Technical University of Lodz
Institute of Electronics

Algorithms and Data Structures

IPython

Łódź 2012

IPython – ipython.org

IP[y]: IPython
Interactive Computing

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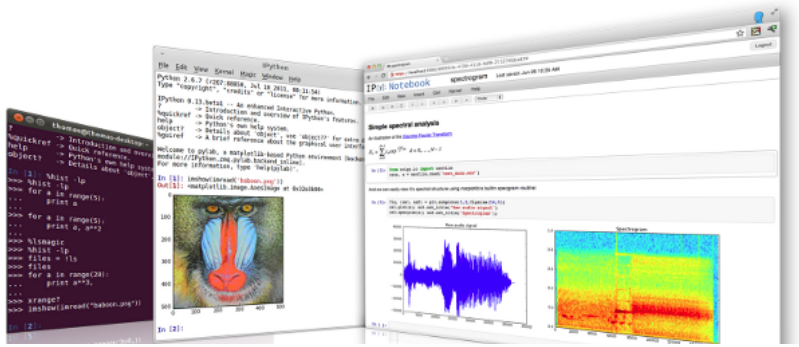
IPython provides a rich toolkit to help you make the most out of using Python, with:

- Powerful Python shells (terminal and Qt-based).
- A web-based notebook with the same core features but support for code, text, mathematical expressions, inline plots and other rich media.
- Support for interactive data visualization and use of GUI toolkits.
- Flexible, embeddable interpreters to load into your own projects.
- Easy to use, high performance tools for parallel computing.

To learn more about IPython, you can watch our *videos and screencasts*, download our talks and presentations, or read our extensive documentation. IPython is open source (BSD license), and is used by a range of other projects; add your project to that list if it uses IPython as a library, and please don't forget to *cite the project*.

IPython supports Python 2.6 to 2.7 and 3.1 or newer. Our older 0.10 series supports Python 2.5, and can be used with Python 2.4.



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MEMORIAL

John Hunter
1968–2012
J. Hunter Memorial Fund

VERSIONS

Stable
0.13 – June 2012
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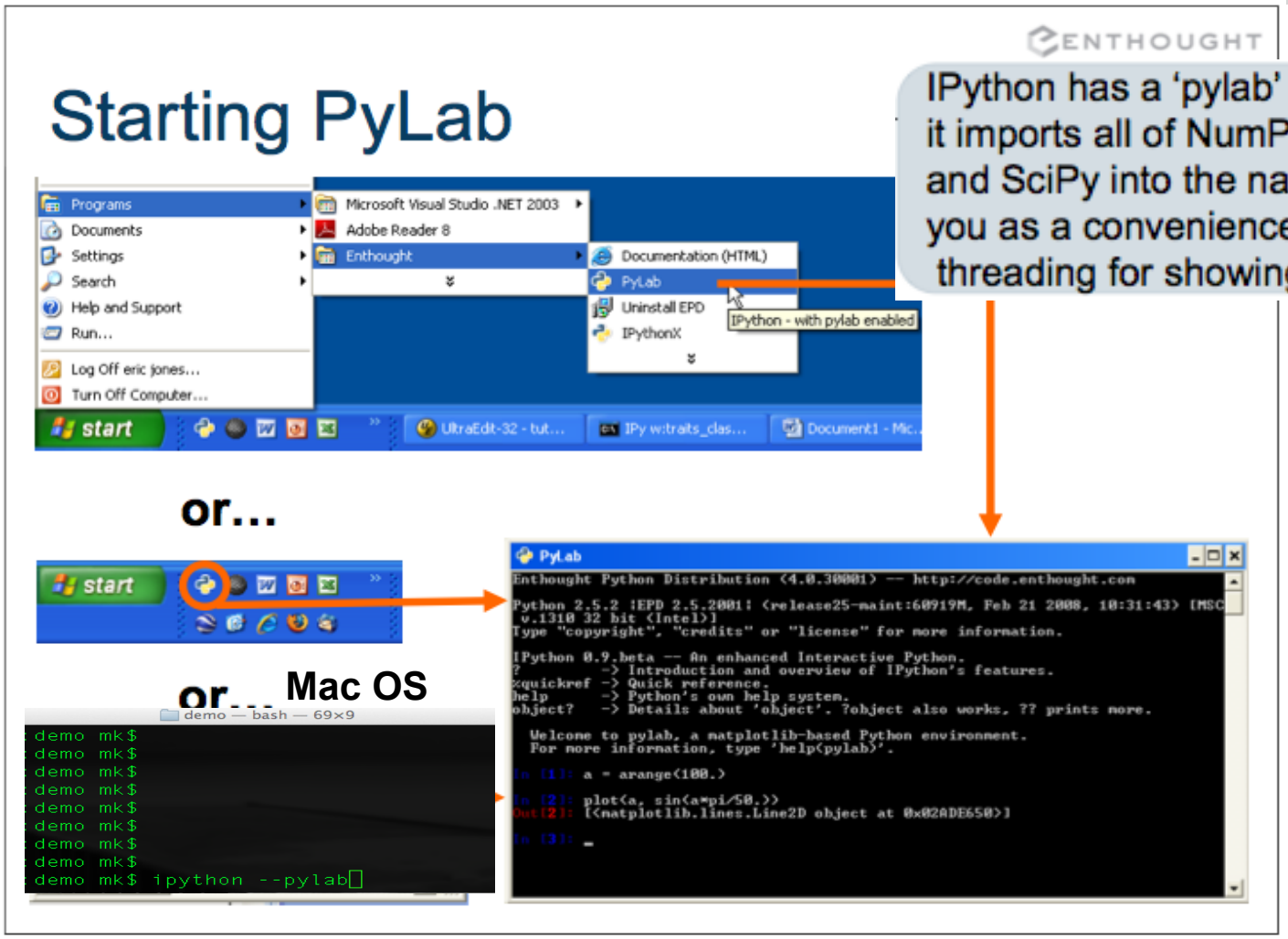
Development
pre-0.14
Github

