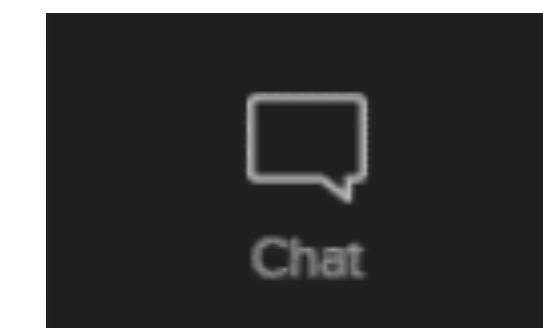
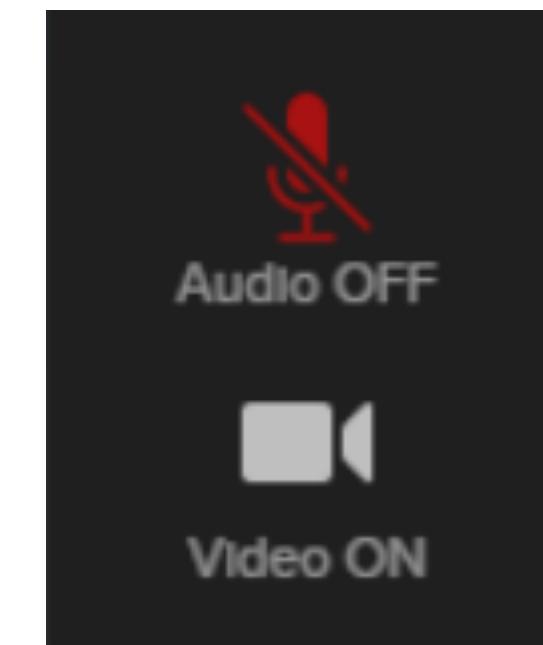


# Welcome to the SGCI Webinar!

- We will be starting shortly.
- Your audio has been muted, and you are encouraged to **turn off your video** during the presentation.
- Controls for these are near the bottom of the right-side control panel for BlueJeans.
- You may submit questions at any time using **Chat**, and the moderator will share them with the presenter when appropriate.
- This presentation will be **recorded** and slides will be posted.



SGCI's week-long **Science Gateways Bootcamp** in October teaches strategies for successful gateway development & sustainability.

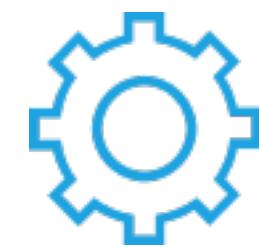
*Apply by Friday 7/28:* <https://sciencegateways.org/bootcamp>

# A few brief words about the Science Gateways Community Institute (SGCI)

**Our goal:** To facilitate community *sharing of experiences, technologies, and practices* at little or no cost to community members through *NSF-funded, online and in-person resources and services*



**Incubator:** Learn best practices from our consultants or Bootcamp.



**Extended Developer Support:** Get direct, custom development help.



**Scientific Software Collaborative:** Find gateways or software components (or promote your own).



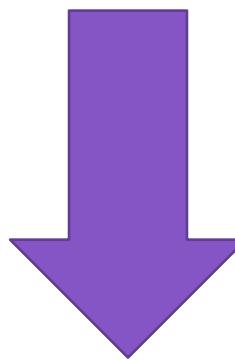
**Community Engagement & Exchange:** Engage with and learn from the gateways community.



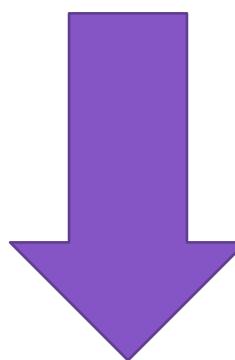
**Workforce Development:** Build your professional career as a student or young professional.

A quick favor at the end of this webinar...

NSF gives money to SGCI.



SGCI gives you a free webinar.



*Could you give SGCI  
30 seconds of feedback?*



# Jupyter

## A Gateway for Scientific Collaboration and Education

The Project Jupyter Team

Carol Willing, Cal Poly  
Brian Granger, Cal Poly  
Fernando Perez, LBNL/Berkeley  
Min Ragan-Kelley, Simula

The Larger Jupyter Team

@ProjectJupyter on Twitter

July 20, 2017



Proud  
member  
of the  
Jupyter  
community



# Carol Willing

- Steering Council, [Project Jupyter](#)
- Core Developer, [Project Jupyter](#)
- Software Engineer, [Cal Poly SLO](#)
- Director, [Python Software Foundation](#)
- Core Developer, [CPython](#)
- Geek in Residence, [Fab Lab San Diego](#)



@willingcarol

# Agenda

- Gateways
- Jupyter Notebook
- JupyterHub
- JupyterLab
- Next steps

# Engage learners

## Convert from kern format to MusicXML

```
In [12]: c = converter.parse('/Users/carol/Downloads/duet/edokomuri.krn')
c.show()
```

Out[12]:

## music21: a toolkit for computer-aided musicology

### What is music21?

music21 is a set of tools for helping scholars and other active listeners answer questions about music quickly and simply. If you've ever asked yourself a question like, "I wonder how often Bach does that" or "I wish I knew which band was the first to use these chords in this order," or "I'll bet we'd know more about Renaissance counterpoint (or Indian ragas or post-tonal pitch structures or the form of minuets) if I could write a program to automatically write more of them," then music21 can help you with your work.

### How simple is music21 to use?

Extremely. After starting Python and typing "from music21 import \*" you can do all of these things with only a single line of music21 code:

Display a short melody in musical notation:

```
converter.parse("tinynotations: 3/4 A4 B4 C4 D4 E4 F4 G4").show()
```

Print the twelve-tone matrix for a tone row (in this case the opening of Schoenberg's Fourth String Quartet):

```
print( converter.parse('tinynotations: 3/4 A4 B4 C4 D4 E4 F4 G4').getRhythmicalRowMatrix() )
```

or since all the 2nd-Viennese school rows are already available as objects, you can type:

```
print( converter.parse('tinynotations: 3/4 A4 B4 C4 D4 E4 F4 G4').getRhythmicalRowMatrix() )
```

Convert a file from Humdrum's <> kern data format to MusicXML, for editing in Finale or Sibelius:

```
converter.parse("/Users/outhbert/docs/composition.krn").write("musicxml")
```

```
def closedPosition(self):
    ...
    return a new Chord object with:
>>> chord1 = Chord(["C#4", "G5",
>>> chord2 = chord1.closedPosition()
>>> print(chord2.tally.value)
<idis' e' g'>4
...
newChord = copy.deepcopy(self)
tempChordNotes = newChord.pitches
chordBassPS = self.bass().ps
for thisPitch in tempChordNotes:
    while thisPitch.ps > chordBassPS:
        thisPitch.octave = thisPitch.octave - 1
    newChord.pitches = tempChordNotes
```

- [Get Started with music21](#)
- [Browse the music21 documentation](#)
- [Download music21 from Google Code](#)
- [Get our latest news and updates at the music21 blog](#)
- [Read the Frequently Asked Questions list](#)
- [Sign up for the music21list mailing list through Google Groups.](#)

```
In [10]: sBach = corpus.parse('bach/bwv7.7')
sBach.show()
```

Out[10]:

## bwv7.7.mxl

The figure shows a Mac OS X application window titled "tmpOph\_K4.txt". The window contains two main sections: musical notation at the top and text lyrics at the bottom.

