

Basic python

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You can get this ppt and related files at:

https://github.com/ryan-leung/2016-JAN_python_workshop/

Learning Outcomes

- Know how to get a working python for your operating system.
- Define different data structures
- Make a loop with for and while
- Defining functions
- Reading files and plotting graphs

What is python



General-purpose, high-level programming language.

Object-oriented, interpreted, interactive.

Easy write, easy read.

Dynamic variables & memory management.

Why python?



- Coding and debugging is a tough task
- Spend less time on it and get your work done!
- Lots of packages written by others for speed deployment.

Installing

How to install python and get it work?

Python distribution

Anaconda / Miniconda

<https://store.continuum.io/cshop/anaconda/>

<http://conda.pydata.org/miniconda.html>

Official Site

<https://www.python.org/downloads/>

Portable Python

<http://portablepython.com/>

IF you run Linux, some Linux distributions has python pre-installed or get it from repository is faster:

```
sudo yum install python numpy scipy python-matplotlib ipython python-pandas  
sympy python-nose
```

```
sudo apt-get install python-numpy python-scipy python-matplotlib ipython  
ipython-notebook python-pandas python-sympy python-nose
```

Get Anaconda for Windows

Anaconda for Windows

PYTHON 2.7	PYTHON 3.5
<div>Windows 64-bit Graphical Installer</div> <div>337M</div>	<div>Windows 64-bit Graphical Installer</div> <div>392M</div>
<div>Windows 32-bit Graphical Installer</div> <div>321M</div>	<div>Windows 32-bit Graphical Installer</div> <div>316M</div>
Behind a firewall? Use these zipped Windows installers .	

Windows Anaconda Installation

1. Download the installer.
2. Double-click the .exe file to install Anaconda and follow the instructions on the screen.
3. Optional: [Verify data integrity with MD5](#).

Get Anaconda for Mac

Anaconda for OS X

PYTHON 2.7	PYTHON 3.5
<div>Mac OS X 64-bit Graphical Installer</div> <div>27411 (OS X 10.7 or higher)</div>	<div>Mac OS X 64-bit Graphical Installer</div> <div>25711 (OS X 10.7 or higher)</div>
<div>Mac OS X 64-bit Command-Line installer</div> <div>23911 (OS X 10.5 or higher)</div>	<div>Mac OS X 64-bit Command-Line installer</div> <div>23311 (OS X 10.5 or higher)</div>

OS X Anaconda Installation

1. Download the installer.
2. Double click the .pkg file and follow the instructions on the screen.
3. **Command-Line Installs:**

After downloading the installer, in the shell execute for Python 2.7:

```
bash Anaconda2-2.4.1-MacOSX-x86_64.sh
```

Or for Python 3.5:

```
bash Anaconda3-2.4.1-MacOSX-x86_64.sh
```

NOTE: You should type "bash", regardless of whether or not you are actually using the bash shell.

4. Optional: [Verify data integrity with MD5](#).

Get Anaconda for Linux

Anaconda for Linux

PYTHON 2.7	PYTHON 3.5
<div>Linux 64-bit</div> <div>23311</div>	<div>Linux 64-bit</div> <div>23511</div>
<div>Linux 32-bit</div> <div>27911</div>	<div>Linux 32-bit</div> <div>27711</div>

Linux Anaconda Installation

1. Download the installer.
2. After downloading the installer, in your terminal window execute for Python 2.7:

```
bash Anaconda2-2.4.1-Linux-x86_64.sh
```

Or for Python 3.5:

```
bash Anaconda3-2.4.1-Linux-x86_64.sh
```

NOTE: Type "bash" regardless of whether or not you are actually using the bash shell.

3. Optional: [Verify data integrity with MD5](#).



GO

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Python Releases for Windows

- [Latest Python 2 Release - Python 2.7.11](#)
- [Latest Python 3 Release - Python 3.5.1](#)
- [Python 3.4.4 - 2015-12-21](#)
 - Download [Windows x86 MSI installer](#)
 - Download [Windows x86-64 MSI installer](#)
 - Download [Windows help file](#)
 - Download [Windows debug information files for 64-bit binaries](#)
 - Download [Windows debug information files](#)
- [Python 3.5.1 - 2015-12-07](#)
 - Download [Windows x86 web-based installer](#)
 - Download [Windows x86 executable installer](#)
 - Download [Windows x86 embeddable zip file](#)
 - Download [Windows x86-64 web-based installer](#)
 - Download [Windows x86-64 executable installer](#)
 - Download [Windows x86-64 embeddable zip file](#)
 - Download [Windows help file](#)
- [Python 3.4.4rc1 - 2015-12-07](#)
 - Download [Windows x86 MSI installer](#)
 - Download [Windows x86-64 MSI installer](#)

Or from official site

Tips in python for Linux users

- Your system may have two different pythons:
 - python 2.x
 - python 3.x
- They may have different binary names:
 - python
 - python2
 - python3
- You can always check the python version by running its interpreter.
 - A common shebang line used for the Python interpreter is as follows:
 - `#!/usr/bin/env python`
 - You must then make the script executable, using the following command:
 - `chmod +x xxxxxxxxxx.py`

Configuring

How to add packages to python?

