Welcome to Python Boot Camp!
Fall
2012!

Objectives

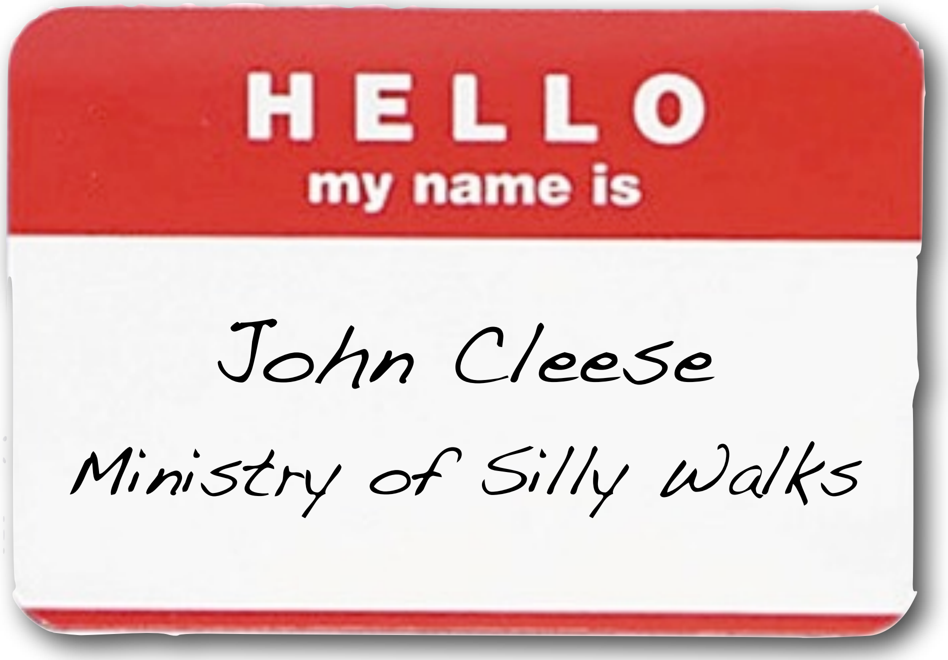
- Introduce you to the Python language
- Get you writing Python code. Build Python hacking muscle memory
- Convince you of its utility in your research life
- Instill good coding and curation practices
- We try not to proselytize, but sometimes it's too hard to resist

Organization

- 3 days of modules (1-1.5 hr) lectures + demos
  http://www.pythonbootcamp.info/lectures/
- Breakout coding sessions (supervised) after each module
- Lunch + Caffeine provided
- Homework (small code projects)
- Blood, sweat, tears → a more productive you

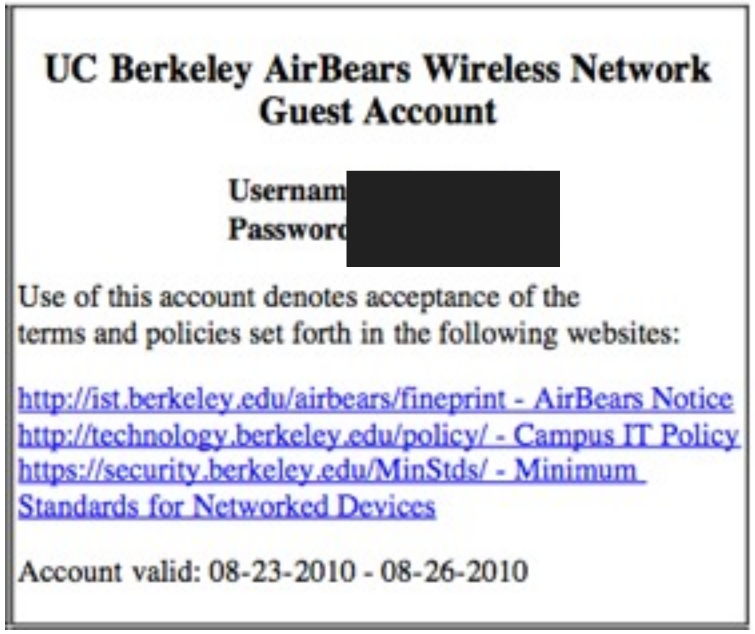
Connecting

In person



Twitter: #pyboot

Wirelessly


UC Berkeley AirBears Wireless Network
Guest Account

Usernam [redacted]
Passwor

Use of this account denotes acceptance of the terms and policies set forth in the following websites:

http://ist.berkeley.edu/airbears/fineprint - AirBears Notice
http://technology.berkeley.edu/policy/ - Campus IT Policy
https://security.berkeley.edu/MinStds/ - Minimum Standards for Networked Devices

Account valid: 08-23-2010 - 08-26-2010

Something you should know about us...

@profjsb

Introduction

- What is Python?
- Why Python?
- Getting Started...

What is Python?

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed.

http://www.python.org/doc/essays/blurb/

What is Python?

interpreted	no need for a compiling stage
object-oriented	programming paradigm that uses objects (complex data structures with methods)
high level	abstraction from the way machine interprets & executes
dynamic semantics	can change meaning on-the-fly
built in	core language (not external)
data structures	ways of storing/manipulating data
script/glue	programs that control other programs
typing	the sort of variable (int, string)
syntax	grammar which defines the language
library	reusable collection of code
binary	a file that you can run/execute

Development History

- started over the Christmas break 1989, by Guido van Rossum (now at Google)
- developed in the early 1990s
- name comes from **Monty Python's Flying Circus**
- Guido is the Benevolent Dictator for Life (BDFL), meaning that he continues to oversee Python's development.

Development History

- Open-sourced development from the start (BSD licensed now)
  http://www.opensource.org/licenses/bsd-license.php
- Relies on large community input (bugs, patches) and 3rd party add-on software
- Version 2.0 (2000), 2.6 (2008), 2.7 (2010). We're using **2.7.3** in this class
- Version 3.X (2008) is not backward compatible with 1.X & 2.X. But 2.7 code is "easily" migrated to 3.X

Why Python?

Some of the Alternatives

C, C++, FORTRAN

Pros: great performance, backbone of legacy scientific computing codes

Cons: syntax not optimized for causal programming, no interactive facilities, difficult visualization, text processing, etc.

Mathematics, Maple, Matlab, IDL

Pros: interactive, great visuals, extensive libraries

Cons: costly, proprietary, unpleasant for large-scale programs and non-mathematical tasks.

Perl: http://www.strombergers.com/python/

Why Python?

- Free (BSD license), highly portable (Linux, OSX, Windows, lots...)
- Interactive interpreter provided.
- Extremely readable syntax ("executable pseudo-code").
- Simple: non-professional programmers can use it effectively
  - great documentation
  - total abstraction of memory management
- Clean object-oriented model, but not mandatory.
- Rich built-in types: lists, sets, dictionaries (hash tables), strings, ...
- Very comprehensive standard library (batteries included)
- Standard libraries for IDL/Matlab-like arrays (NumPy)
- Easy to wrap existing C, C++ and FORTRAN codes.

Why Python?

Amazingly Scalable

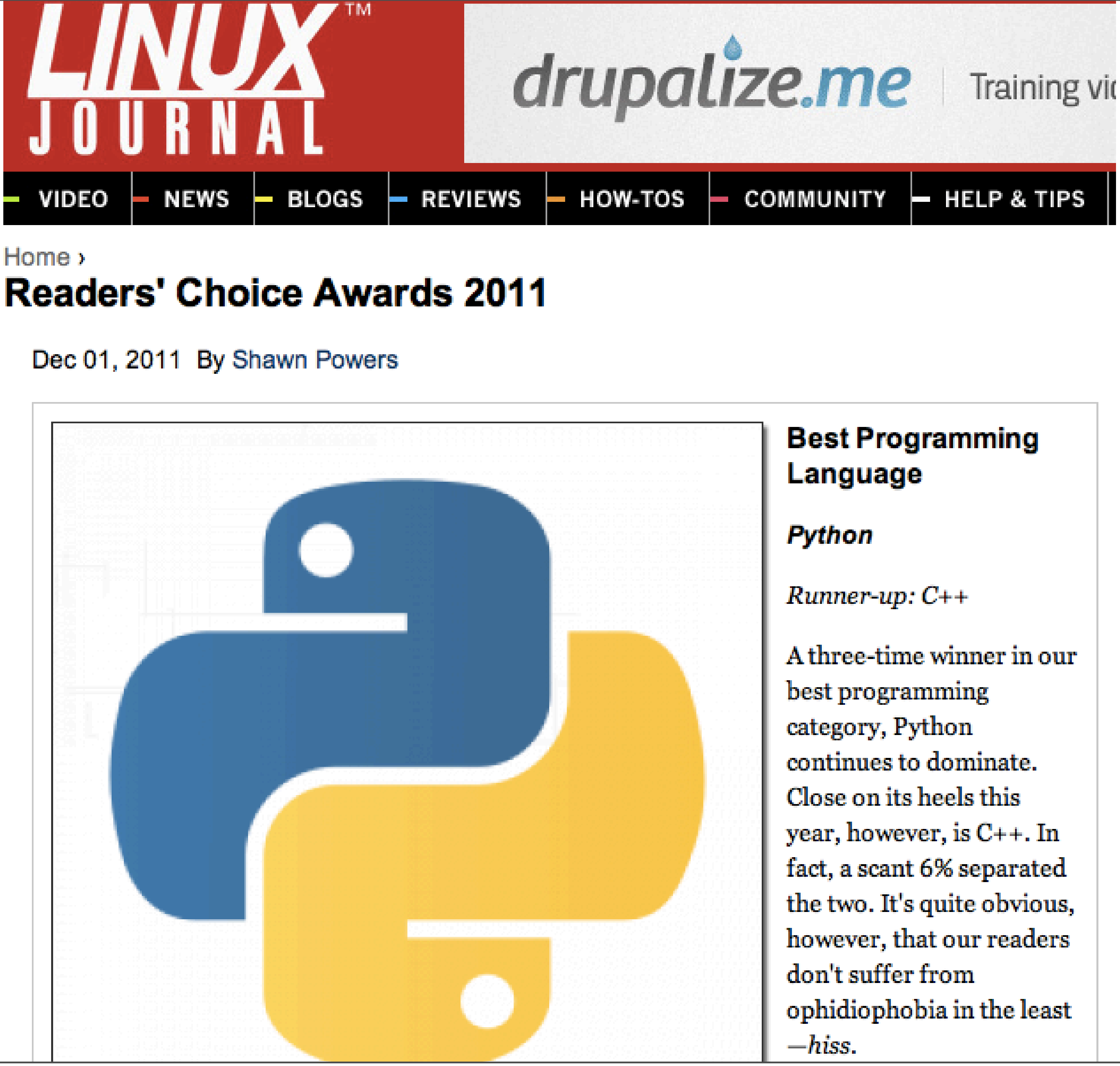
Interactive experimentation
build small, self-contained scripts or million-lines projects.
From occasional/novice to full-time use (try that with C++).