**Musical Notation:** The top section displays three staves of music. The top staff is in treble clef, C major, with a tempo of 110 BPM. The middle staff is also in treble clef, C major, with a tempo of 110 BPM. The bottom staff is in bass clef, C major, with a tempo of 110 BPM. The music consists of eighth and sixteenth note patterns.

**Text Lyrics:** The bottom section contains five lines of lyrics in a stylized font. Each line corresponds to a measure of music above it.

```
Movement Name: bwv7.7.mxl
    110 BPM
A4 ABB BCCC DDDDD E BBBB BCCC CCCC
    BBBB CCCC DDDDD BBBB BCCC CCCC
    BBBB BCCC CCCC BBBB BCCC CCCC
    110 BPM
A4 B4 C4 D4 E4 F4 G4 H4 I4 J4 K4 L4 M4 N4
    B4 C4 D4 E4 F4 G4 H4 I4 J4 K4 L4 M4
    B4 C4 D4 E4 F4 G4 H4 I4 J4 K4 L4 M4
    B4 C4 D4 E4 F4 G4 H4 I4 J4 K4 L4 M4
    110 BPM
A4 B4 C4 D4 E4 F4 G4 H4 I4 J4 K4 L4 M4 N4
    B4 C4 D4 E4 F4 G4 H4 I4 J4 K4 L4 M4
    B4 C4 D4 E4 F4 G4 H4 I4 J4 K4 L4 M4
    B4 C4 D4 E4 F4 G4 H4 I4 J4 K4 L4 M4
    110 BPM
A4 B4 C4 D4 E4 F4 G4 H4 I4 J4 K4 L4 M4 N4
```

**Michael Scott Cuthbert** (cuthbert [at] mit.edu) is Associate Professor of Music and Homer A. Burnell Career Development Professor at M.I.T.

# Break down barriers to entry

## Intro to Python San Diego Python

- Start with a proven curriculum

<http://pyvideo.org/pycon-us-2013/a-hands-on-introduction-to-python-for-beginning-p.html>

- Hands on to engage students
- Takeaway notebooks reduce student stress

<https://github.com/pythonsd/intro-to-python>





“Project Jupyter serves not only the academic and scientific communities but also a much broader constituency of data scientists in research, education, industry and journalism...”

- *Fernando Pérez*

*UC Berkeley*

“

...we see uses of our tools that range from **high school education** in programming to the nation's **supercomputing** facilities and the **leaders of the tech industry**.

- *Fernando Pérez*

*UC Berkeley*

“

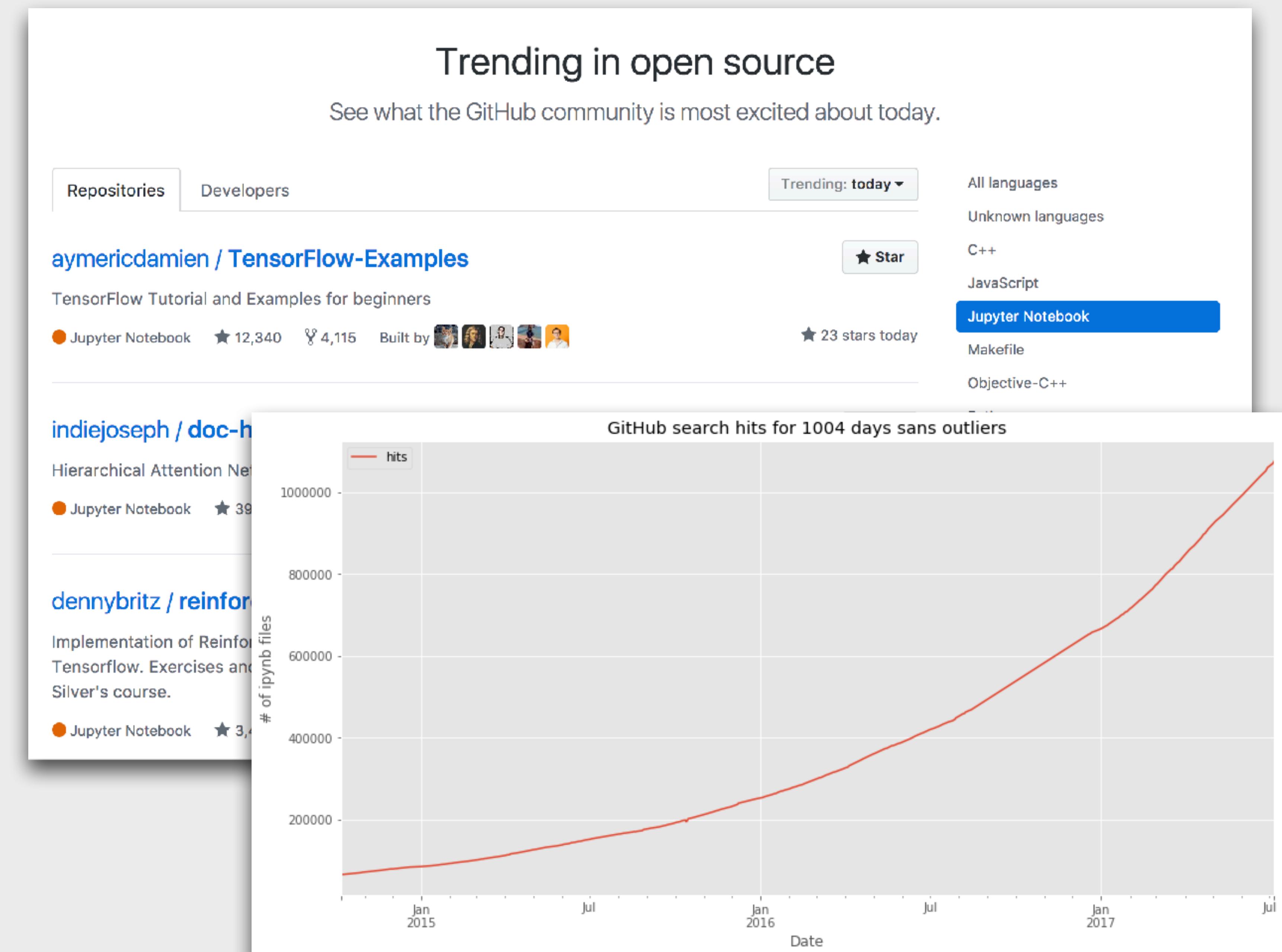
More than **a million people** are  
currently using Jupyter for everything  
from...

*-Prof. Brian Granger  
Cal Poly*

>6M Users



# Over 1M Notebooks on GitHub



“...analyzing massive gene sequencing  
**datasets** to processing **images** from  
the Hubble Space Telescope and  
developing **models** of financial  
markets.

*-Prof. Brian Granger  
Cal Poly*

“We are excited by the potential of Project Jupyter to **reach even wider audiences** and to contribute to **increased cross-disciplinary collaboration** in the sciences.

-Betsy Fader

*Helmsley Charitable Trust*

“

Jupyter Notebook... will enable **data exploration, visualization, and analysis** in a way that **encourages sound science** and **speeds progress**.

-Chris Mentzel

*The Gordon and Betty Moore Foundation*

# Enabling Reproducible Science



## LIGO Open Science Center

LIGO is operated by California Institute of Technology and Massachusetts Institute of Technology and supported by the U.S. National Science Foundation.