I USE IT +1

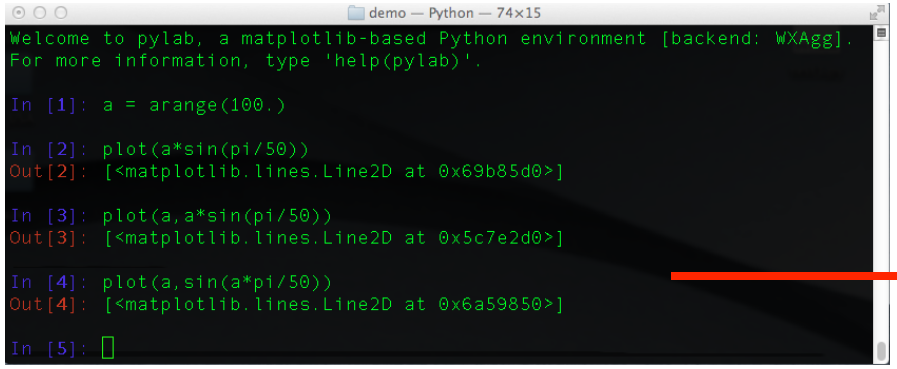
LINKS

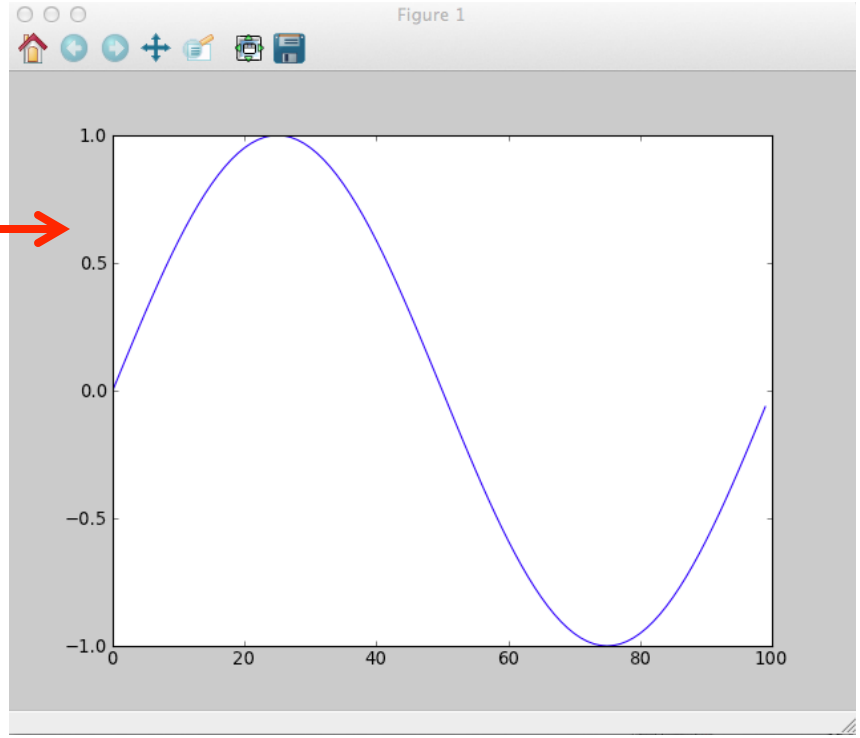
Issue tracker
Mailing lists:
User · Dev
IRC channel
(Freenode, #ipython)
Try IPython online