Install package (Anaconda build)

- To search/install packages, use “conda”
- Command:
 - `conda search xxxxxx`
 - `conda install xxxxxx`
- Other commands:

http://conda.pydata.org/docs/_downloads/conda-cheatsheet.pdf

Install package (Normal build)

- To search/install packages, use “pip”
- Python 3.4 (released March 2014) and Python 2.7.9 (released December 2014) ship with Pip.
- Package list: <https://pypi.python.org/pypi>
- Command:
 - `pip search xxxxxx`
 - `pip install xxxxxx`

Full Commands:

<code>install</code>	Install packages.
<code>uninstall</code>	Uninstall packages.
<code>freeze</code>	Output installed packages in requirements format.
<code>list</code>	List installed packages.
<code>show</code>	Show information about installed packages.
<code>search</code>	Search PyPI for packages.
<code>zip</code>	Zip individual packages.
<code>unzip</code>	Unzip individual packages.
<code>bundle</code>	Create pybundles.
<code>help</code>	Show help for commands.

Packages for Symbolic/numerical/statistical



NumPy



SciPy.org



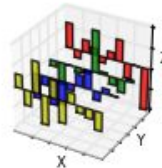
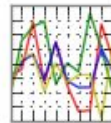
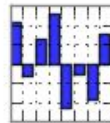
machine learning in Python



SymPy

pandas

$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$



- For symbolic
 - sympy
- For numerical
 - numpy
 - scipy
- For statistical and machine learning
 - scikit-learn
 - pandas

Python plotting / visualising packages



- **matplotlib**
 - all-round, major plotting in python
- **aplpy**
 - fits image plotting in high quality
- **yt**
 - large data / volumetric data visualising
- **bokeh**
 - interactive plots in html & javascript

Python in astronomy



Until ~2012 python astronomy modules were scattered.

Several core modules are now unified under astropy:

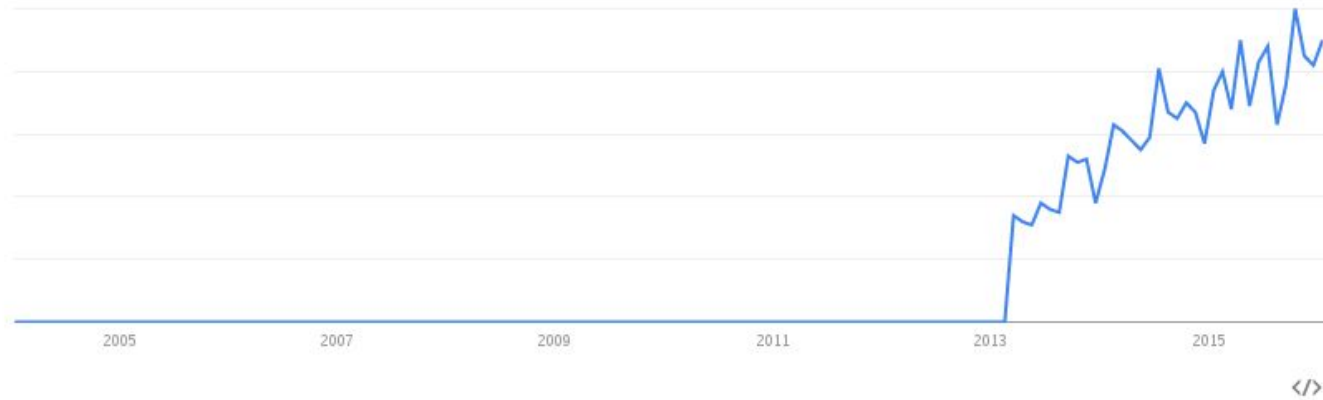
- **astropy.wcs** (World coordinate system (WCS) supported by PyWCS.)
- **astropy.io.fits** (FITS files support supported by PyFITS.)
- **astropy.coordinates** (Celestial coordinate and time transformations.)
- **astropy.units** (Unit and physical quantity conversions, physical constants specific to astronomy.)

astropy
Search term

+ Add term

Interest over time ?

☐ News headlines ? ☐ forecast ?



Regional interest ?



Running python

How to run your scripts?