**Welcome to the LIGO Open Science Center**

[About LIGO](#)  
[Get Started with LIGO data](#)  
[Join the E-mail list for updates](#)  
For general information on LIGO, please visit [ligo.org](http://ligo.org)  
If you have LSC credentials, you may go to the [development site](#)

---

**More discoveries from LIGO!**  
**Data Releases from two events and a candidate event**

*released 2016 June 15:*  
[Event of December 26, GW151226: Chirp mass 9](#)

*released 2016 June 15:*  
[Candidate event of October 12, LVT151012: Chirp mass 15](#)

*released 2016 Feb 11:*  
[Event of September 14, GW150914: Chirp mass 30](#)

---

The [LIGO Laboratory's Data Management Plan](#) describes the scope and timing of LIGO data releases.

---

**Jupyter notebook**  
See the new tutorial on signal processing with LIGO data, as a Jupyter (iPython) notebook.  
[Tutorial on Binary Black Hole Signals in LIGO Open Data](#)

<https://losc.ligo.org/about/>



# Scaling globally



Credit: <http://pythonineducation.org/>

# Agenda

- Gateways
- Jupyter Notebook
- JupyterHub
- JupyterLab
- Next steps

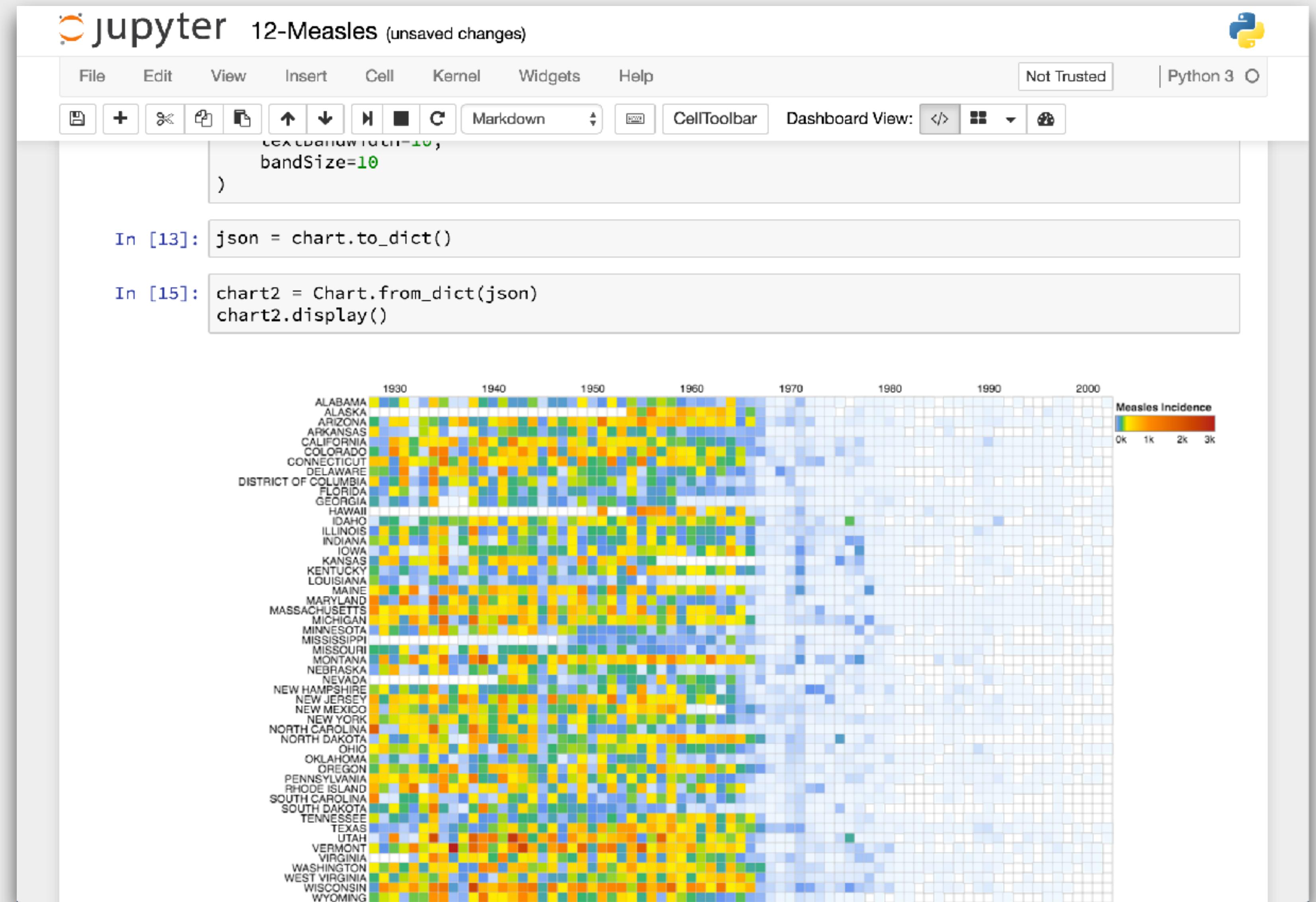
# Jupyter Notebook



## Interactive, Exploratory, Reproducible

- **Interactive**, browser-based computing environment
- **Exploratory** data science, ML, visualization, analysis, stats
- **Reproducible** document format:
  - Code
  - Narrative text (markdown)
  - Equations (LaTeX)
  - Images, visualizations
- Over 50 programming languages
- Everything open-source (BSD license)

# Jupyter Notebook



A Jupyter Notebook document with a visualization of measles data.

Where  
we are



# ipywidgets 6.0

- **Docs** <https://ipywidgets.readthedocs.io>
- **Website** <http://jupyter.org/widgets.html>
- **Blog 6.0 release** <https://blog.jupyter.org/2017/03/01/ipywidgets-6-release/>
- **cookiecutter** to simplify creating new widgets