The Kitchen Sink (in a good way)

really can do anything you want, with impressive simplicity

Performance, if you need it

As an interpreted language, Python is slow.
But...if you need speed you can do the heavy lifting in C or FORTRAN
or you can use a Python compiler (e.g. Cython)



Readers' Choice Awards 2011

Dec 01, 2011 By Shawn Powers

Best Programming Language

Python

Runner-up: C++

A three-time winner in our best programming category, Python continues to dominate. Close on its heels this year, however, is C++. In fact, a scant 6% separated the two. It's quite obvious, however, that our readers don't suffer from ophidiophobia in the least —*hiss*.

My group uses it for....

Running a robotic telescope

- interfacing with legacy hardware device drivers
- talking over serial & parallel lines to telescope control hardware
- oversee functioning of all sub-systems (themselves written in Python)
- sending email and pager alerts when distressed
- writing real-time web pages
  (for data display, weather)
- moving image data over the network
- interacting with databases

http://pairitel.org

My group uses it for....

Data reduction & Analysis

- processing FITS images quickly
- wrapping around 3rd party software

A Handy & Quick Calculator

Prototyping new algorithms/ideas

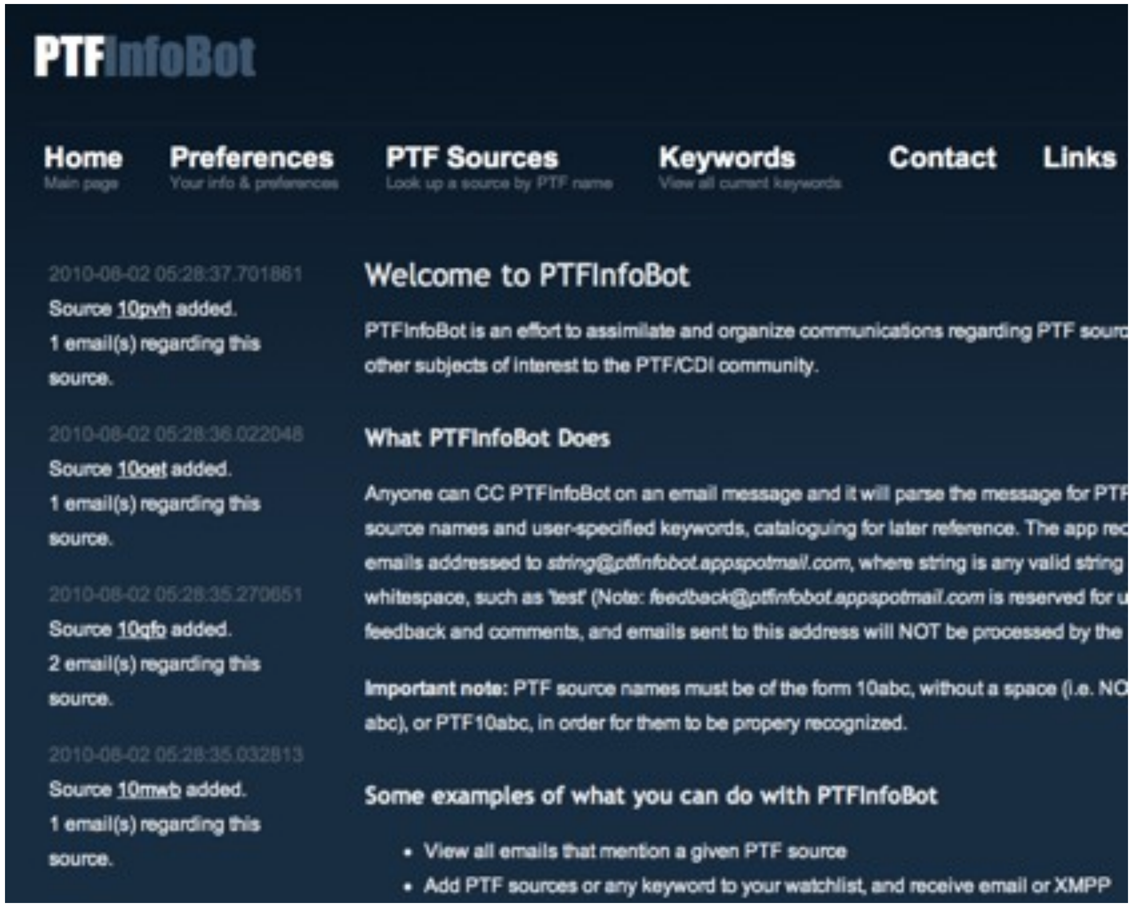
Making plots for papers

Making fast, parallel, and efficient webservices

http://dotastro.org

My group uses it for....

Writing Google-hosted (cloud-based) websites that we use for research (& collaboration)



2010-08-02 05:28:37.701861
Source 10pvh added.
1 email(s) regarding this source.

2010-08-02 05:28:36.022048
Source 10oet added.
1 email(s) regarding this source.

2010-08-02 05:28:35.270651
Source 10qfo added.
2 email(s) regarding this source.

2010-08-02 05:28:35.032813
Source 10mwb added.
1 email(s) regarding this source.

Welcome to PTFInfoBot

PTFInfoBot is an effort to assimilate and organize communications regarding PTF sourc
other subjects of interest to the PTF/CDI community.

What PTFInfoBot Does

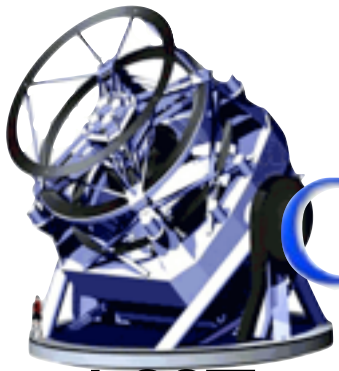
Anyone can CC PTFInfoBot on an email message and it will parse the message for PTF
source names and user-specified keywords, cataloguing for later reference. The app rec
emails addressed to *string@ptfinfobot.appspotmail.com*, where string is any valid string
whitespace, such as 'test' (Note: *feedback@ptfinfobot.appspotmail.com* is reserved for u
feedback and comments, and emails sent to this address will NOT be processed by the

Important note: PTF source names must be of the form 10abc, without a space (i.e. NO
abc), or PTF10abc, in order for them to be propery recognized.

Some examples of what you can do with PTFInfoBot

- View all emails that mention a given PTF source
- Add PTF sources or any keyword to your watchlist, and receive email or XMPP

Many Others Use it Too


LSST

Google

reddit

Honeywell

REALESTATEAGENT .com

You Tube Broadcast Yourself

resolver systems ltd

devis

EVE ONLINE

USA United Space Alliance

INDUSTRIAL LIGHT & MAGIC

AstraZeneca

Quora

PollenationInternet.

PHILIPS

Eventbrite

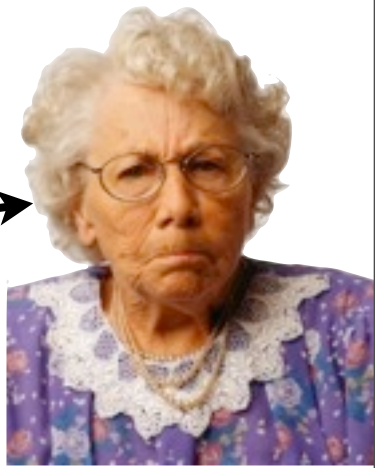
NASA NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Verity