Python interpreter

- For Linux / OSX, type “python” in terminal.
- For windows, open “Anaconda” folder in Start menu.

```
python
# yanyan at vela in ~ [17:34:44]
$ python
Python 2.7.11 |Anaconda 2.3.0 (64-bit)| (default, Dec 6 2015, 18:08:32)
[GCC 4.4.7 20120313 (Red Hat 4.4.7-1)] on linux2
Type "help", "copyright", "credits" or "license" for more information.
Anaconda is brought to you by Continuum Analytics.
Please check out: http://continuum.io/thanks and https://anaconda.org
>>> □
```

```
python
Deactivating environment "D:\Apps\Anaconda"...
Activating environment "D:\Apps\Anaconda"...

[Anaconda] C:\Users\yanyan>python
Python 2.7.11 |Anaconda 2.4.1 (32-bit)| (default, Dec 7 2015, 14:13:17) [MSC v.1500 32
Type "help", "copyright", "credits" or "license" for more information.
Anaconda is brought to you by Continuum Analytics.
Please check out: http://continuum.io/thanks and https://anaconda.org
>>>
```

Spyder IDE



Spyder (Python 3.4)

File Edit Search Source Run Debug Consoles Tools View Help

Editor - /tmp/interpolation.py

```
4 From the SciPy Cookbook
5 """
6
7 from numpy import arange, cos, linspace, pi, sin, random
8 from scipy.interpolate import splprep, splev
9
10 # make ascending spiral in 3-space
11 t=linspace(0,1.75*2*pi,100)
12
13 x = sin(t)
14 y = cos(t)
15 z = t
16
17 # %% add noise
18 x+= random.normal(scale=0.1, size=x.shape)
19 y+= random.normal(scale=0.1, size=y.shape)
20 z+= random.normal(scale=0.1, size=z.shape)
21
22 # %% spline parameters
23 s=3.0 # smoothness parameter
24 k=2 # spline order
25 nest=-1 # estimate of number of knots needed (-1 = maximal,
26
27 # %% find the knot points
28 tckp,u = splprep([x,y,z],s=s,k=k,nest=-1)
29
30 # %% evaluate spline, including interpolated points
31 xnew,ynew,znew = splev(linspace(0,1,400),tckp)
32
33 import pylab
```

Object inspector

Source Console Object numpy.mean

mean

Definition: mean(a, axis=None, dtype=None, out=None, keepdims=False)

Type: Function of numpy.core.fromnumeric module

Compute the arithmetic mean along the specified axis.

Returns the average of the array elements. The average is

Object inspector Variable explorer File explorer Static code analysis

IPython console

IP: Console 1/A

Python 3.4.0 on linux -- IPython 4.0.0

In [1]: runfile('/tmp/interpolation.py', wdir='/tmp')

Internal console Console History log IPython console

Permissions: RW End-of-lines: LF Encoding: UTF-8 Line: 18 Column: 43 Memory: 86 %

ipython / jupyter

For more
interaction and
fun, we use
ipython to run our
python code

1. Syntax

https://github.com/ryan-leung/2016-JAN_python_workshop/blob/master/Syntax.ipynb

2. Data Structures and Loops

https://github.com/ryan-leung/2016-JAN_python_workshop/blob/master/Data%20Structures%20and%20Loops.ipynb

3. Functions

https://github.com/ryan-leung/2016-JAN_python_workshop/blob/master/Functions.ipynb

4. Files and Plots

https://github.com/ryan-leung/2016-JAN_python_workshop/blob/master/Files%20and%20Plot.ipynb

Need more performance?

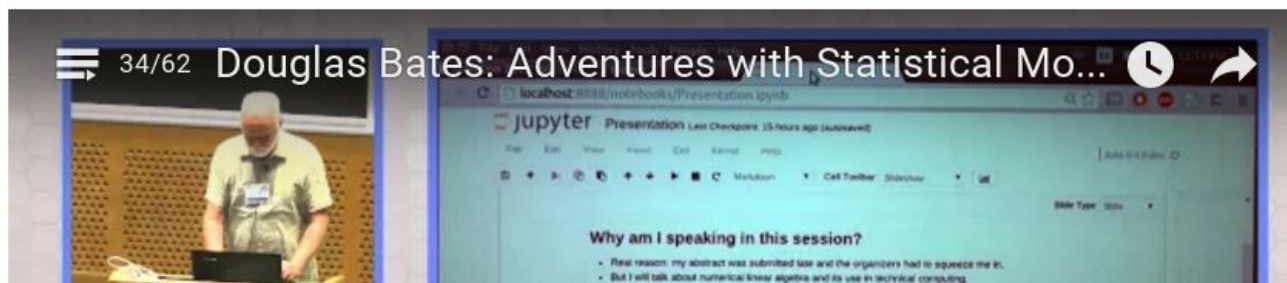
Any language apart from python and have a great performance?