IPython


ENTHOUGHT
Starting PyLab
IPython has a 'pylab' mode where it imports all of NumPy, Matplotlib, and SciPy into the namespace for you as a convenience. It also enable threading for showing plots.
Programs
Documents
Settings
Search
Help and Support
Run...
Log Off eric jones...
Turn Off Computer...
Microsoft Visual Studio .NET 2003
Adobe Reader 8
Enthought
Documentation (HTML)
PyLab
Uninstall EPD
IPythonX
IPython - with pylab enabled
start
or...
start
or... Mac OS
demo — bash — 69×9
demo mk$
demo mk$ ipython --pylab
PyLab
Enthought Python Distribution (4.0.30001) -- http://code.enthought.com
Python 2.5.2 |EPD 2.5.2001| (release25-maint:60919M, Feb 21 2008, 10:31:43) [MSC v.1310 32 bit (Intel)]
Type "copyright", "credits" or "license" for more information.
IPython 0.9.beta -- An enhanced Interactive Python.
? -> Introduction and overview of IPython's features.
%quickref -> Quick reference.
help -> Python's own help system.
object? -> Details about 'object'. ?object also works, ?? prints more.
Welcome to pylab, a matplotlib-based Python environment.
For more information, type 'help(pylab)'.
In [1]: a = arange(100.)
In [2]: plot(a, sin(a*pi/50.))
Out[2]: [<matplotlib.lines.Line2D object at 0x02ADE650>]
In [3]:

PyLab – Interactive Python Environment

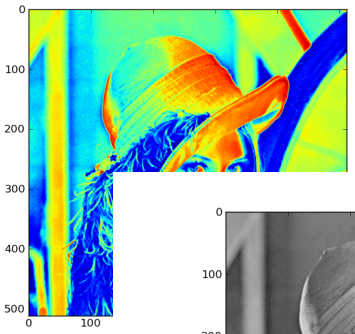


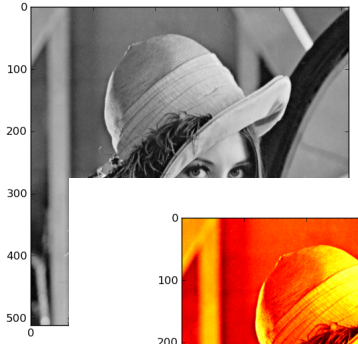


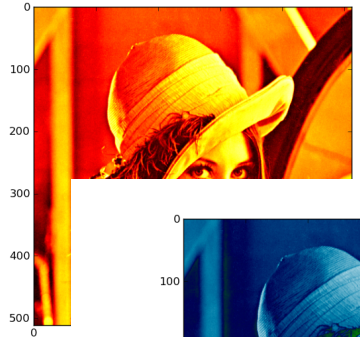

```
x = arange(100.)
y1 = sin(x*pi/50)
y2 = cos(x*pi/50)

plot(x,y1)
plot(x,y2)

#or
figure(2)
plot(x,y1,xy2)
title(‘ sinus and cosinus’)
```