Dropbox

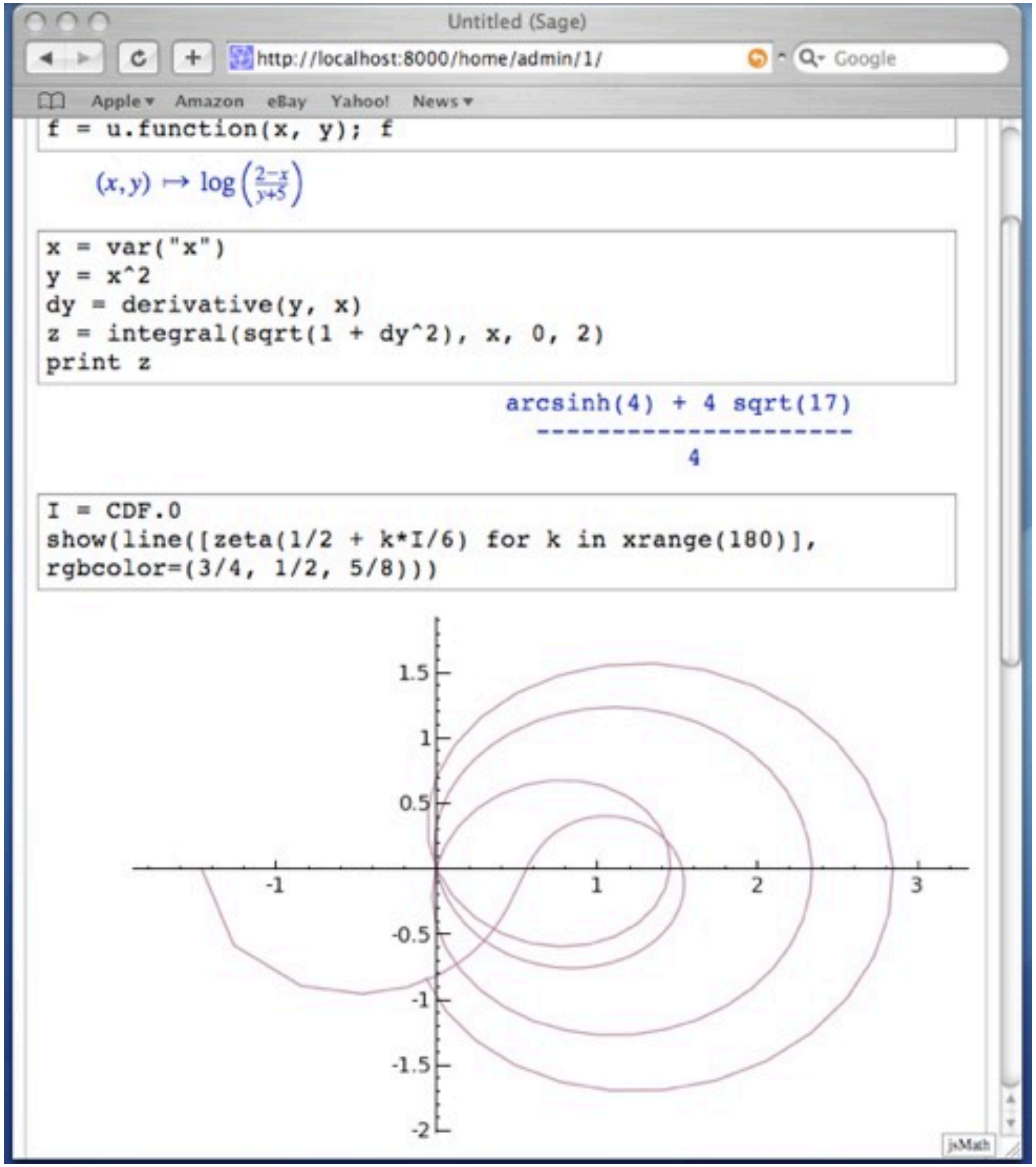
GravityZoo

your grandmother



http://www.quora.com/Python-programming-language-1/Which-Internet-companies-use-Python

Interactive Notebooks



```
f = u.function(x, y); f
```

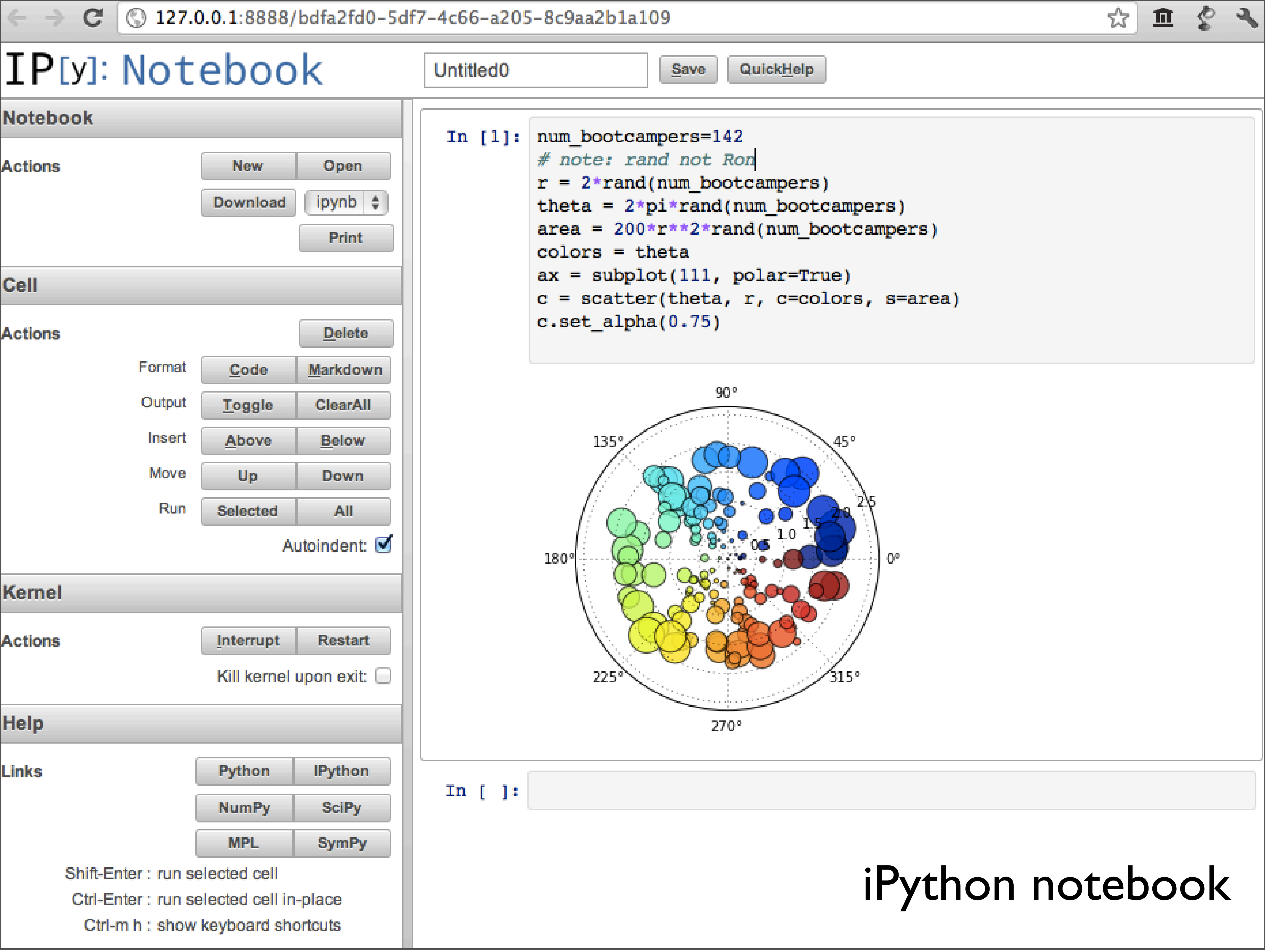
$(x,y) \mapsto \log\left(\frac{2-x}{y+5}\right)$

```
x = var("x")
y = x^2
dy = derivative(y, x)
z = integral(sqrt(1 + dy^2), x, 0, 2)
print z
```

```
arcsinh(4) + 4 sqrt(17)
-----------------------
           4
```

```
I = CDF.0
show(line([zeta(1/2 + k*I/6) for k in xrange(180)],
rgbcolor=(3/4, 1/2, 5/8)))
```

Sage



127.0.0.1:8888/bdfa2fd0-5df7-4c66-a205-8c9aa2b1a109

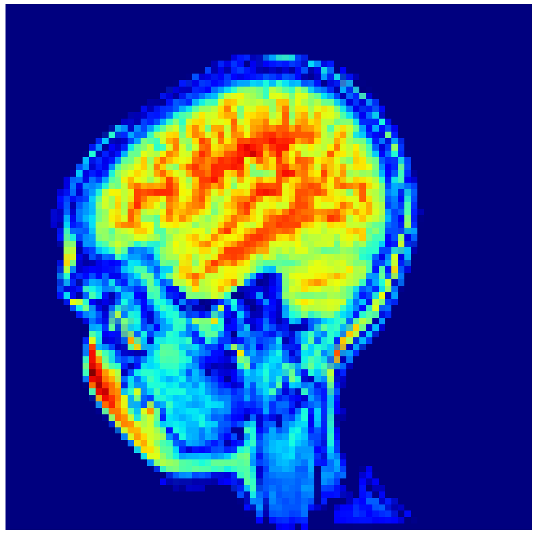
Shift-Enter : run selected cell
Ctrl-Enter : run selected cell in-place
Ctrl-m h : show keyboard shortcuts

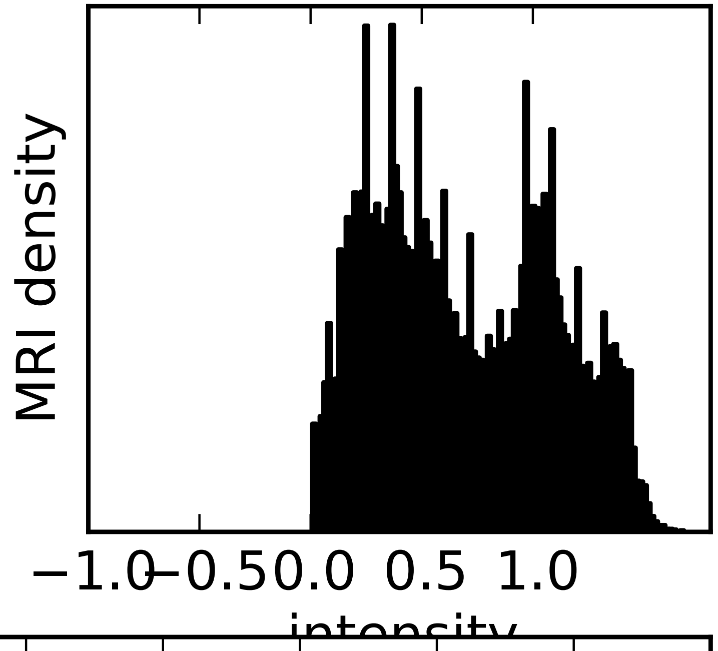
```
In [1]: num_bootcampers=142
        # note: rand not Ron
        r = 2*rand(num_bootcampers)
        theta = 2*pi*rand(num_bootcampers)
        area = 200*r**2*rand(num_bootcampers)
        colors = theta
        ax = subplot(111, polar=True)
        c = scatter(theta, r, c=colors, s=area)
        c.set_alpha(0.75)
```

