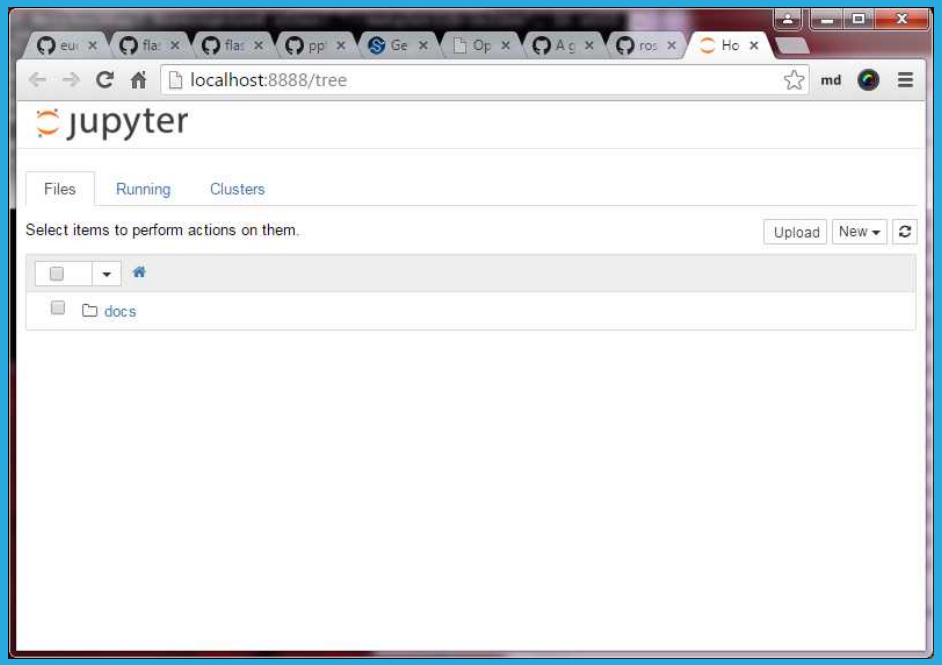

Jupyter Notebook



Jupyter Notebook

The Jupyter Notebook is a web application for **interactive** data science and scientific computing.

Using the Jupyter Notebook, you can author engaging documents that combine live-code with narrative text, equations, images, video, and visualizations. By encoding a complete and reproducible record of a computation, the documents can be shared with others on GitHub, Dropbox, and the Jupyter Notebook Viewer.

```
# Install
sudo apt-get install build-essential python-dev
pip install jupyter

# Start
jupyter notebook

# Previously
pip install "ipython[notebook]"
ipython notebook
```

See: Jupyter@RTD

- Open source, interactive data science and scientific computing across over 40 programming languages.
- The Jupyter Notebook is a web application that allows you to create and share documents that contain live code, equations, visualizations and explanatory text.
- Uses include: data cleaning and transformation, numerical simulation, statistical modeling, machine learning and much more.

Language of Choice

The Notebook has support for over 40 programming languages, including those popular in Data Science such as Python, R, Julia and Scala.

Share Notebooks

Notebooks can be shared with others using email, Dropbox, GitHub and the Jupyter Notebook Viewer.