# Where we are going

Interactive Documentation  
Engaging User Content  
Rapid “what if” scenarios



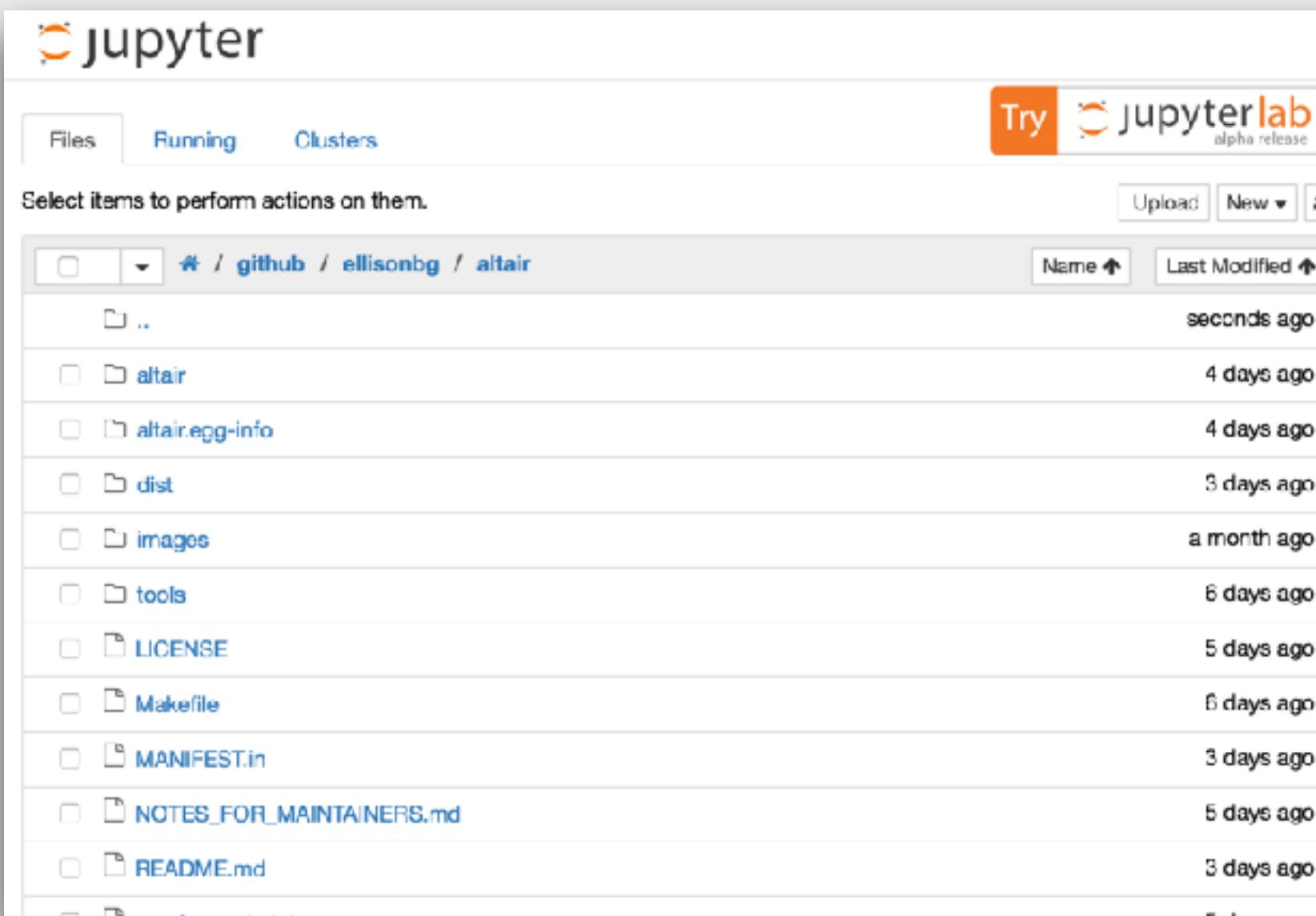
Where  
we are  
going



# ipyvolume

- **3D interactivity** in notebooks
- **Innovation** by Maarten Breddels and team
- **Documentation** engages and demonstrates
- **Try and enjoy** at [ipyvolume.readthedocs.io](http://ipyvolume.readthedocs.io)

# Classic Jupyter: More Than Just Notebooks



This screenshot shows a Jupyter code cell containing Python code. The code defines two functions: `read` and `version`. The `read` function takes a path and reads it with a specified encoding. The `version` function reads a package's `setup.py` file to find the package's version number. It uses regular expressions to search for the `__version__` assignment in the file.

```
import io
import os
import re

try:
    from setuptools import setup
except ImportError:
    from distutils.core import setup

def read(path, encoding='utf-8'):
    path = os.path.join(os.path.dirname(__file__), path)
    with io.open(path, encoding=encoding) as fp:
        return fp.read()

def version(path):
    """Obtain the package version from a python file e.g. pkg/__init__.py
    See <https://packaging.python.org/en/latest/single_source_version.html>.
    """
    version_file = read(path)
    version_match = re.search(r'''^__version__ = ['"]([^"]*)['"]''',
                             version_file, re.M)
    if version_match:
        return version_match[1]
    else:
        raise RuntimeError('No __version__ defined in %r' % path)
```

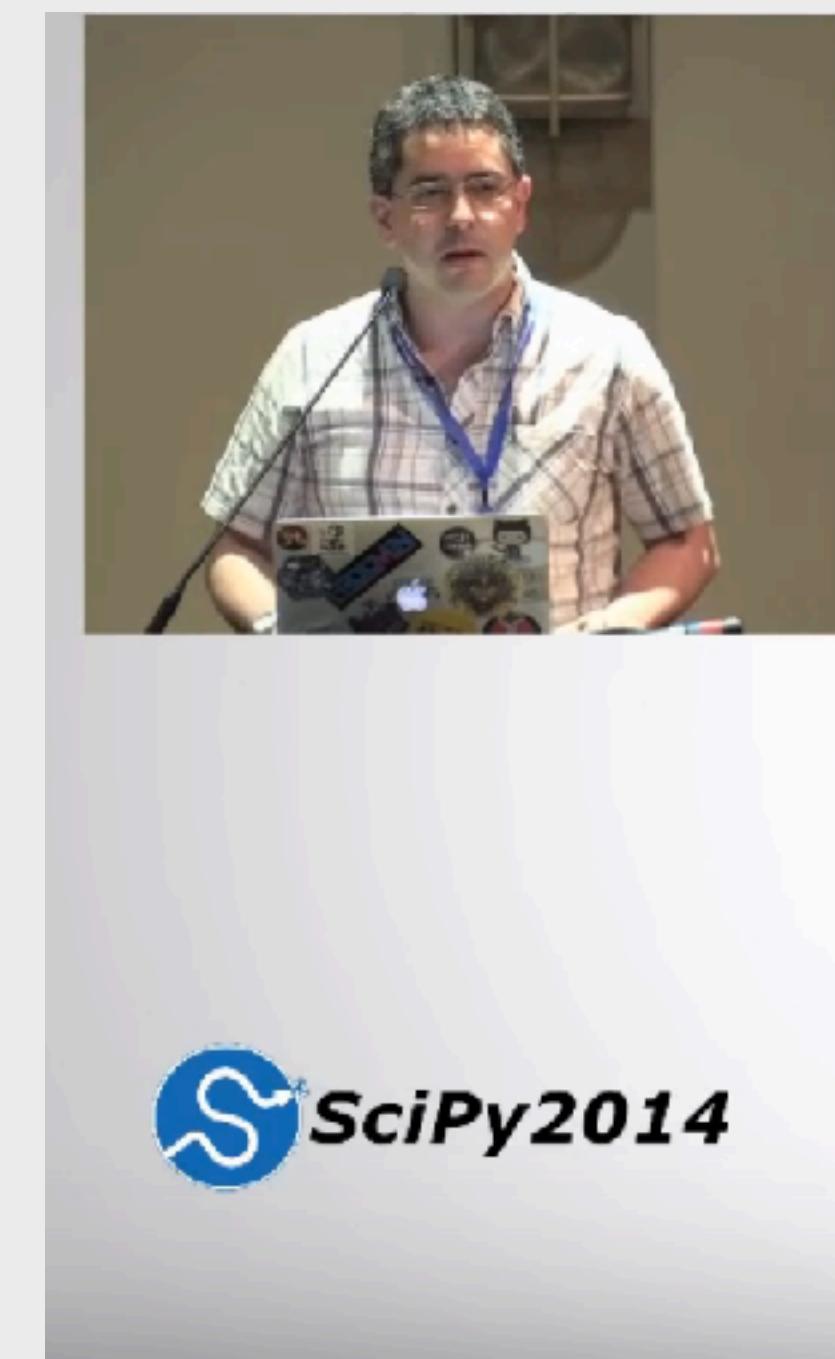
This screenshot shows a terminal window with a black background and white text. The user is in the directory '/github/ellisonbg/altair'. They run the command 'ls' to list the contents of the directory, which includes: LICENSE, MANIFEST.in, Makefile, NOTES\_FOR\_MAINTAINERS.md, README.md, altair, and altair.notebooks. In the altair.notebooks directory, there are several IPython notebook files: 01-Index.ipynb, 02-Introduction.ipynb, 03-ScatterCharts.ipynb, 04-BarCharts.ipynb, 05-LineCharts.ipynb, 06-AreaCharts.ipynb, and 07-LayeredCharts.ipynb. There are also other files like auto\_examples and example.html.