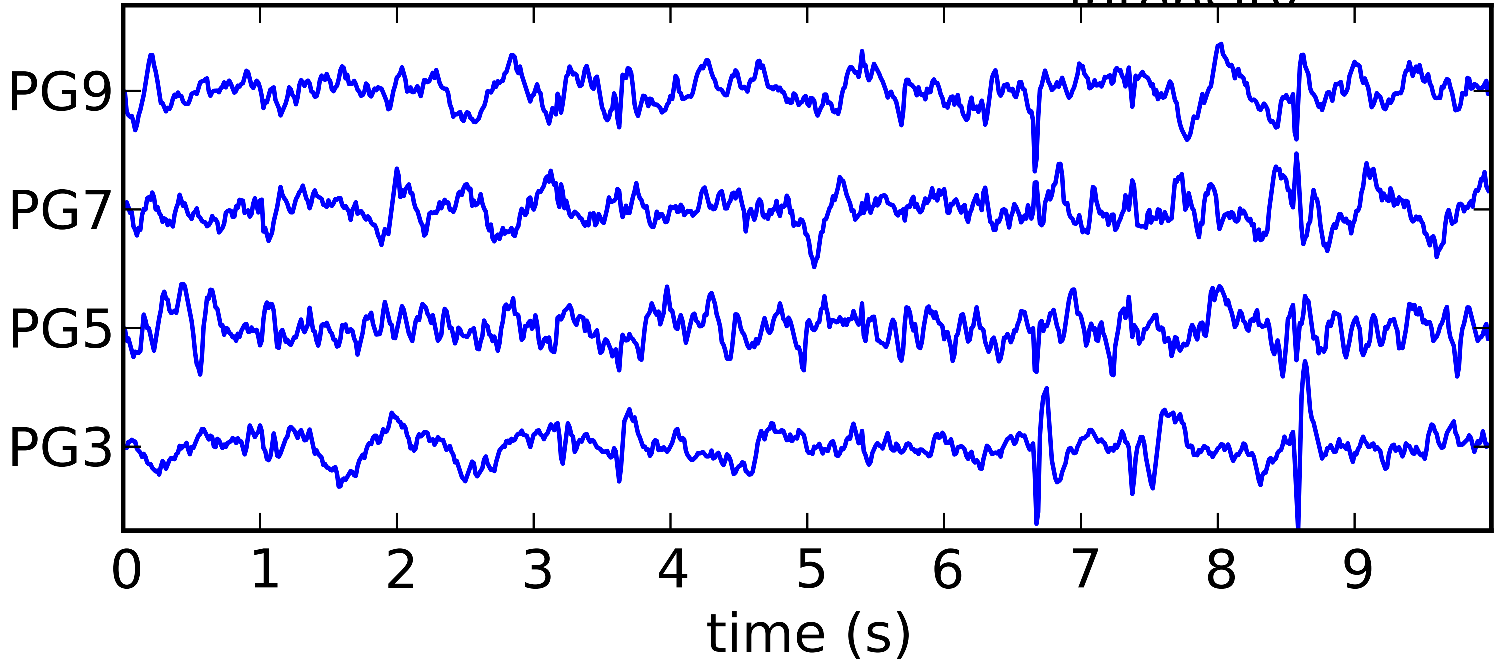
```
In [ ]:
```

iPython notebook

Visualization

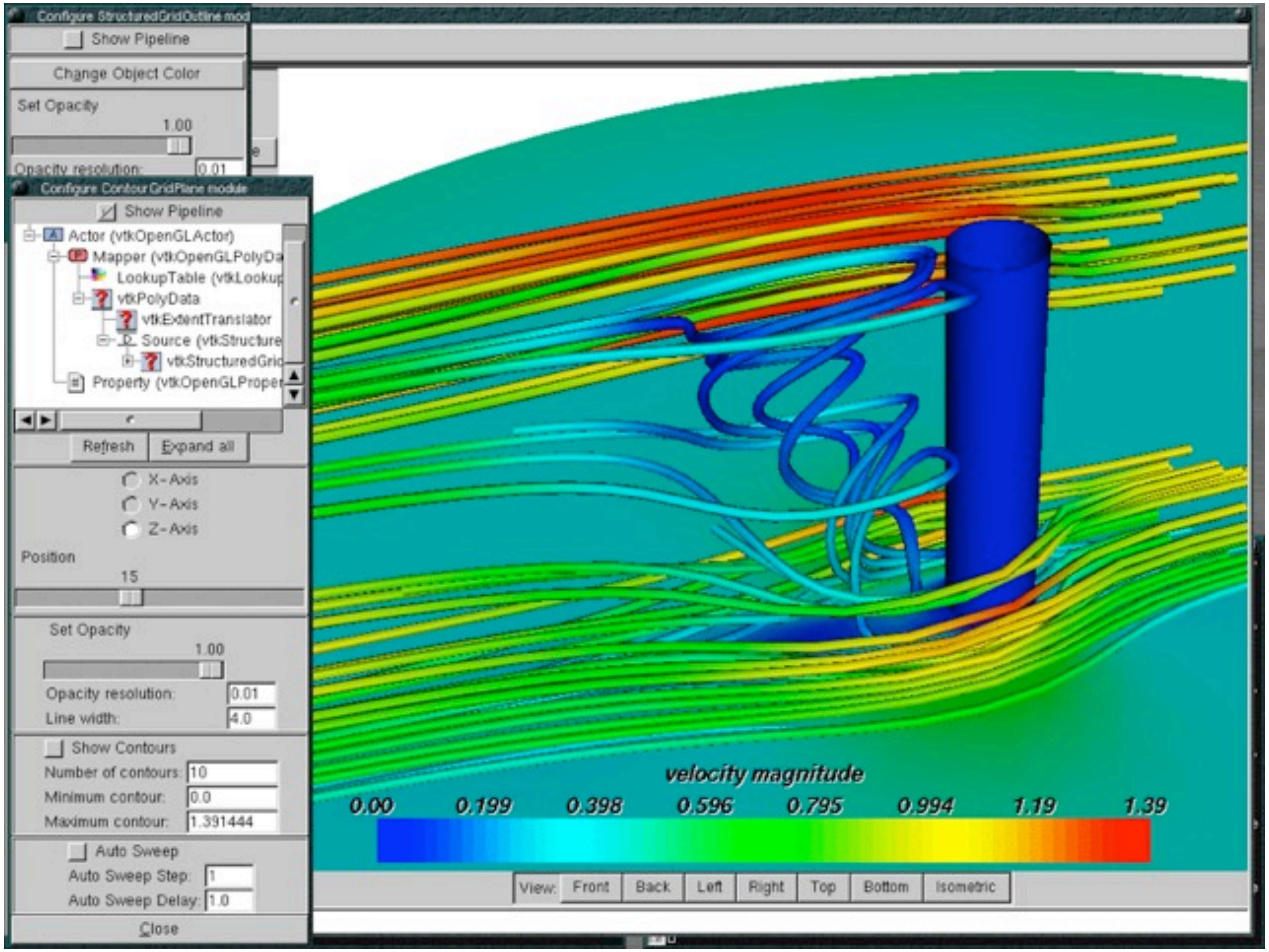






matplotlib

Visualization



Set Opacity 1.00

Opacity resolution: 0.01

Position 15

Set Opacity 1.00

Opacity resolution: 0.01

Line width: 4.0

Number of contours: 10

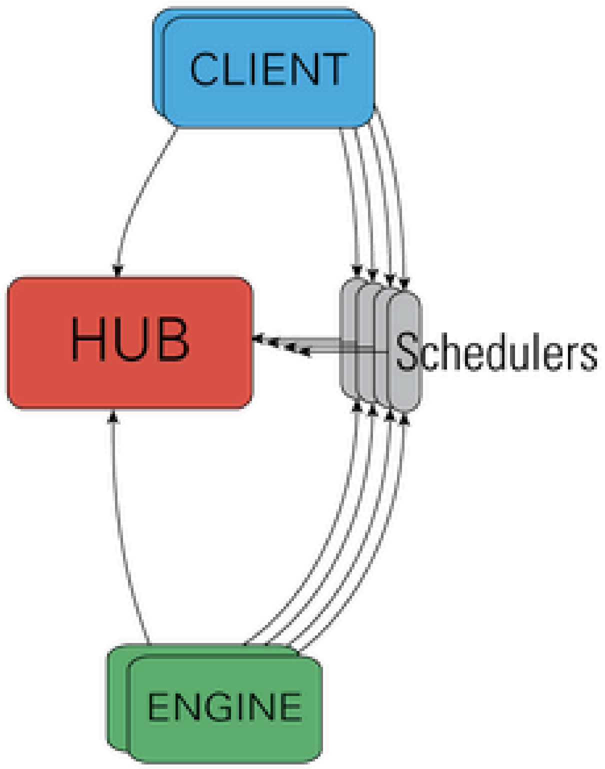
Minimum contour: 0.0

Maximum contour: 1.391444

Auto Sweep Step: 1

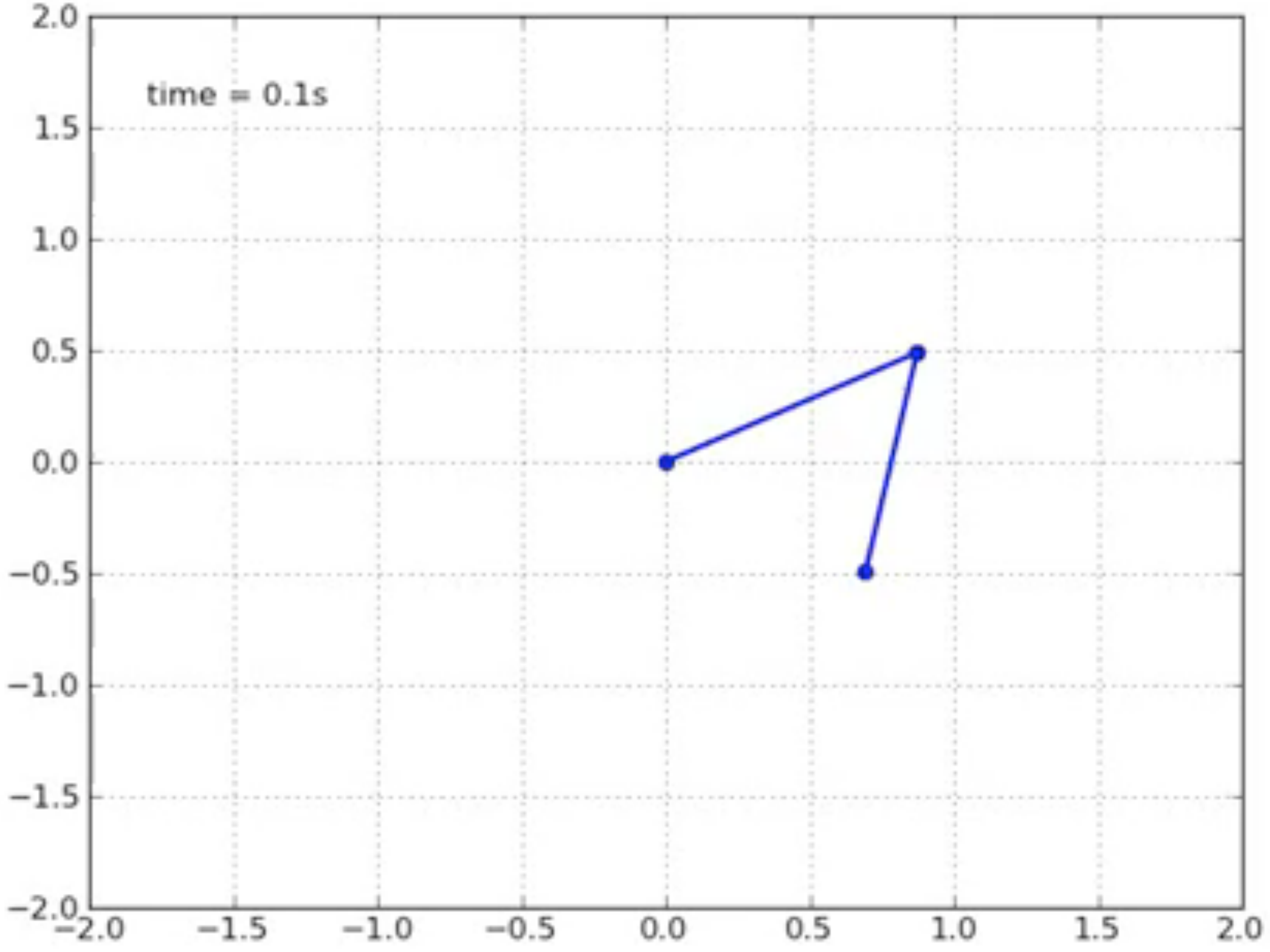
Auto Sweep Delay: 1.0

Mayavi



Parallelization is now very accessible (via the ipython notebook)

Animation



http://matplotlib.sourceforge.net/examples/animation/double_pendulum_animated.html

