousasag@asusg51jx:~/Dropbox/Python/AdvancedCourse/examples$ python
Python 2.7.4 (default, Apr 19 2013, 18:28:01)
[GCC 4.7.3] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> import pickle
>>> list=["El", 'terrorista']
>>> dic={"TimTim": 223421232, "Mickey":221232546}
>>> tuple=(list,dic)
>>> tuple
(['El', 'terrorista'], {'Mickey': 221232546, 'TimTim': 223421232})
>>> pickle.dump(tuple, file("filedump.pkl",'w')
... )
>>> import pickle
>>> list=["El", 'terrorista']
>>> dic={"TimTim": 223421232, "Mickey":221232546}
>>> tuple=(list,dic)
>>> tuple
(['El', 'terrorista'], {'Mickey': 221232546, 'TimTim': 223421232})
>>> pickle.dump(tuple, file("filedump.pkl",'w'))
>>>
sousasag@asusg51jx:~/Dropbox/Python/AdvancedCourse/examples$ python
Python 2.7.4 (default, Apr 19 2013, 18:28:01)
[GCC 4.7.3] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> l
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'l' is not defined
>>> import pickle
>>> pickle.load(file("filedump.pkl"))
(['El', 'terrorista'], {'Mickey': 221232546, 'TimTim': 223421232})
>>> tuple=pickle.load(file("filedump.pkl"))
>>> (list,dic)=tuple
>>> list
['El', 'terrorista']
>>> dic
{'Mickey': 221232546, 'TimTim': 223421232}
```

Questions?

Exercises...