# Agenda

- Gateways
- Jupyter Notebook
- JupyterHub
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- Next steps

# Jupyter for Science and Data Science



## Galileo's *Sidereal Messenger*: 1610

OBSERVATIONS OF THE STARS

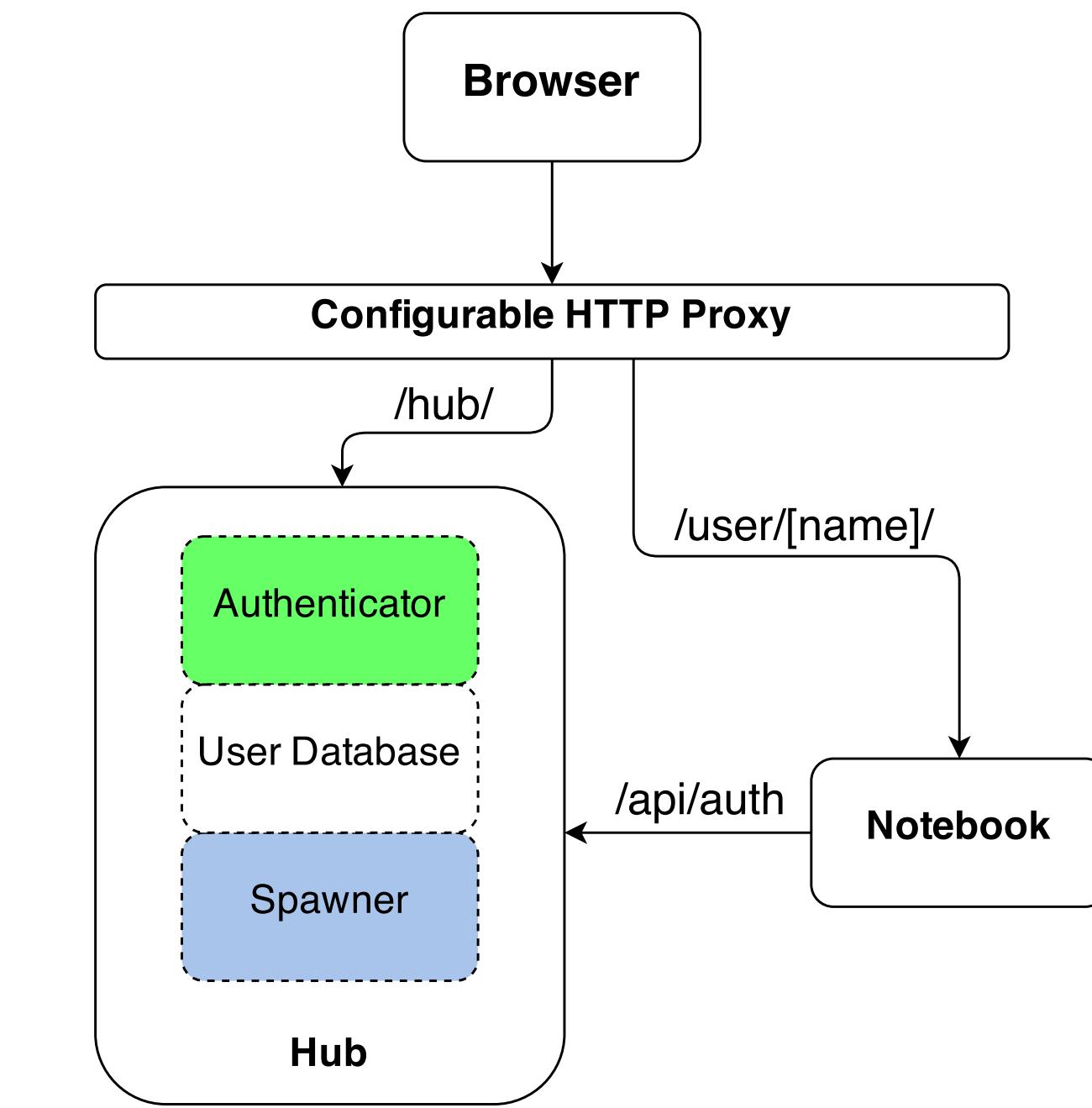
Ori. \* \* O \* Occ.

was greater than the star furthest to the west; but both were very conspicuous and bright; the distance of each one from Jupiter was two minutes. A third star, certainly not in view before, began to appear at the third hour; it nearly touched Jupiter on the east side, and was exceedingly small. They were all arranged in the same straight line, along the ecliptic.

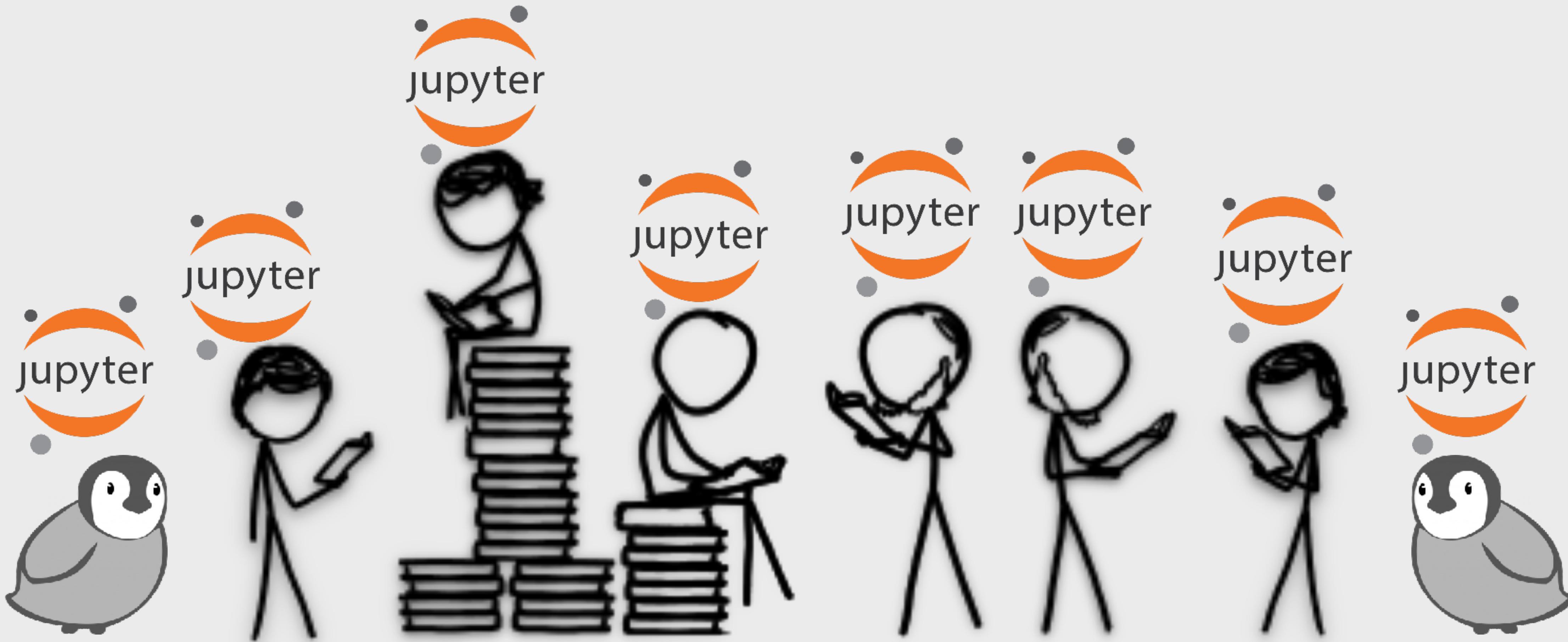
Jan. 13. For the first time four stars were in view in the following position with regard to Jupiter. There were three to the west, and one to the east; they made a nearly straight line,

