Jupyter for Everything Else
Michael Bright, EuroPython 2016 - Bilbao, 22 July.

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About Me

Solution Architect working at Hewlett-Packard Enterprise, Grenoble, France

Working in the EMEA OpenNFV lab.

Interests:

• Docker, Docker, Docker, Jupyter, Python, OpenStack
• Run a local Python User Group in Grenoble
• From the UK, married to a Chilean, living in France for 24 years
• Argentinian Tango, Salsa, ...

TODO: add images ... Grenoble mountains, unicycle, Argentinian Tango, UK, NFV? SDN? Python UserGroup, Docker!!!, Jupyter, Linux, OStack
OUTLINE

• Introduction: From IPython to Jupyter
• The Jupyter Project & Ecosystem:
  ▪ Kernels, Widgets, Extensions, Tools
  ▪ Incubating projects
  ▪ External: Thebe, Hosting, Binder ...
• Jupyter for Everything Else
  ▪ Blog, Present, Web, Command-line, Status reports
A tool to help in the exploration process

- Individual exploration
- Collaborative work
- Parallel Production Runs
- Publication odf **reproducible** results
- Education
- Repeat
IPython - The Console

Initial 0.0.1 version **Gist**

- REPL in 259 lines
- Input / Output cells
- History
- Plotting
THE JUPYTER PROJECT

A notebook runs under one kernel
THE (JUPYTER) DASHBOARD & NOTEBOOK
Create & share documents of code, equations, visualizations and explanatory text as a (reproducible) narrative
**JUPYTER: PUBLIC NOTEBOOKS**

Jupyter notebooks are used in many

- scientific (physics, chemistry, biology, genomics, data analysis)
- and non-scientific (finance) domains

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<thead>
<tr>
<th>Site</th>
<th>URL</th>
<th>Info</th>
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<tbody>
<tr>
<td>nbviewer</td>
<td><a href="https://nbviewer.org">https://nbviewer.org</a></td>
<td>submit your url, browse by theme</td>
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<tr>
<td>github</td>
<td><a href="https://github.com">https://github.com</a></td>
<td>&gt; 200k notebooks [Announcement - May '15]</td>
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<tr>
<td>IPython gallery</td>
<td>A-gallery-of-interesting-IPython-Notebooks</td>
<td>many notebooks organized by domain</td>
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<td><a href="http://nb.binap.net/">nb.binap.net</a></td>
<td>view submitted notebooks by 'most viewed' or 'data'</td>
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JUPYTER: RUNNING NOTEBOOKS

- Native OS Python distribution + Pip, or Anaconda
- JupyterHub, multi-user server
- Under Docker [e.g. docker-stacks images]
- Integrated into data science Cloud Hosting or plain IaaS:
  - Azure ML Studio
  - Google Cloud DataLab Beta
  - IBM Data Scientist Workbench
- Cloud hosted (ephemereal)
  - tryjupyter.org [uses docker-demo image]
  - Binder (https://mybinder.org), an example github repo
JUPYTER & AZURE ML STUDIO

Jupyter integration in Azure ML Studio

- R
- Python
KERNELS, WIDGETS & EXTENSIONS
~50 KERNELS

Kernels are execution environments - typically a language

<table>
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<tr>
<th>IJulia</th>
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<td>IMathics</td>
<td>IAlfod</td>
<td>Calico Pro</td>
<td>Calysto Prolog</td>
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<td>IPerl6</td>
<td>IPHP</td>
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<td>KDB+/Q Ker</td>
<td>ICryptol</td>
<td>C++ (cling)</td>
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<td>Redis</td>
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<td>Prolog</td>
<td>IFSharp</td>
<td>Calysto Scheme</td>
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Widgets

Widgets are eventful python objects with a representation in the browser.

[documentation]

Provided widgets include:
- IntSlider, FloatSlider, FloatProgress
- Buttons, Checkboxes, Radio buttons
- Dropdown menus
EXTENSIONS

• Collection [github]: ipython-contrib/IPython-notebook-extensions
• Installed to http://localhost:8888/nbextensions/

Many extensions available, including:

• **RISE** - these slides are running under Jupyter
  • **nbgrader** - creation/grading of classroom assignments

Generally installable via pip or from github repo
Part B (3 points)

Describe the difference between an arithmetic mean, a harmonic mean, and a geometric mean.

Arithmetic mean:
\[ \frac{1}{N} \sum_{i=1}^{N} x_i \]

Harmonic mean:
\[ \left( \frac{1}{N} \sum_{i=1}^{N} \frac{1}{x_i} \right)^{-1} \]

Geometric mean:
\[ \left( \prod_{i=1}^{N} x_i \right)^{\frac{1}{N}} \]
THE ECOSYSTEM & FUTURE PROJECTS
JUPYTER INCUBATOR PROJECTS
(https://github.com/jupyter-incubator) proposals

sparkmagic  Jupyter magics and kernels for working with remote Spark clusters
declarativewidgets  Declare Widgets in HTML
dashboards  Create Dashboards from Notebooks
contentmanagement  Extensions for search, notebook modules/cookbooks, ToC, bundlers vid
kernel_gateway  Support different protocols to Jupyter server, e.g. non-nb web clients, u-services, cluster
INCUBATOR: JUPYTER DASHBOARDS
(https://github.com/jupyter-incubator/dashboards) - alternative layouts
JUPYTERLAB
(https://github.com/jupyter/jupyterlab/) - the future interface
EXTERNAL JUPYTER PROJECTS

There are many external projects such as Beaker, Hydrogen (ATOM), EIN (Emacs), Rodeo, SageMathCloud integrating Jupyter.