Asking Questions during Module presentations

- Speak up
- Raise your hand

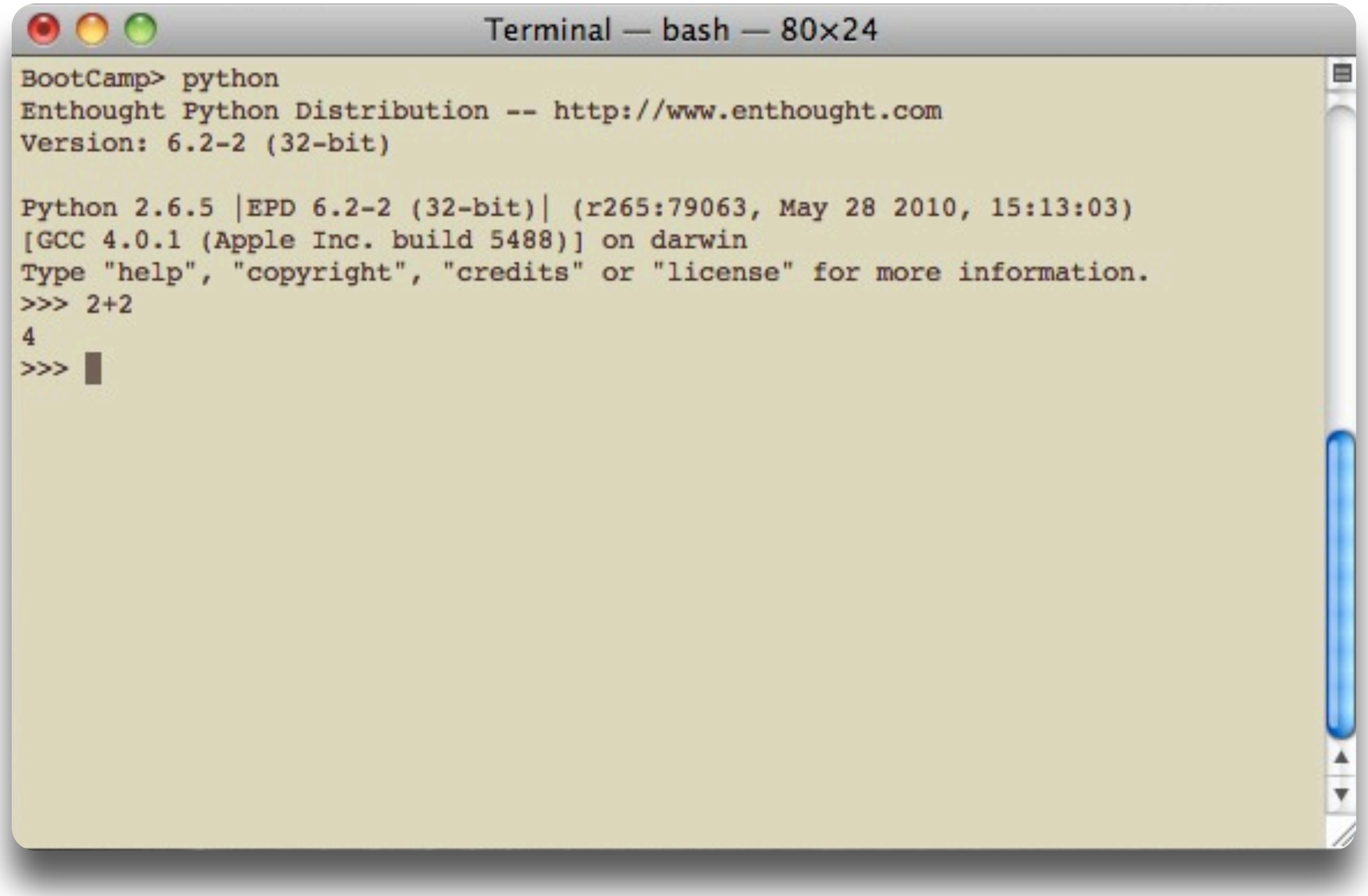
Getting Help at Any Time

- Raise your hand and make eye contact with a counselor

- Join the IRC chat (#pyboot)

- Send email ucbpythonclass+bootcamp@gmail.com
- Twitter Hashtag: #pyboot

Firing up the Interpreter

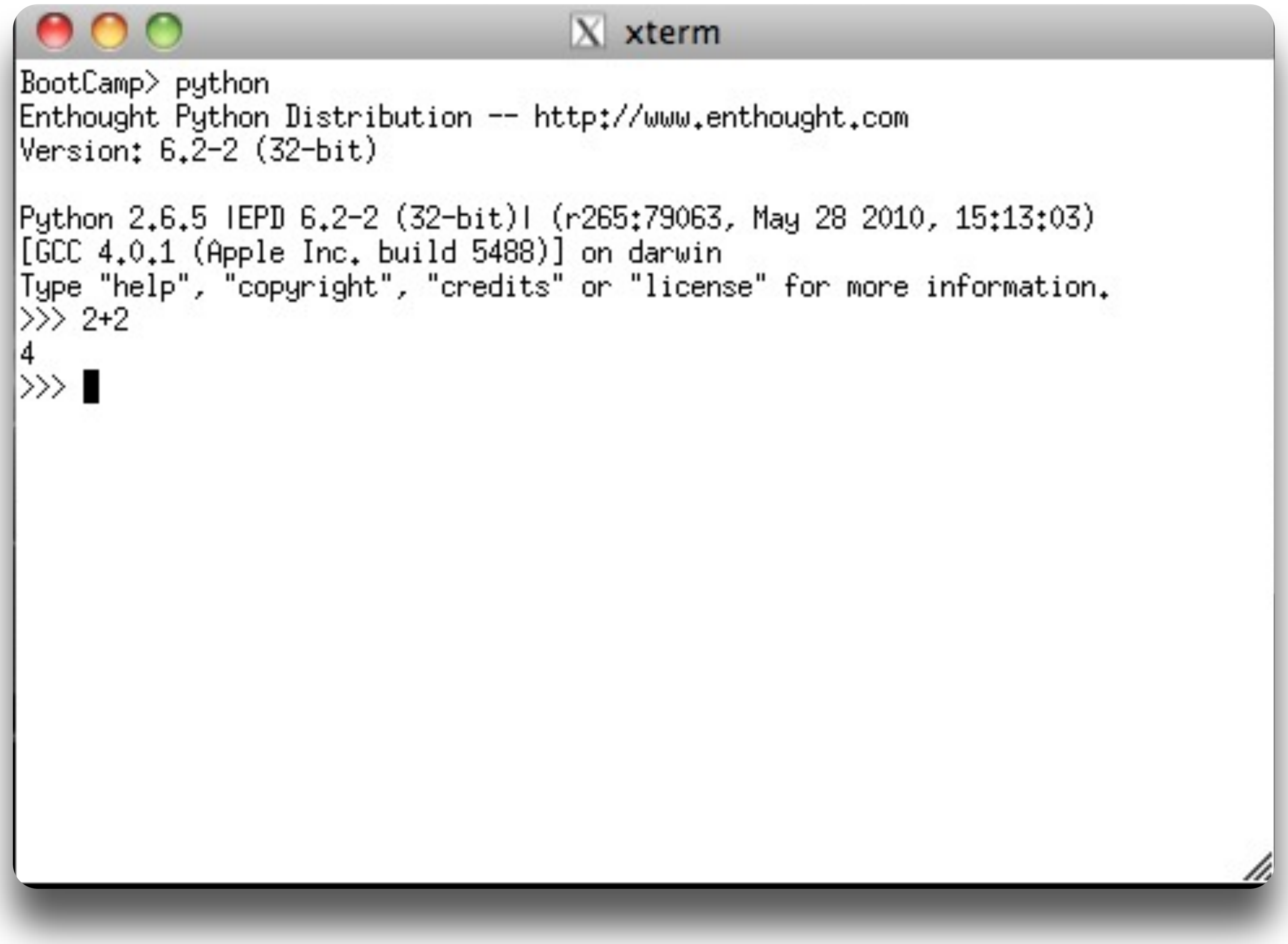


```
BootCamp> python
Enthought Python Distribution -- http://www.enthought.com
Version: 6.2-2 (32-bit)

Python 2.6.5 |EPD 6.2-2 (32-bit)| (r265:79063, May 28 2010, 15:13:03)
[GCC 4.0.1 (Apple Inc. build 5488)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> 2+2
4
>>> 
```