Ori. \* \* O \* Occ.

but the middle star of the straight line toward was at a distance of 2' only between Jupiter and themselves, west of Jupiter, in size, and though small in comparison with the fixed stars of the same magnitude.



# JupyterHub

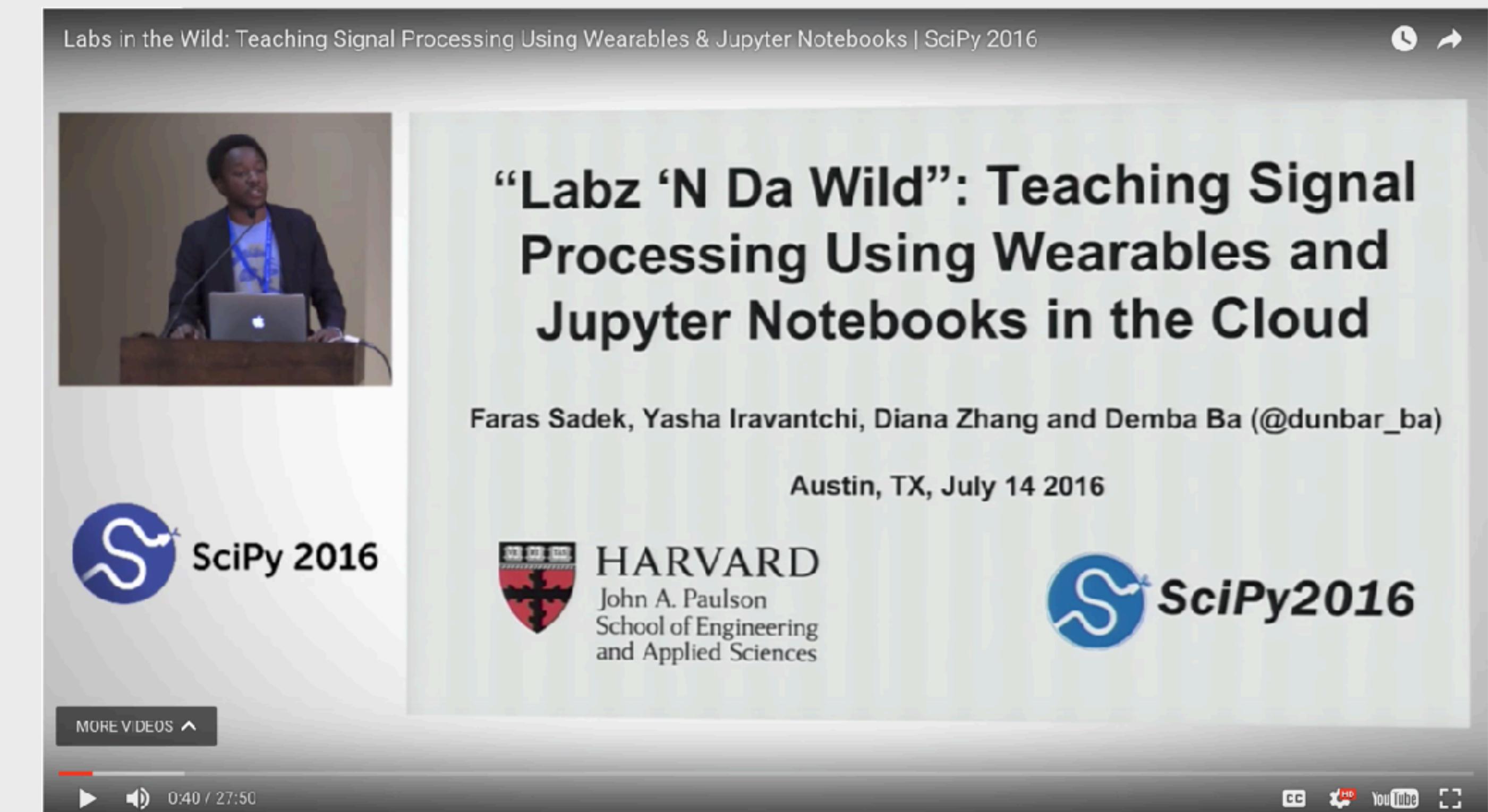


# Exploration and prototyping

## Teaching Signal Processing using Wearables and Jupyter Notebooks

Dr. Demba Ba

- Exploration and experimentation  
<http://pyvideo.org/scipy-2016/labs-in-the-wild-teaching-signal-processing-using-wearables-jupyter-notebooks-scipy-2016.html>
- Physical media with wearables and electronics
- Real world, self-directed projects