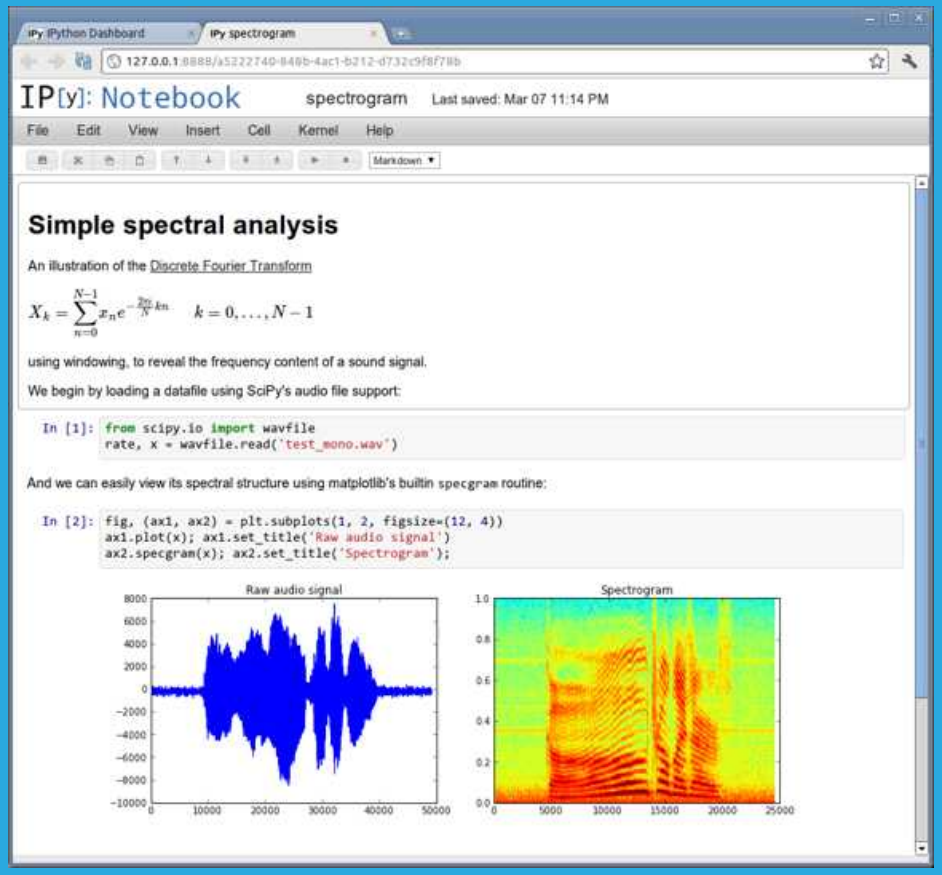
Interactive Widgets

Code can produce rich output such as images, videos, LaTeX, and JavaScript. Interactive widgets can be used to manipulate and visualize data in realtime.

Big-Data Integration

Leverage big data tools, such as Apache Spark, from Python, R and Scala. Explore that same data with pandas, scikit-learn, ggplot2, dplyr, etc.

See: Jupyter.ORG Website



Project Jupyter

The IPython Notebook (2011)

- Rich Web Client
- Text & Math
- Code
- Results
- Share, Reproduce.

See: **Fernando Perez**, IPython & Project Jupyter

Project Jupyter

IPython

- Interactive Python shell at the terminal
- Kernel for this protocol in Python
- Tools for Interactive Parallel computing

Jupyter

- Network protocol for interactive computing
- Clients for protocol
  - Console
  - Qt Console
  - Notebook
- Notebook file format & tools (nbconvert…)
- Nbviewer

What's in a name?

- Inspired by the open languages of science:
  - Julia, Python & R
  - Not an acronym: all languages equal class citizens.
- Astronomy and Scientific Python: A long and fruitful collaboration
- Galileo's notebooks:
  - The original, open science, data-and-narrative papers
  - Authorea: "Science was Always meant to be Open"