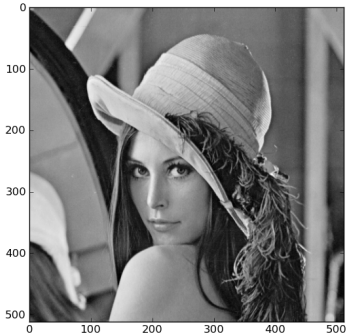
PyLab – Interactive Python Enviroment

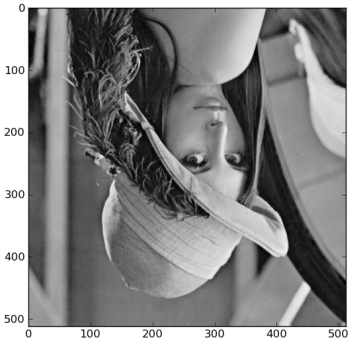
```
>> from scipy.misc import lena

>> image = lena()
>> imshow(image)
>> imshow(image, cmap='gray')
>> imshow(image, cmp='hot')
>> imshow(image, cmap='ocean')

>> imshow(image[::,::-1],cmap='gray') # flip lr
>> imshow(image[::-1,::],cmap='gray') # flip ud
```

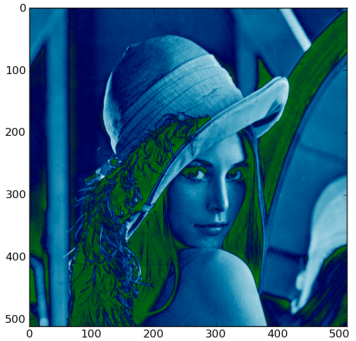












IPython Introducion

STANDARD PYTHON

```
>>>  a=1
>>>  a
>>>  1
```

AVALIABLE VARIABLES

```
>>> b = [1,2,3]

# Comments # (to the end of the line)
# List available variables
>>> %whos

Variable   Type    Data/Info
--------------------------
a          int     1
b          list    n=3
```

RESET & RELOAD

```
# Reset user defined variables
>>> %reset
Once deleted, variables cannot be recovered. Proceed (y/[n])?  y

# Let's check our namespace
>>> %whos
Interactive namespace is empty.

WARNING:  %reset also removes the names imported by PyLab.
>>> plot
NameError: name 'plot' is not defined
# Reload
>>> %pylab
Welcome to pylab, a matplotlib-based Python environment…
```

Directory navigation in IPython

Get path to current working directory

>>> *pwd*

>>> u'/Users/mk'

Change directory (note Unix style forward slashes)

>>> *cd Desktop/* (or *cd Pulpit* in Polish OS)

 # Tab completition helps you find and type directory and file names

Check the following commands (with *pwd* command):

- cd ..
- cd

List directory contents (Unix style, not “dir”)

In [11]: ls

Desktop/	Library/ Music/	Public/ mipav/	Documents/ Dropbox/	Movies/ Pictures/	Sites/ mySoft/	Downloads/

Directory navigation in IPython

```
# Go to the D: drive and create folder:
#python_lecture_1_tests
cd d://
mkdir python_lecture_1_test

#Go inside this directory and list its content
cd python_lecture_1_test
ls

# edit and run (if exists) or create new script
edit test_file_1.py
```

```
# fill the script with commands (the detailed
# explanation will appear during next lectures)
import pylab as pl
import numpy as np

x = np.arange(100)
y = np.sin(x*np.pi/50.)
pl.plot(x,y)

pl.show()
# here is end of the script !!!

# in the IPython  terminal write:
plot(x,cos(x*pi/50.))

# IPython is interactive!!!
```

Directory navigation in IPython

```
# Run script insight IPython(without editing it)
# Interactive mode
%run test_file_1.py

# To quit IPython use command
In [12]: quit()

# Run script from the sysetm level (Windos, Unix, Mac OS)
# Batch mode
# Run system console and write
python test_file_1.py
```

Directory Bookmarks

Bookmark the python_lecture_1_test directory

cd python_lecture_1_test

#bookmark as some name (alias)

%bookmark lect1

bookmark 2 more folders

lists bookmarked directories

%bookmark –l

go easily to bookmarked directory

go to home directory *cd*

go to lect1 directory

cd lect1

Function Info and Help

```
# Follow the command '?' to  print its documentation
>>> squeeze?

Remove single-dimensional entries from the shape of an array.
Parameters
----------
a : array_like
    Input data.
Returns
-------
squeezed : ndarray
    The input array, but with with all dimensions of length 1
    removed.  Whenever possible, a view on `a` is returned.
```