Publishers are also turning to Jupyter for books, blogs, reports, theses sometimes with live code examples.

- e.g. Thebe (O'Reilly)
- Nature, Scientific American Magazines is a simplified notebook interface

Educators

- tutorials, assignments, presentations, documenting
- MOOCs - online education:
  - notebook-based (Edx/Apache Spark)
  - instructor controlled (Z-Math)
OREILLY BLOG ARTICLE - USING THEBE

This blog post contains modifiable, runnable code cells with a **RUN** button as shown below.
MOOCS, E.G. F.U.N., GWU, EDX/SPARK...
JUPYTER FOR EVERYTHING ELSE

- Use of web technologies: mix-in HTML, CSS, js, SVG ...
- Use of bash kernel for command-line work
- Supplement command-line tools with graphics
- Create interactive presentations (thanks RISE extension !)
- Publish "live blog posts"
- Creating status reports from notebooks using nbconvert
EVERYTHING ELSE: WEB TECHNOLOGIES

- HTML/JavaScript/css experimentation
  - Many HTML, CSS, JS capabilities if you **proceed with care**
  - d3.js animations if
    - Need more interactivity
    - Prototyping a D3 project
    - Reusing existing D3 e.g. from [http://bl.ocks.org](http://bl.ocks.org)

- SVG

- Example notebook

  Select Theme: mysky
Everything Else: web technologies

- HTML/JavaScript/css experimentation
  - Many HTML, CSS, JS capabilities if you **proceed with care**
  - d3.js animations if
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- SVG

- Example notebook

  **Select Theme:** mybloodredsky
Everything Else: command-line

Two bash kernels are available for Jupyter bash_kernel and calysto/metakernel_bash

**Calysto Metakernels**

- easy to fix for Windows/Cygwin
- Provides magics
- Family of metakernels
- Under development
Why?

Inspired by the notebook as an educational tool, I wanted to use it for command-line tasks.

- **Docker demos / labs in Jupyter**
- Why not Bash as 1st-class citizen with magics, graphics?
- **Example notebook**
- Write command-line tutorials, cheat sheets
  in an easy to maintain "live notebook" (runnable) format.
Everything Else: Binder "live notebooks"

Turn a GitHub repo into a collection of interactive notebooks

Have a repository full of Jupyter notebooks? With Binder, you can add a badge that opens those notebooks in an executable environment, making your code immediately reproducible by anyone, anywhere.

100% free and open source. Browse examples. Read the FAQ.

Build a repository

https://github.com/mygithub/binder_jupyter_notebook

submit

How it works

In the field above, enter a GitHub repository that contains Jupyter notebooks, and click Submit to start the build. All files will be included, and if there’s an index.ipynb notebook it will load first. Check out an example.
Everything Else: "live notebooks" as runnable tutorials

We can create live tutorials online on Binder. The notebook server can be launched by clicking on the binder icon in a github repo:

I wrote a Blog post with link to "live notebook" of bash tutorials.
Everything Else: Binder command-line "live notebooks"

In that [github repo](https://github.com) I created an **INDEX notebook**
other notebooks in the same repo
Everything Else: Slideshows

This **slideshow** is made using Jupyter with the RISE extensions.
RISE adds special "Slide Type" menu options to each cell to specify one of:

- Slide
- Sub-Slide
- Fragment
- Notes
- Skip
Everything Else: Automated e-mail status reports

Using nbconvert we can **execute notebooks** from the command-line

- Automatically run the notebook under cron
- **nbconvert** notebook result to html
- send html report as e-mail via cron
- Capabilities created incrementally in notebook,
code migrated to modules to reduce notebook (report) code
Everything Else: Automated e-mail status reports (nbconvert)

We can use nbconvert to automatically run the notebook under cron and send the results by e-mail.

```
nbconvert --execute --template basic --to html Monitoring.ipynb
```

- `--execute`: execute the notebook
- `--template`: specify the o/p template
- `--to`: specify o/p format
- Input notebook
Everything Else: Coming up ...

- Experiment with JupyterHub, nbgrader, Binder
  - I'd like to reimplement some labs as a set of graded assignments
- More Metakernel_Bash experiments
- Make pull requests to Metakernel_bash
- Propose this stuff outside of the Python community
- Xonsh_kernel
  - Take advantage of new Python / unix-like shell
- CLing C++ interpreter kernel
Questions?

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The End ...
References: IPython / Jupyter Books

Learning IPython for Interactive Computing & Data Visualization
Cyrille Rossant
*Introductory usage*

IPython Interactive Computing & Visualization Cookbook
Cyrille Rossant
*Advanced usage*

The Jupyter GitBook
*Extension writing*

Documentation on ReadTheDocs
*Extension writing*