[julia](#) | [source](#) | [downloads](#) | [docs](#) | [packages](#) | [blog](#) | [community](#) | [learning](#) | [teaching](#) | [publications](#) | [jsoc](#) | [juliacon](#)

Julia is a high-level, high-performance dynamic programming language for technical computing, with syntax that is familiar to users of other technical computing environments. It provides a sophisticated compiler, [distributed parallel execution](#), numerical accuracy, and an [extensive mathematical function library](#). Julia's Base library, largely written in Julia itself, also integrates mature, best-of-breed open source C and Fortran libraries for [linear algebra](#), [random number generation](#), [signal processing](#), and [string processing](#). In addition, the Julia developer community is contributing a number of [external packages](#) through Julia's built-in package manager at a rapid pace. [IJulia](#), a collaboration between the [IPython](#) and Julia communities, provides a powerful browser-based graphical notebook interface to Julia.

[JuliaCon 2015](#) at MIT was a huge success. The [videos](#) are now online, and a random video from JuliaCon 2015 is presented here.



Some basic features in julia

- Syntax similarities: python, MATLAB and C
- Utilize matplotlib for plotting, clever and sweet

	Fortran	Julia	Python	R	Matlab	Octave	Mathe- matica	JavaScript	Go	LuaJIT	Java
	gcc 4.8.2	0.3.7	2.7.9	3.1.3	R2014a	3.8.1	10.0	V8 3.14.5.9	go1.2.1	gsl- shell 2.3.1	1.7.0_75
fib	0.57	2.14	95.45	528.85	4258.12	9211.59	166.64	3.68	2.20	2.02	0.96
parse_int	4.67	1.57	20.48	54.30	1525.88	7568.38	17.70	2.29	3.78	6.09	5.43
quicksort	1.10	1.21	46.70	248.28	55.87	1532.54	48.47	2.91	1.09	2.00	1.65
mandel	0.87	0.87	18.83	58.97	60.09	393.91	6.12	1.86	1.17	0.71	0.68
pi_sum	0.83	1.00	21.07	14.45	1.28	260.28	1.27	2.15	1.23	1.00	1.00
rand_mat_stat	0.99	1.74	22.29	16.88	9.82	30.44	6.20	2.81	8.23	3.71	4.01
rand_mat_mul	4.05	1.09	1.08	1.63	1.12	1.06	1.13	14.58	8.45	1.23	2.35

- Ijulia and Jupyter

Home
x
Untitled1
x

localhost:8888/notebooks/Untitled1.ipynb?kernel_name=julia-0.4

jupyter
Untitled1 (unsaved changes)

File
Edit
View
Insert
Cell
Kernel
Help
Julia 0.4.2

CellToolbar

Out[2]: PyObject <matplotlib.collections.PathCollection object at 0x7f6e10c3e9b0>

In [4]: ?repmat

search:

Out[4]: repmat(A, n, m)

Construct a matrix by repeating the given matrix n times in dimension 1 and m times in dimension 2.

repmat

In []: If A_1, A_2, \dots are subsets of X , then $\bigcup_n A_n$ is the set

$\{x \in X \mid x \in A_n \text{ for some } n \in \mathbb{N}\}$

In []:

That's all

You can stay here for practising, I have collected some programming tasks for you

Practise and hands-on session

Questions are obtained from <https://projecteuler.net/>

Q1 Factorial

Write a program which can compute the factorial of a given numbers.

Suppose the input is:

8

Then, the output should be:

40320

Q2 Even Fibonacci numbers

Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10 terms will be:

1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ...

By considering the terms in the Fibonacci sequence whose values **do not exceed four million**, find the **sum of the even-valued terms**.

Q3 10001st prime

By listing the first six prime numbers: 2, 3, 5, 7, 11, and 13, we can see that the 6th prime is 13.

What is the 10 001st prime number?

Q4 Largest product in a series

The four adjacent digits in the 1000-digit number that have the greatest product are $9 \times 9 \times 8 \times 9 = 5832$.

7316717653133062491922511967442657474235534919493496983520312774506326239578318016984801869478851843

8586156078911294949545950173795833195285320880551112540698747158523863050715693290963295227443043557

6689664895044524452316173185640309871112172238311362229893423380308135336276614282806444486645238749

3035890729629049156044077239071381051585930796086670172427121883998797908792274921901699720888093776

6572733300105336788122023542180975125454059475224352584907711670556013604839586446706324415722155397

5369781797784617406495514929086256932197846862248283972241375657056057490261407972968652414535100474

8216637048440319989000889524345065854122758866688116427171479924442928230863465674813919123162824586

178664583591245665294765456828489128831426076900422421902267105562632111109370544217506941658960408

07198403850962455444362981230987879927244284909188845801561660979191338754992005240636899125607