Mac OS X (Terminal)

Firing up the Interpreter



```
BootCamp> python
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Version: 6.2-2 (32-bit)

Python 2.6.5 |EPD 6.2-2 (32-bit)| (r265:79063, May 28 2010, 15:13:03)
[GCC 4.0.1 (Apple Inc. build 5488)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> 2+2
4
>>> 
```
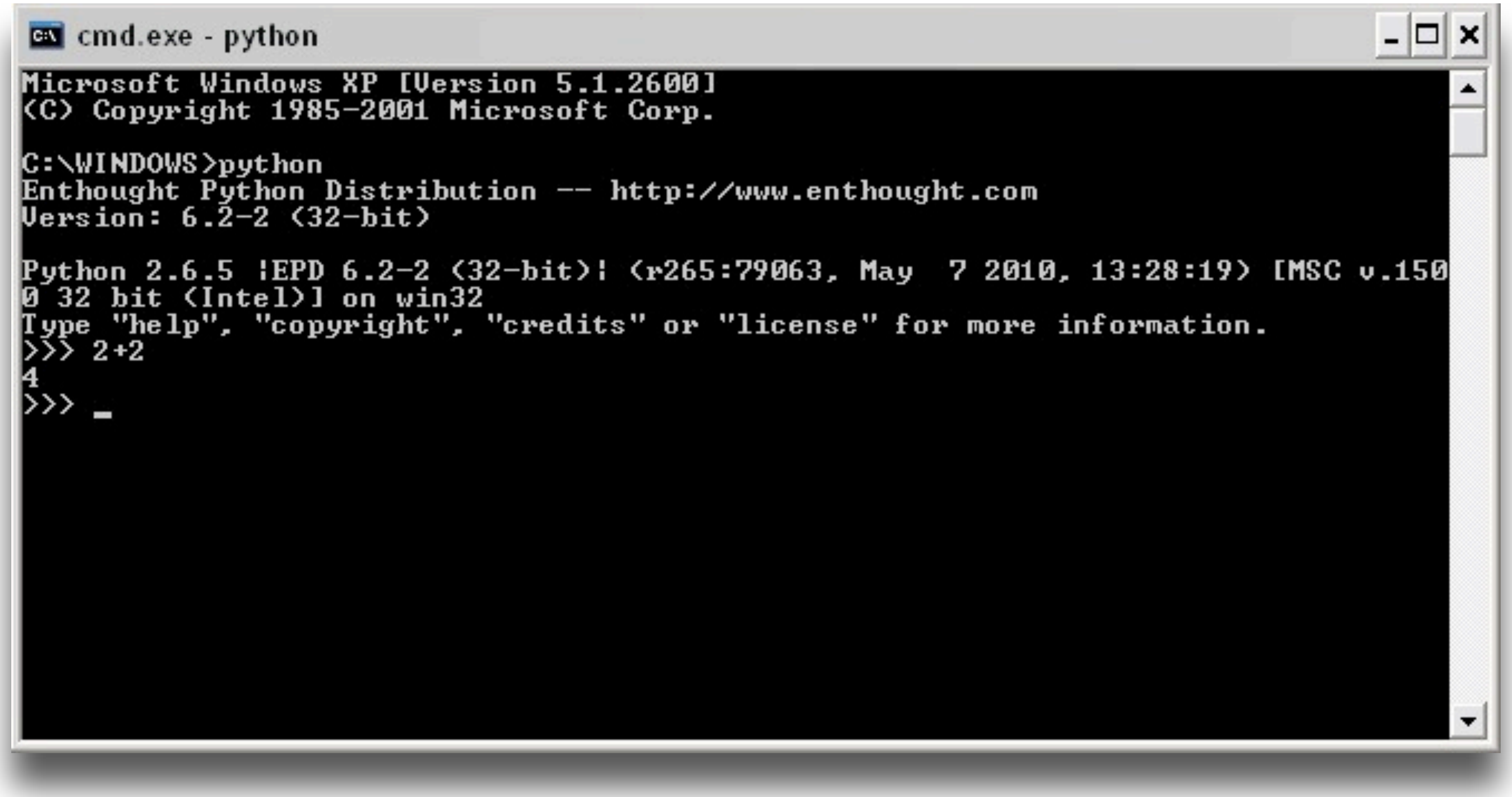

Linux/UNIX/Mac OS X (X11/Xterm)

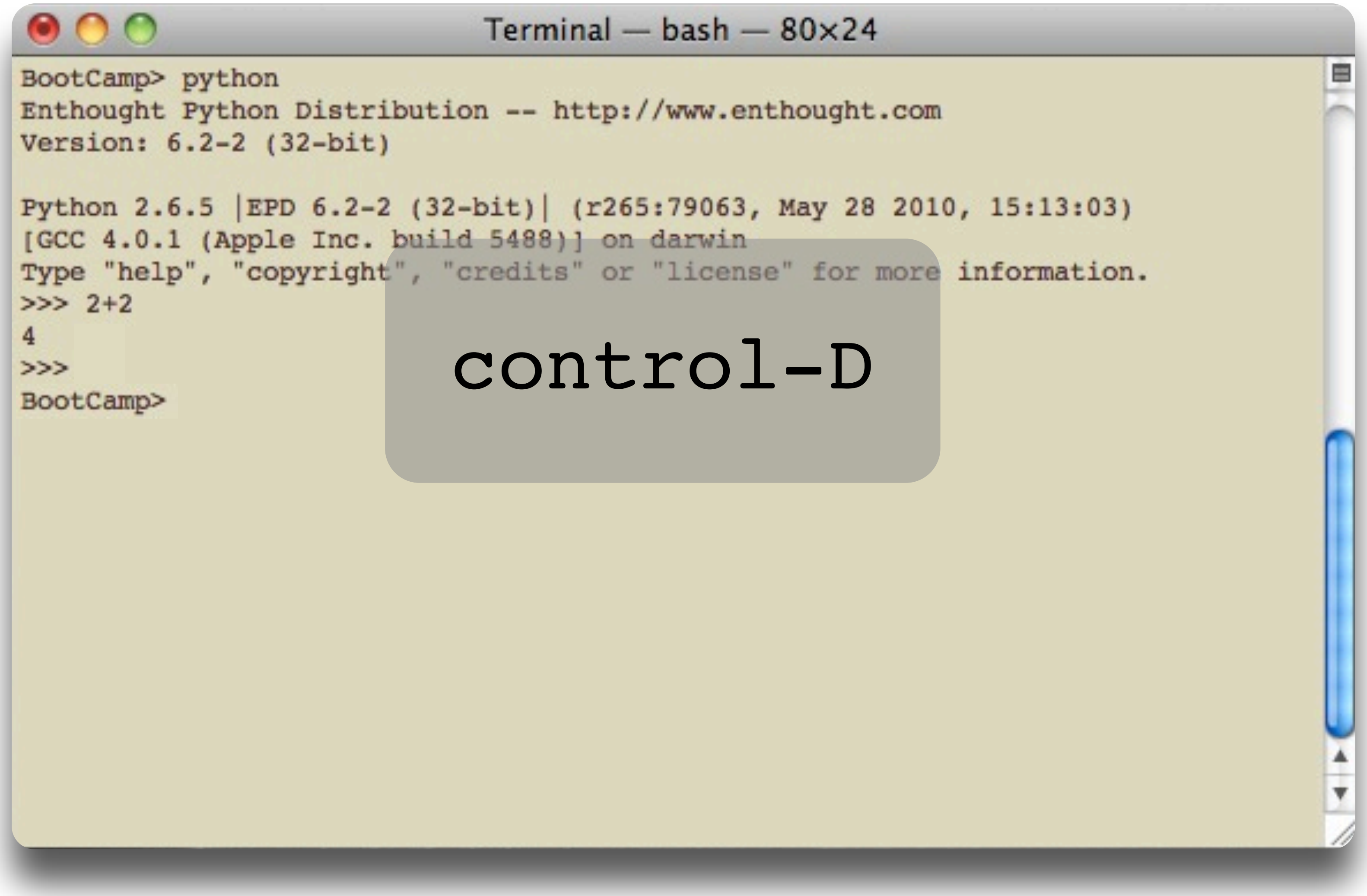
Firing up the Interpreter



```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\WINDOWS>python
Enthought Python Distribution -- http://www.enthought.com
Version: 6.2-2 (32-bit)

Python 2.6.5 |EPD 6.2-2 (32-bit)| (r265:79063, May  7 2010, 13:28:19) [MSC v.150
0 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> 2+2
4
>>> _
```