See: **Fernando Perez**, IPython & Project Jupyter

Project Jupyter

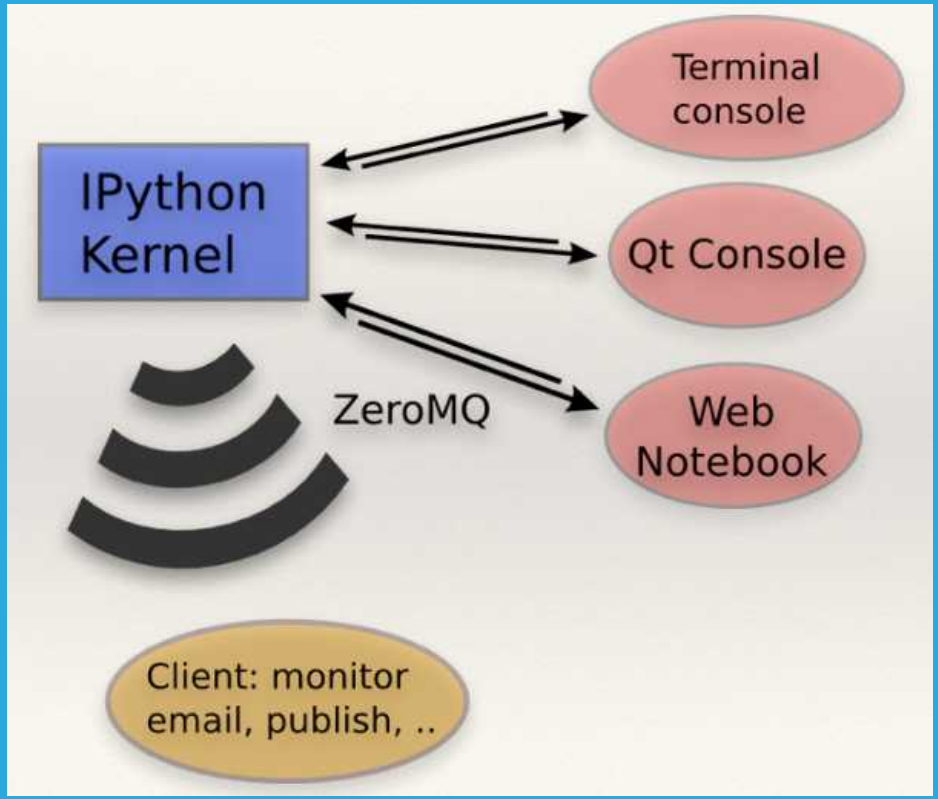
From IPython to Project Jupyter

- Not just about Python: Kernels in **any** language
- IPython : "Official"
- IJulia, IRKernel, IHaskell, IFSharp, Ruby, IScala, IErlang, .. Lots more! ~37 and counting
- Why is it called IPython, if it can do Julia, R, Haskell, Ruby, … ?"

TL;DR

- Separation of the language-agnostic components
- **Jupyter**: protocol, format, multi-user server
- **IPython**: interactive Python console, Jupyter kernel
- Jupyter kernels = Languages which can be used from the notebook (37 and counting)

A Simple and Generic Architecture



See: **Fernando Perez**, IPython & Project Jupyter

Convention

In this document, we use the terms **Jupyter** and **IPython** Notebooks interchangeably. It might refer to the previous version of the Notebook (IPython).

The Notebook

Notebook mode supports **literate computing** and **reproducible** sessions

- Allows to store chunks of python along side the results and additional comments (HTML, Latex, MarkDown)
- Can be exported in various file formats

Notebook are the de-facto standard for sharing python sessions.