# Visualize and communicate

## Python for Geosciences

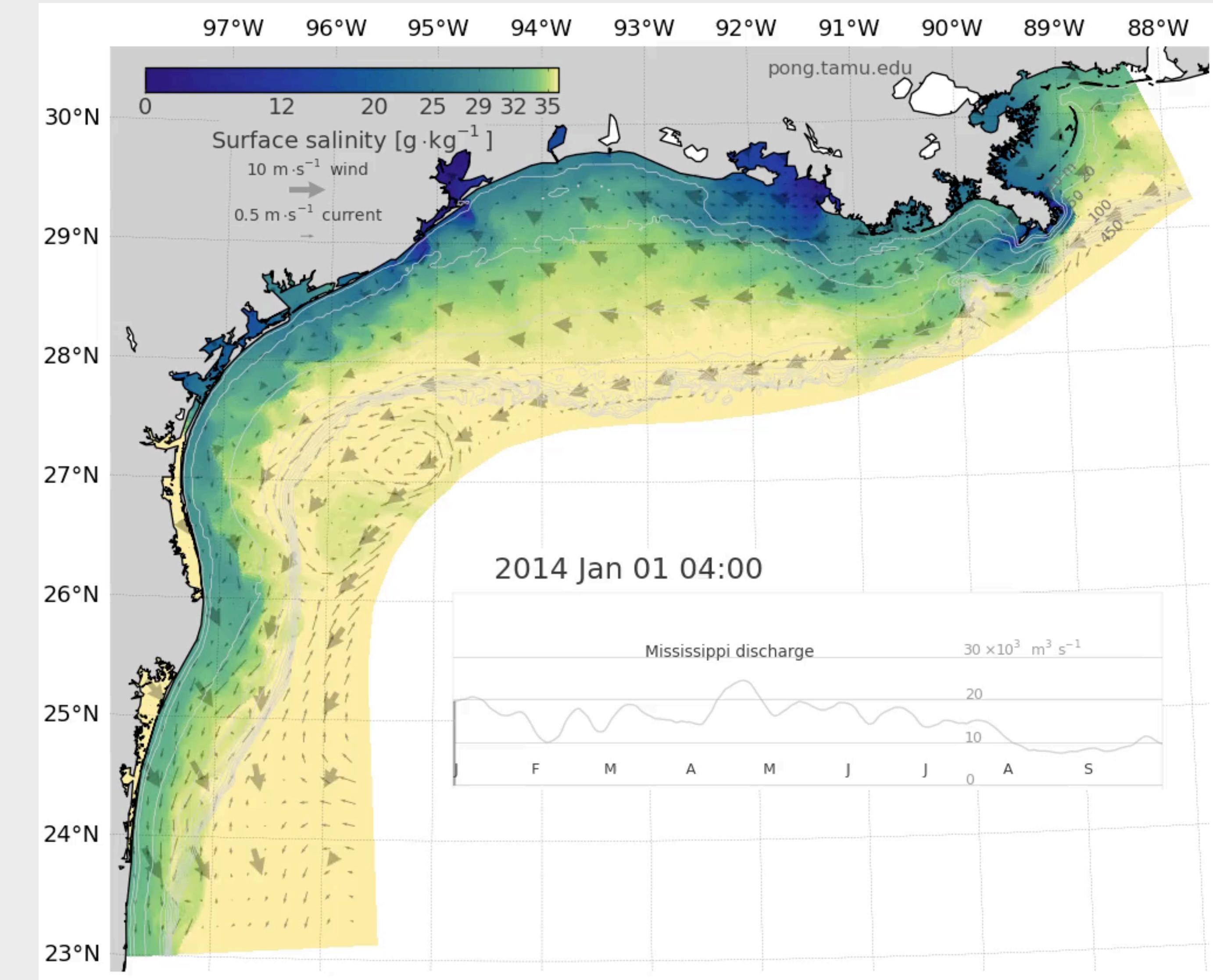
Dr. Kristen Thyng

- Feedback and communication with students using nbgrader

<http://kristenthyngh.com/blog/2016/09/07/jupyterhub+nbgrader/>

- Progression to complex examples and tasks

<https://github.com/kthyng/python4geosciences>

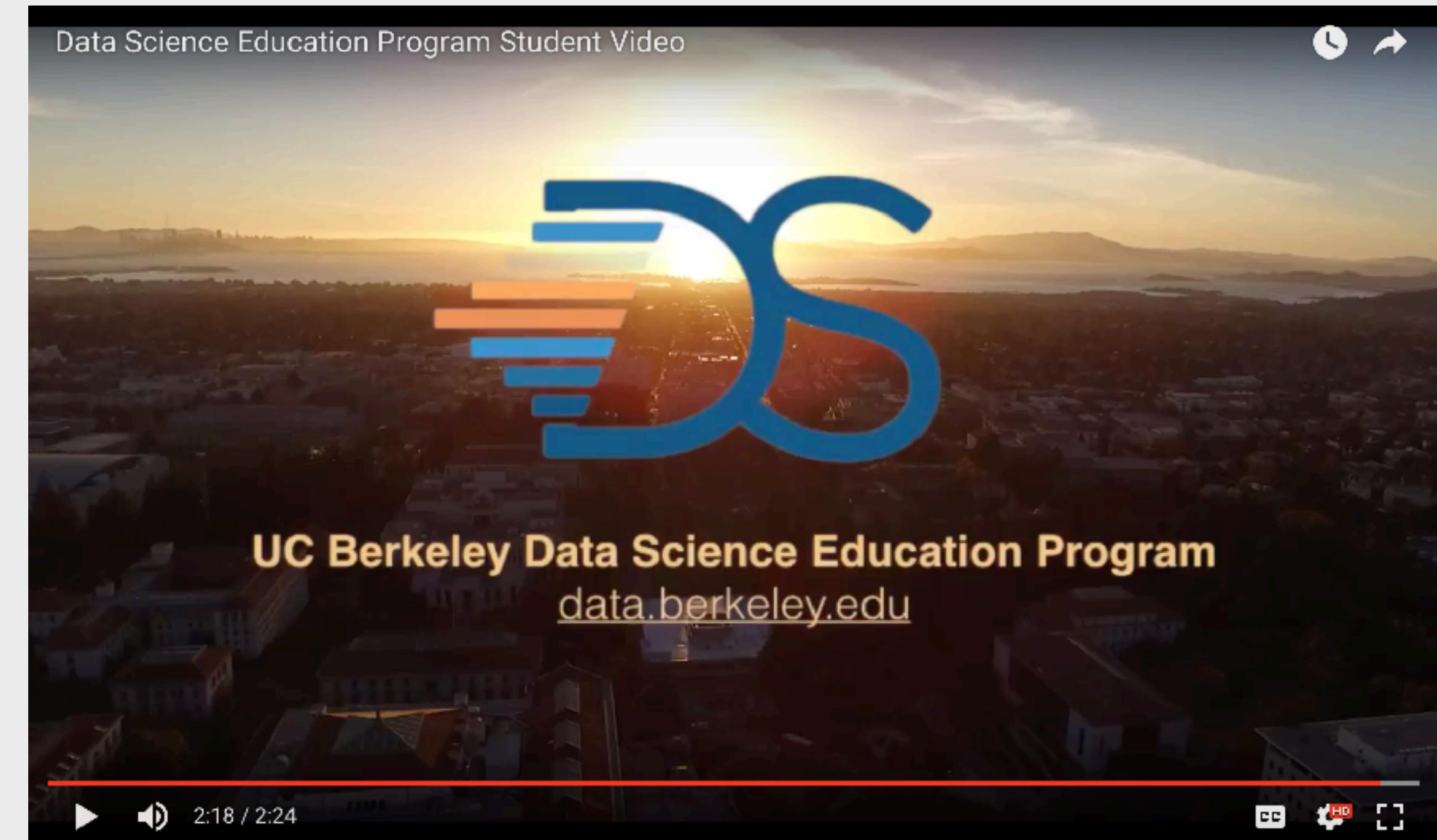


# Scale learning with research tools

## Berkeley Data Science Data8 UC Berkeley

- Campus wide curriculum
- Cross-discipline
- Zero to JupyterHub with Kubernetes

<https://zero-to-jupyterhub.readthedocs.io>



<http://denero.org/data-8-in-spring-2017.html>

<https://github.com/data-8/jupyterhub-k8s>

<http://data8.org/>

<http://data.berkeley.edu/>

<http://data.berkeley.edu/about/videos>



# Where we are



0.7 - 12/2016

- introduce **Services**
- Anything that can talk to the Hub's API that's not a **User**
- **Managed Service:** A process started by the Hub
- **External Service:** Anything not started by the Hub  
(may or may not be a process)

Where  
we are



## 0.7 Services can...

- run a web service at /services/:service-name
- authenticate requests with the **Hub** via **HubAuth**
- talk to the **Hub API** with their **API token(s)**