Windows

Firing up the Interpreter

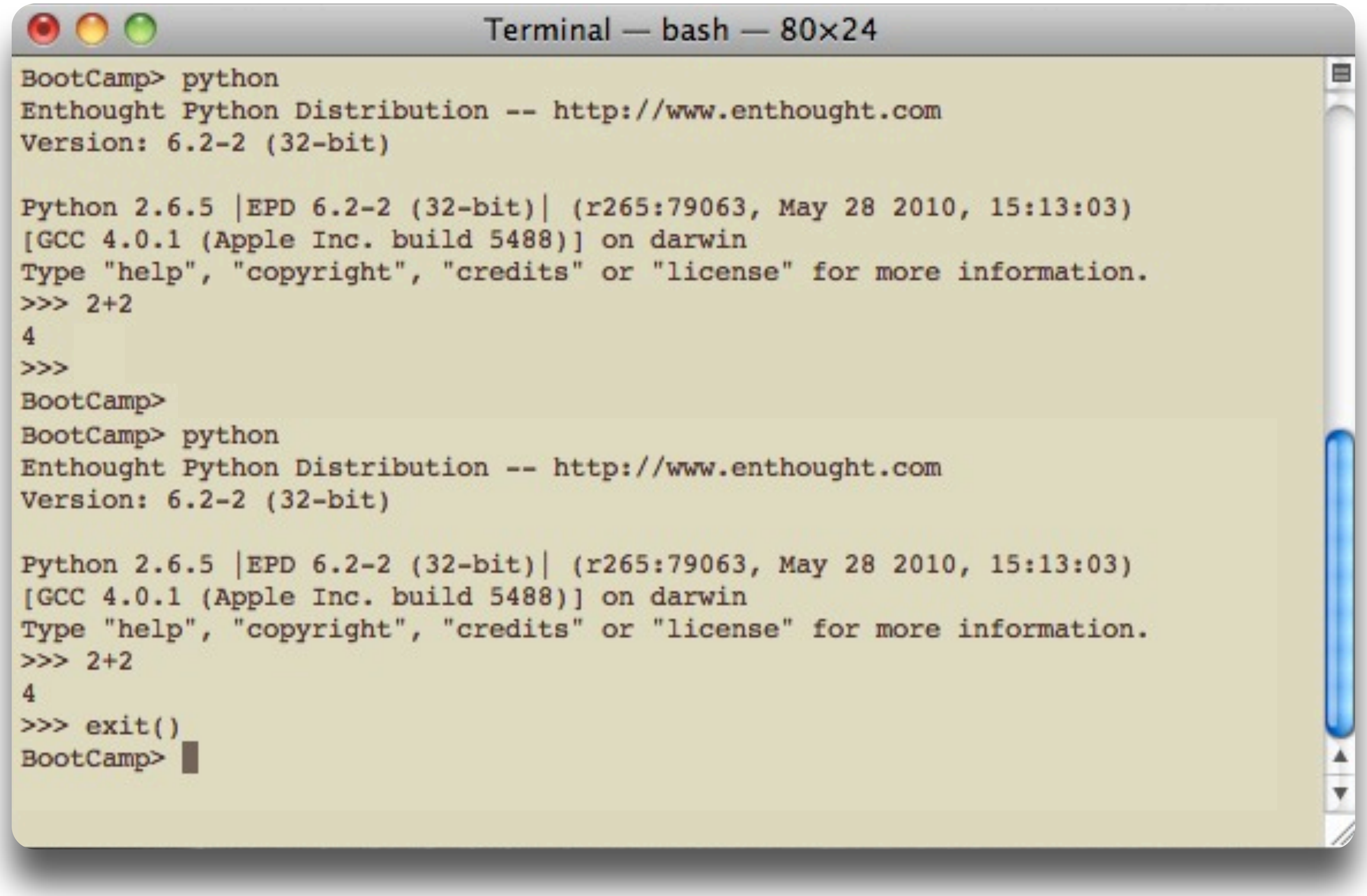


```
BootCamp> python
Enthought Python Distribution -- http://www.enthought.com
Version: 6.2-2 (32-bit)

Python 2.6.5 |EPD 6.2-2 (32-bit)| (r265:79063, May 28 2010, 15:13:03)
[GCC 4.0.1 (Apple Inc. build 5488)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> 2+2
4
>>>
BootCamp>
```

`control-D`

to exit: either `control-D` or `exit()`

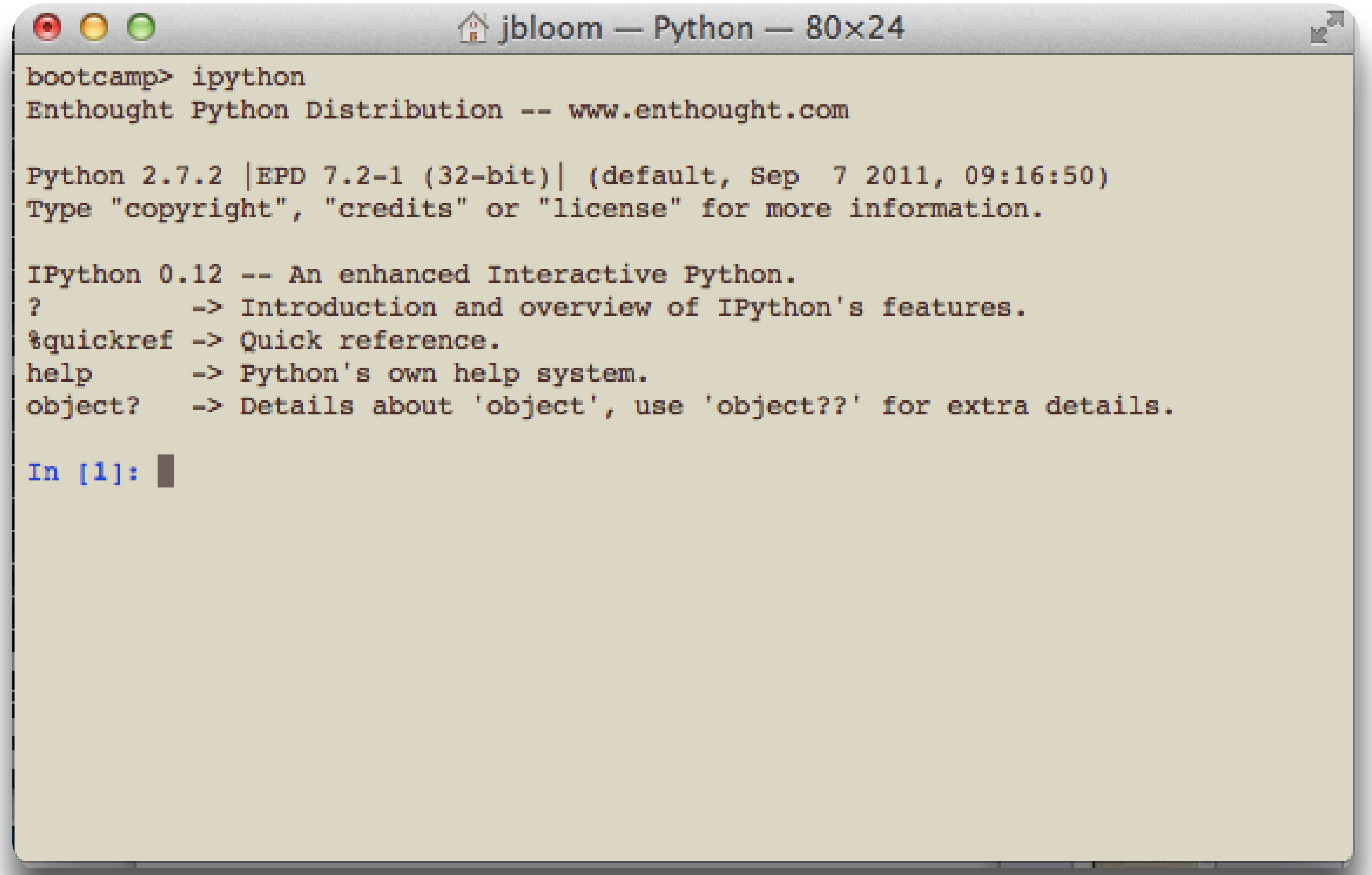
Firing up the Interpreter



```
BootCamp> python
Enthought Python Distribution -- http://www.enthought.com
Version: 6.2-2 (32-bit)

Python 2.6.5 |EPD 6.2-2 (32-bit)| (r265:79063, May 28 2010, 15:13:03)
[GCC 4.0.1 (Apple Inc. build 5488)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> 2+2
4
>>>
BootCamp>
BootCamp> python
Enthought Python Distribution -- http://www.enthought.com
Version: 6.2-2 (32-bit)

Python 2.6.5 |EPD 6.2-2 (32-bit)| (r265:79063, May 28 2010, 15:13:03)
[GCC 4.0.1 (Apple Inc. build 5488)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> 2+2
4
>>> exit()
BootCamp>
```