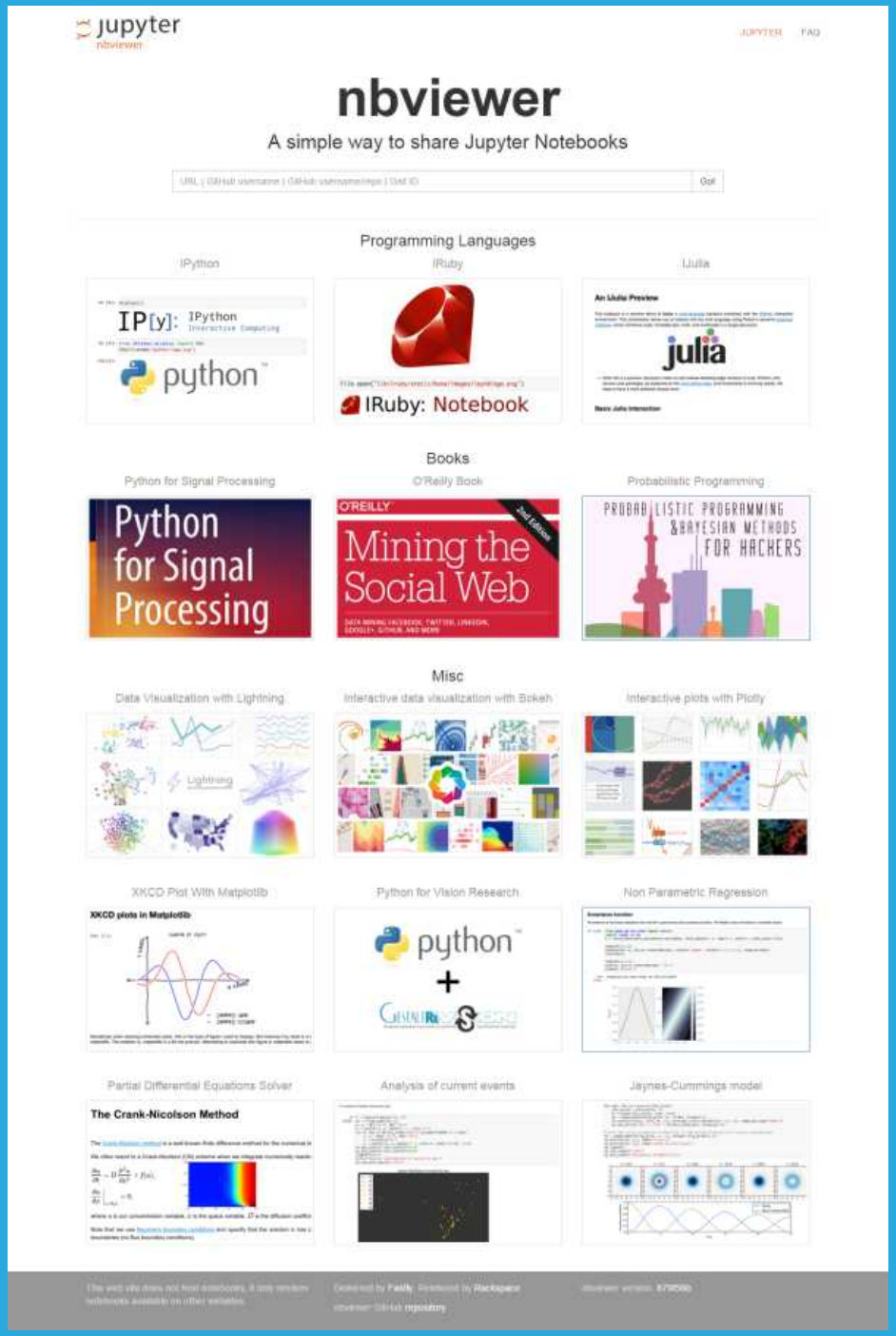
The Notebook: "Literate Computing"

Computational Narratives

- Computers deal with code and data.
- Humans deal with narratives that communicate.

Literate Computing (not Literate Programming)

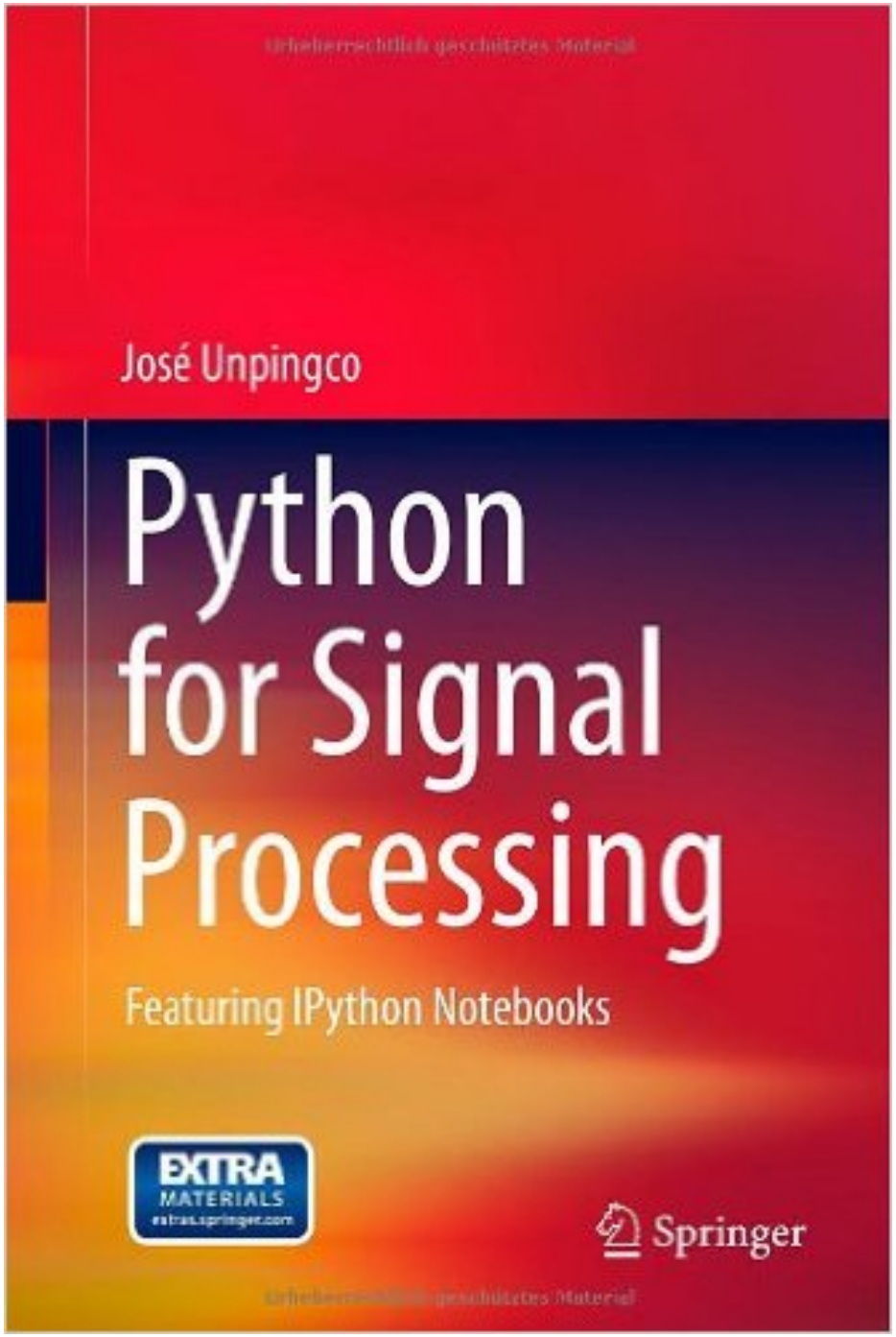
- Narratives anchored in a live computation, that communicate a story based on data and results.