Function Info and Help

```
# Follow a command with '??' to print its source code
# compare: squeeze? And squeeze??
>>> squeeze??
def squeeze(a):
    """    Remove single-dimensional entries from the shape of an array.
 Examples
    >>> x = np.array([[[0], [1], [2]]])
    >>> x.shape
    (1, 3, 1)
    >>> np.squeeze(x).shape
    (3,)    """
    try:
        squeeze = a.squeeze
    except AttributeError:
        return _wrapit(a, 'squeeze')
    return squeeze()
```

Function Info and Help

History command

list previous commands. Use ‘magic’ % because ‘hist’ is histogram function in pylab

%hist

The up and down arrows scroll through your IPython input history

IPython magic functions

http://ipython.org/ipython-doc/dev/interactive/tutorial.html#magic-functions

>>> %lsmagic

Available magic functions:

%alias %autocall %autoindent %automagic %bookmark %cd %colors %config %cpaste %debug %dhist %dirs %doctest_mode %ed %edit %env %fread %fwrite %gui %hist %history %inplace %install_default_config %install_profiles %load_ext %loadpy %logoff %logon %logstart %logstate %logstop %lsmagic %macro %magic %notebook %page %paste %pastebin %pdb %pdef %pdoc %pfile %pinfo %pinfo2 %pm %pop_err %pop_print %popd %pprint %precision %print_methods %print_traits %profile %prun %psearch %psource %pt %push_err %push_print %pushd %pwd %pycat %pylab %quickref %recall %rehashx %reload_ext %rep %replace_context %rerun %reset %reset_selective %run %run_examples %save %sc %store %sx %sym %tb %time %timeit %unalias %unload_ext %who %who_ls %whos %xdel %xmode

Read simple Trackbacks

```
>>> 100 + "Hello world!"
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
/Users/mk/<ipython-input-7-3d139ed9b46e> in <module>()
----> 1 100 + "Hello world!”
TypeError: unsupported operand type(s) for +: 'int' and 'str’
```

```
>>> undevined_variable + 1
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
/Users/mk/<ipython-input-8-8514a074ce6b> in <module>()
----> 1 undevined_variable + 1
NameError: name 'undevined_variable' is not defined
```

Interactive Calculator

```
# adding two values
>>> 5 + 10
15

# setting a variable
>>> a = 5
>>> a
5

# checking the variable's type
>>> type(a)
int

# an arbitrary long integer
>>> a = 12345678901234567890
>>> a
12345678901234567890L
>>> type(a)
long

# remove 'a' from the 'namespace'
>>> del a
>>> a

NameError  Traceback (most recent call last)
/Users/mk/<ipython-input-27-60b725f10c9c>
in <module>()
----> 1 a

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

Interactive Calculator

```
# real numbers
>>> b = 1.4 + 2.3
>>> b
3.6999999999999997

# “prettier” version
>>> print b
3.7
>>> type(b)
float

# colplex  numbers
 c = 5+5.5j
>>> c
(5+5.5j)
```

Variable declaration and initalization

Matlab/Python

a = 5

variable name — value

a = ‘hello world’

a = 5.56

C/C++/Java

int a = 5

type — variable name — value

~~a = “hello world”~~

a = 5.5

float b = 5.5

std::string text= “Hello world” (C++)

Interactive Calculator

```
# arithmetic operations
>>> 1+2-(3*4/6)**5+(7%2)
-27

# simple math functions
>>> abs(-6e3)
6000.0

>>> max(0, min(10, -1, 4, 3))
0

>>> round(2.71235897456)
3.0
```

Python math functions:

http://docs.python.org/library/math.html

```
# casting
>>> int(2.718281828)
2
>>> float(2)
2.0
>>> 1 + 2.
3.0
>>> int('456')
456
>>> str(65)
'65'
```

← string

```
# in place operations +=, -=, *=, /=, etc.
>>> b = 2.5
>>> b+=0.5                # b = b+5
>>> b
3.0
```