to exit: either `control-D` or `exit()`

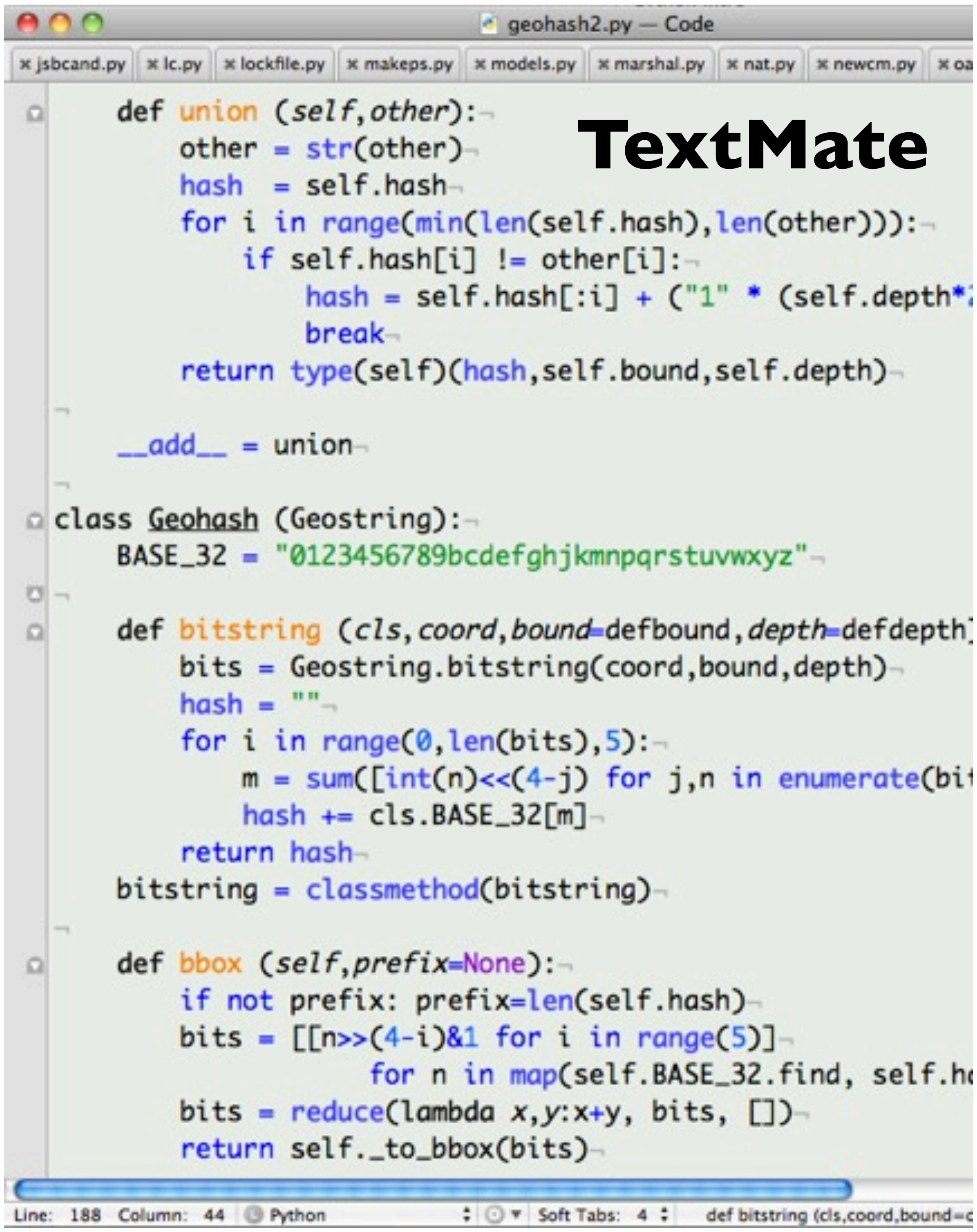
Firing up the Interpreter



```
bootcamp> ipython
Enthought Python Distribution -- www.enthought.com

Python 2.7.2 |EPD 7.2-1 (32-bit)| (default, Sep  7 2011, 09:16:50)
Type "copyright", "credits" or "license" for more information.

IPython 0.12 -- 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]: 
```

`ipython`

Editing Python Files



```
    def union (self,other):
        other = str(other)
        hash  = self.hash
        for i in range(min(len(self.hash),len(other))):
            if self.hash[i] != other[i]:
                hash = self.hash[:i] + ("1" * (self.depth*
                break
        return type(self)(hash,self.bound,self.depth)

    __add__ = union

class Geohash (Geostring):
    BASE_32 = "0123456789bcdefghjkmnpqrstuvwxyz"

    def bitstring (cls,coord,bound=defbound,depth=defdepth
        bits = Geostring.bitstring(coord,bound,depth)
        hash = ""
        for i in range(0,len(bits),5):
            m = sum([int(n)<<(4-j) for j,n in enumerate(bi
            hash += cls.BASE_32[m]
        return hash
    bitstring = classmethod(bitstring)

    def bbox (self,prefix=None):
        if not prefix: prefix=len(self.hash)
        bits = [[n>>(4-i)&1 for i in range(5)]
                    for n in map(self.BASE_32.find, self.h
        bits = reduce(lambda x,y:x+y, bits, [])
        return self._to_bbox(bits)
```

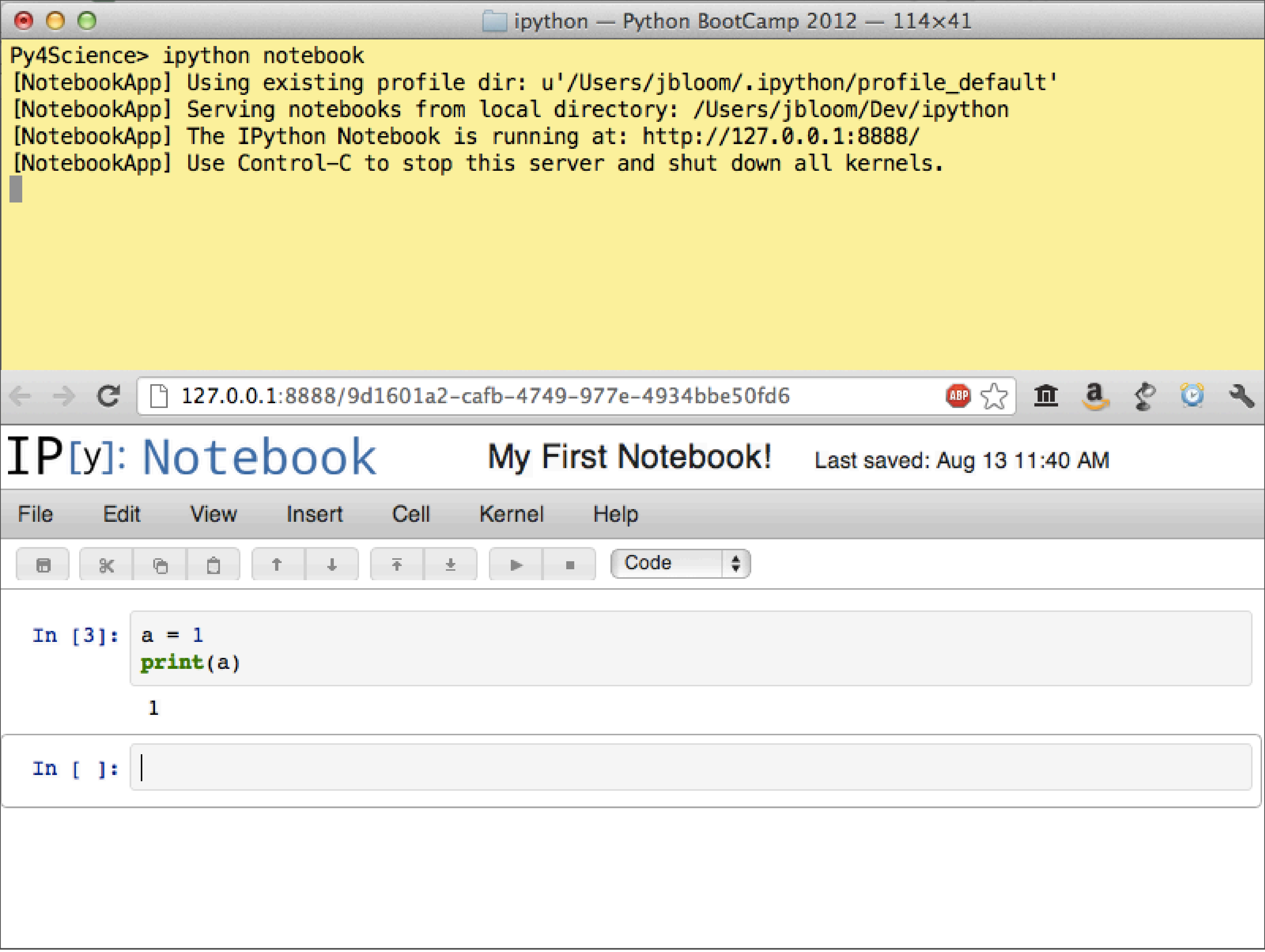
usually we name python files with a **.py** suffix

- snazzy GUI-based editors:
BBEdit, TextWrangler (Mac);
NotePad++, SublimeText (Windows);
KWrite, Scribes, eggy (linux)

- old/powerful editors:
vim, emacs, nano, ...

http://bit.ly/ucb-textmate

http://wiki.python.org/moin/PythonEditors


ipython — Python BootCamp 2012 — 114×41

```
Py4Science> ipython notebook
[NotebookApp] Using existing profile dir: u'/Users/jbloom/.ipython/profile_default'
[NotebookApp] Serving notebooks from local directory: /Users/jbloom/Dev/ipython
[NotebookApp] The IPython Notebook is running at: http://127.0.0.1:8888/
[NotebookApp] Use Control-C to stop this server and shut down all kernels.
```

127.0.0.1:8888/9d1601a2-cafb-4749-977e-4934bbe50fd6
IP[y]: Notebook
My First Notebook!
Last saved: Aug 13 11:40 AM
File
Edit
View
Insert
Cell
Kernel
Help
Code

```
In [3]: a = 1
        print(a)

        1

In [ ]:
```

Wednesday, August 15, 12