Seamless Notebook Sharing

nbviewer

- Zero-install reading of notebooks
- Just share a URL
- nbviewer.ipython.org



Jupyter Ecosystem

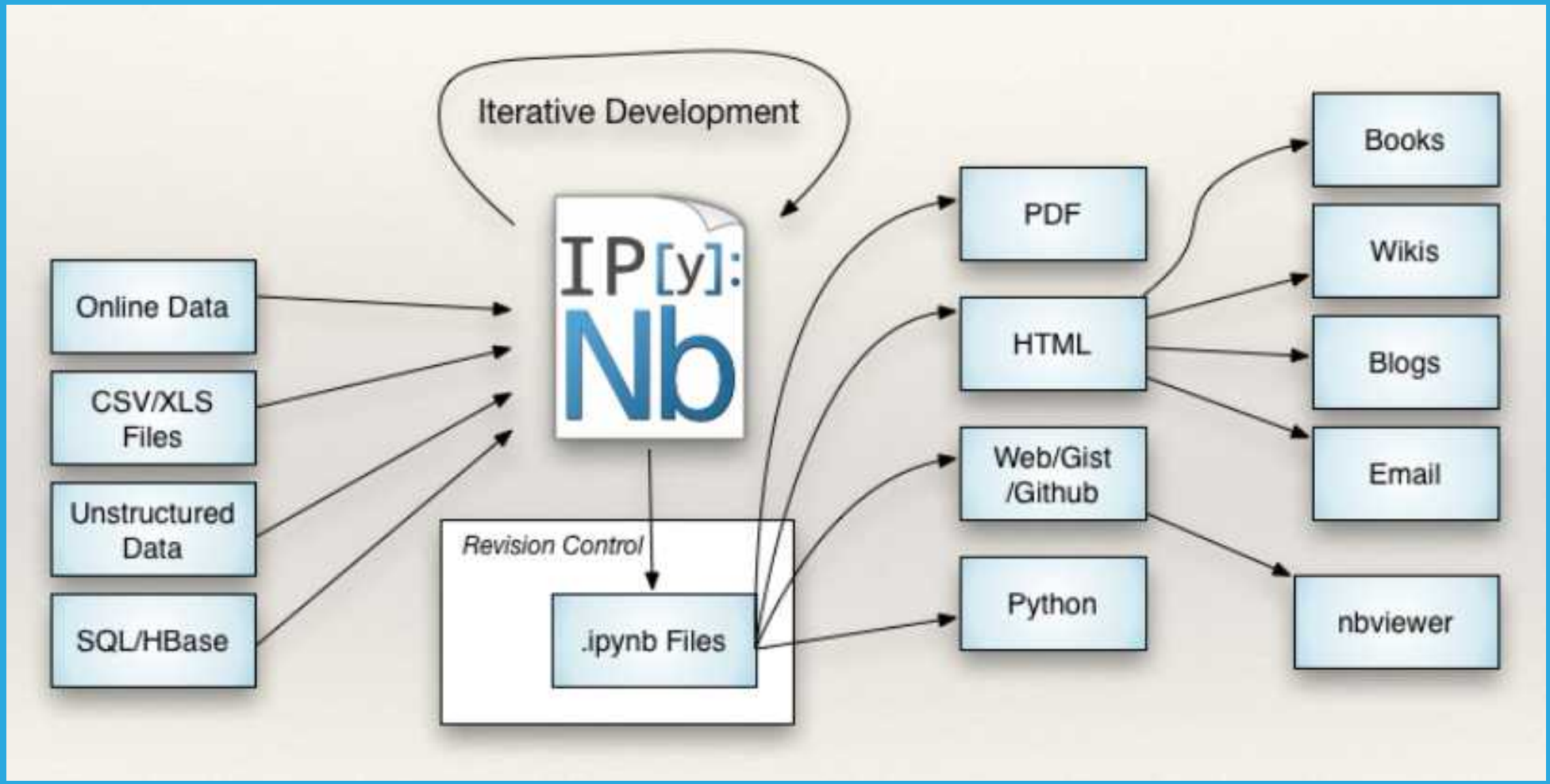
- Reproducible Research
- Paper, Notebooks and Virtual Machine
- Scientific Blogging
- Executable books
- MOOCs and University Courses
- Executable Papers
- ...

Jose Unpingco

Python for Signal Processing

- Springer hardcover book
- Chapters: IPython Notebooks
- Posted as a blog entry
- All available as a Github repo

Notebook Workflows



Credit: Joshua Barrat (via F. Perez)


Notebook: Getting Started

Review

IPython Notebook

IPython notebook is an HTML-based notebook environment for Python. It is based on the IPython shell, but provides a cell-based environment with great interactivity, where calculations can be organized and documented in a structured way.

Although using a web browser as graphical interface, IPython notebooks are usually run locally, from the same computer that run the browser.

IPython Notebook

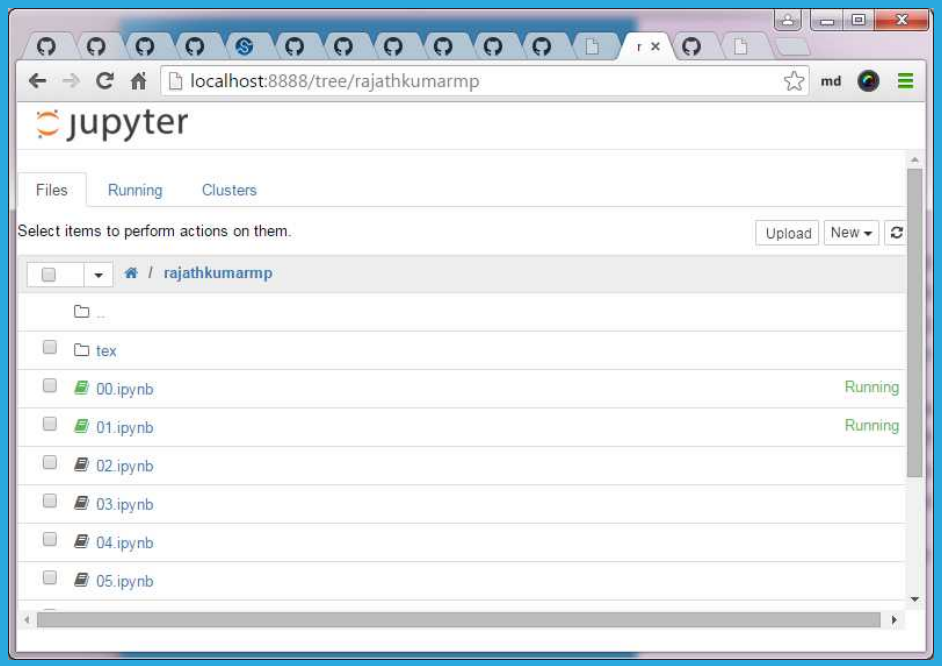
- Web-based user interface to IPython, Interactive Python interpreter in the browser
- Literate computing, Open format combining executable code, text and multimedia
- Pretty graphs
- Version controlled science!

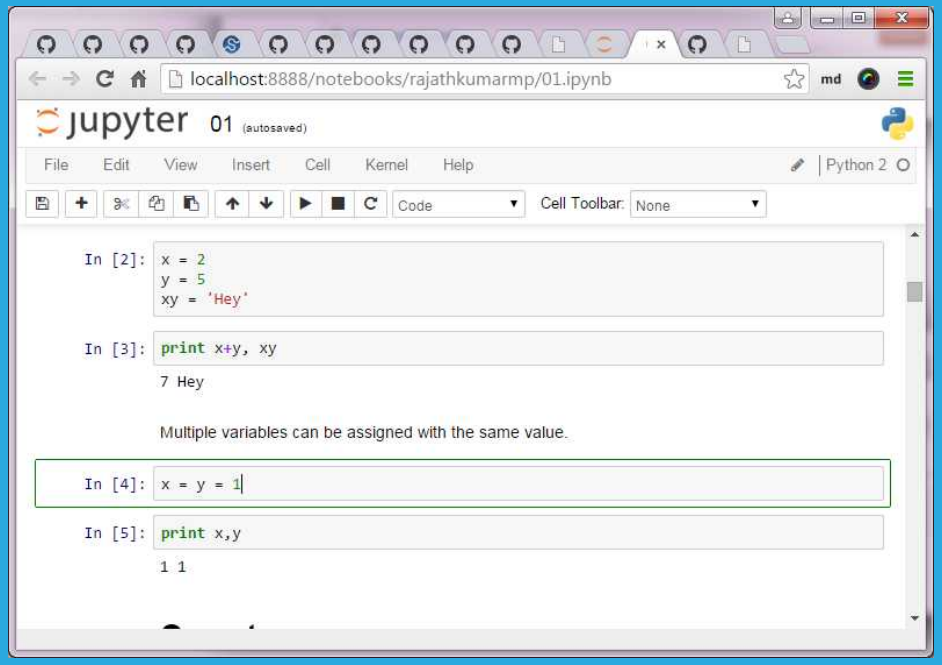
To start a new IPython notebook session, run the following command:

```
ipython notebook
# or
jupyter notebook
```

from a directory where you want the notebooks to be stored.

This will open a new browser window (or a new tab in an existing window) with an index page where existing notebooks are shown and from which new notebooks can be created.





Up and Running

An IPython notebook lets you write and execute Python code in your web browser. IPython notebooks make it very easy to tinker with code and execute it in bits and pieces; for this reason IPython notebooks are widely used in scientific computing.

Once IPython is running, point your web browser at http://localhost:8888 to start using IPython notebooks. If everything worked correctly, you should see a screen showing all available IPython notebooks in the current directory.

If you click through to a notebook file, it will be executed and displayed on a new page.

See: **CS231n**: IPython Tutorial

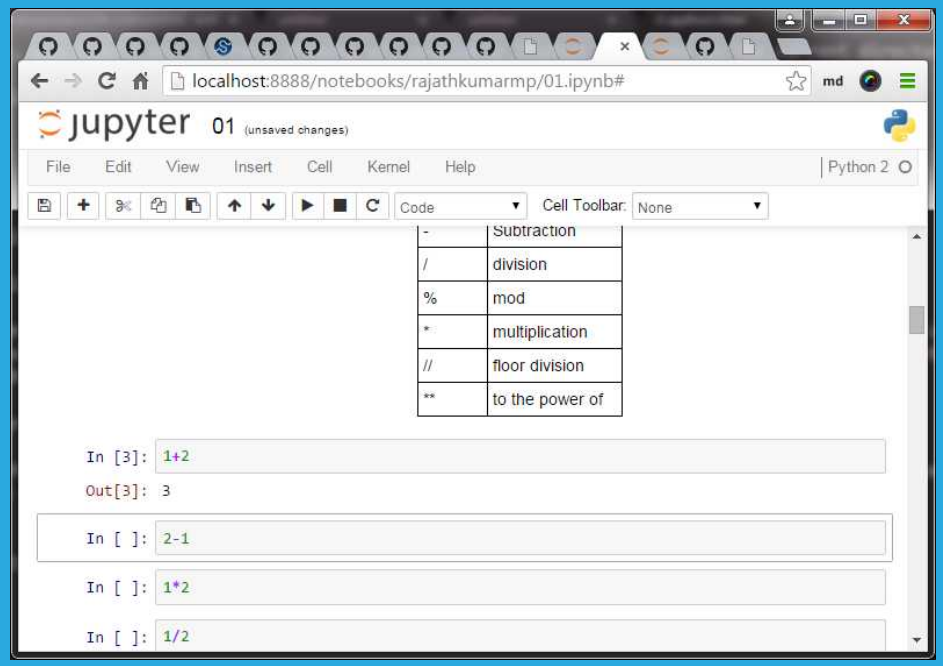
Up and Running

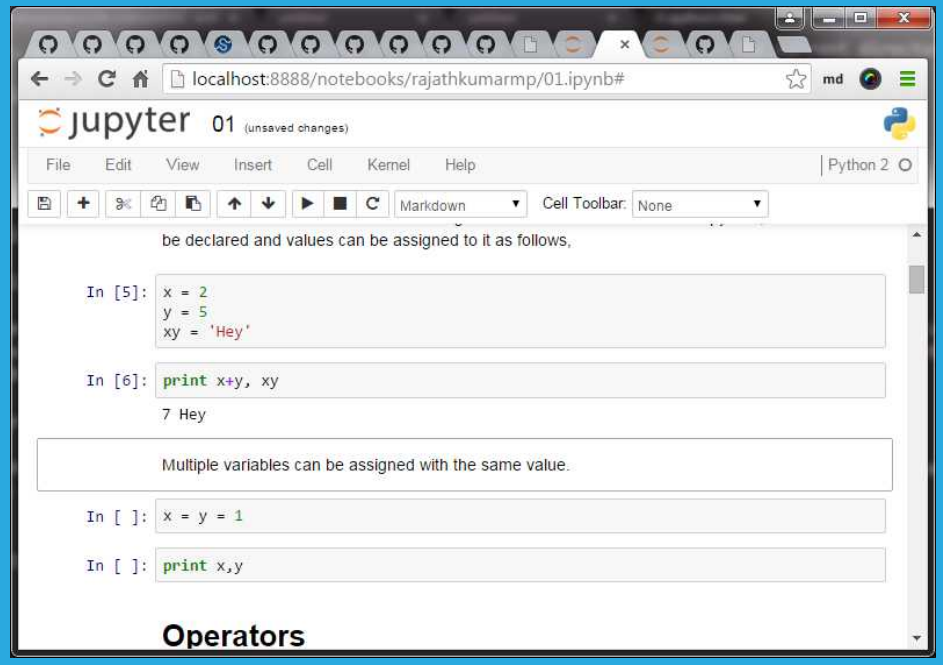
An IPython notebook is made up of a number of **cells**. Each cell can contain Python code. You can execute a cell by clicking on it and pressing `Shift-Enter`. When you do so, the code in the cell will run, and the output of the cell will be displayed beneath the cell. See example.

Global variables are shared between cells. See the notebook after executing the second cell.

By convention, IPython notebooks are expected to be run from top to bottom. Failing to execute some cells or executing cells out of order can result in errors.

See: **CS231n**: IPython Tutorial





Collections and Links

- A gallery of interesting IPython Notebooks

Notebooks for Learning

- Python Fundamentals | DLAB @ Berkeley
- Python Lectures | Rajath Kumar MP
- Intro Programming | Eric Matthes
- Python Crash Course | Eric Matthes
- IPython Minibook | Cyrille Rossant
- IPython & Project Jupyter | Fernando Perez