Where  
we are

# 0.7 Services are for...

- interacting with the **Hub**
- nbgrader formgrader
- culling idle servers
- sharing files
- shared notebook server(s)
- nbviewer

# Where we are going

JupyterHub

0.8



# Where we are going



## 0.8

- abstract **Proxy** API
- define spec and Python API for Hub's proxy needs
- Better support nginx, kubernetes proxies
- Requires moving activity tracking to single-user servers (done in notebook 5.0)

# Where we are going



0.8

- multiple **servers** per user
  - useful when single **Hub** exposes a variety of computational resources (clusters)
  - servers can have different configurations (different Spawners?)
  - need to keep common single server-per-user case well supported, to avoid overcomplicating things
  - contributions started by Christian Barra

# Where we are going



## OAuth

- JupyterHub as **OAuth provider**
  - removes need for complicated cookie management by the Hub
  - Will be needed as number of endpoints for which users are authorized grows (shared servers for collaboration)

Where  
we are  
going

# HubShare

- **Service** for sharing
- unit of sharing: directory
- push/pull model
- simple REST spec (possibly WebDAV)
- share with individuals, groups
- target use case: nbgrader assignments

<https://github.com/jupyterhub/hubshare>



Live  
Code on  
Binder



# LIGO Binder

The screenshot shows the LIGO Binder interface. At the top is the binder logo, followed by the text "Turn a GitHub repo into a collection of interactive notebooks". Below this, a subtext explains: "Have a repository full of Jupyter notebooks? With Binder, open those notebooks in an executable environment, making your code immediately reproducible by anyone, anywhere." A large central box contains fields for "GitHub repo or URL" (set to <https://github.com/minrk/ligo-binder.git>), "Git branch, tag, or commit" (set to "master"), and "Path to a notebook file (Optional)" (set to "index.ipynb"). A "Launch" button is to the right of these fields. Below the form is a progress bar with segments labeled "Waiting", "Already built!", and "Launching". At the bottom is a "Build logs" section with a "show" link.

<https://losc.ligo.org/tutorials/>  
<https://beta.mybinder.org/v2/gh/minrk/ligo-binder/master?filepath=index.ipynb>

# Agenda

- Gateways
- Jupyter Notebook
- JupyterHub
- JupyterLab
- Next steps

# Building Blocks



**File Browser**

**Notebooks**

**Terminal**

**Text Editor**

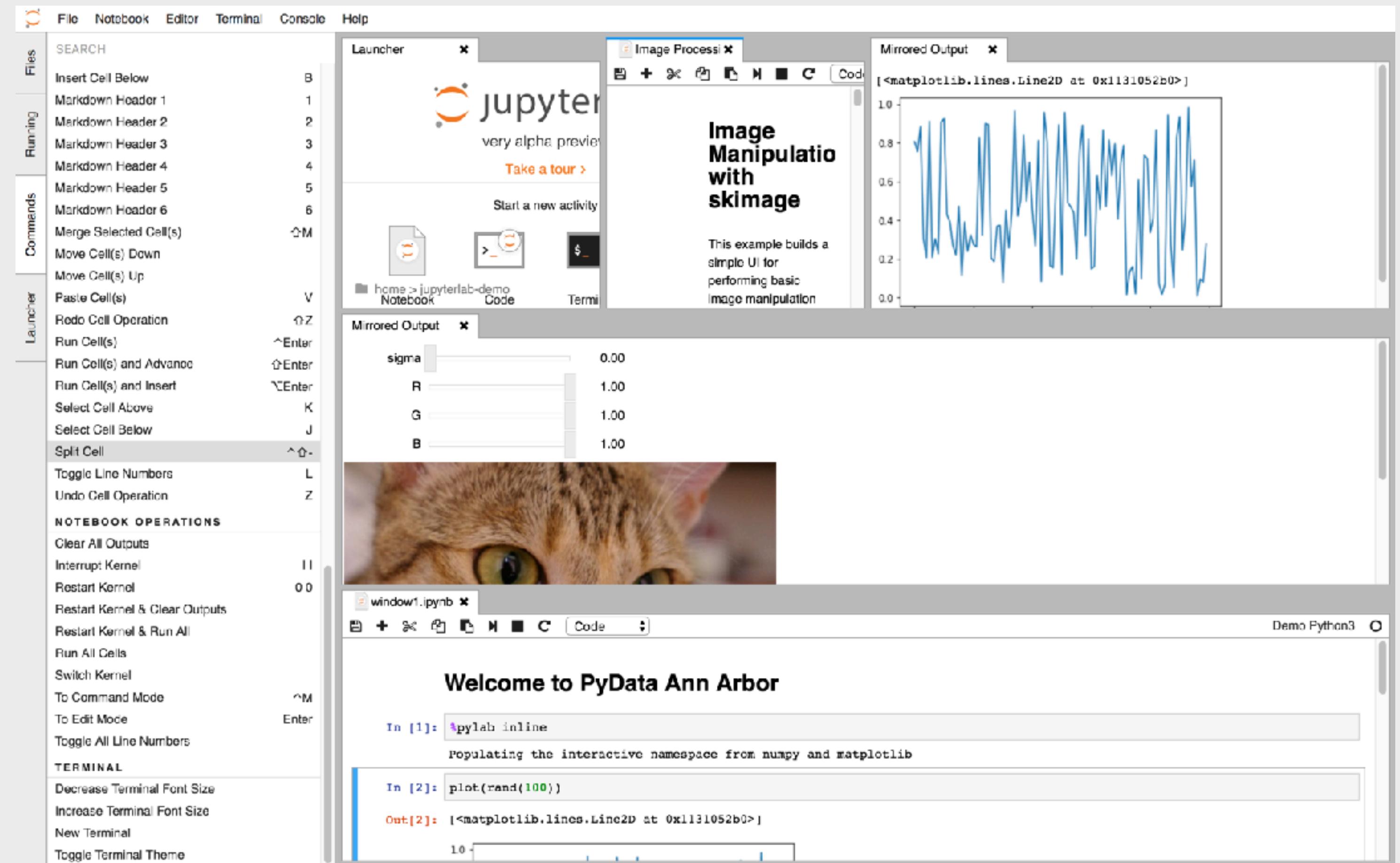
**Kernels**

**Output**

# Introducing JupyterLab (almost beta)



# JupyterLab



<https://github.com/jupyterlab/jupyterlab>

Try JupyterLab <https://github.com/jupyterlab/jupyterlab#installation>

# Learn more about JupyterLab

PyData Seattle: [https://www.youtube.com/watch?v=tHZT\\_mpNRcY](https://www.youtube.com/watch?v=tHZT_mpNRcY)

Demo from SciPy 2017: <https://youtu.be/X8zPuBu22Y4?t=44m50s>

<http://pyvideo.org/pydata-dc-2016/jupyterlab-building-blocks-for-interactive-computing.html>



# Agenda

- Gateways
- Jupyter Notebook
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- JupyterLab
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# Call to action

- Join **Jupyter** mailing lists
- Participate in a **sprint**
- Give a **talk** or **write** a post
- Offer a **workshop**
- **Contribute** to a favorite project
- **Share** your trials and successes



# Resources



jupyter.org

pyvideo.org

jupyter google  
groups and  
Gitter

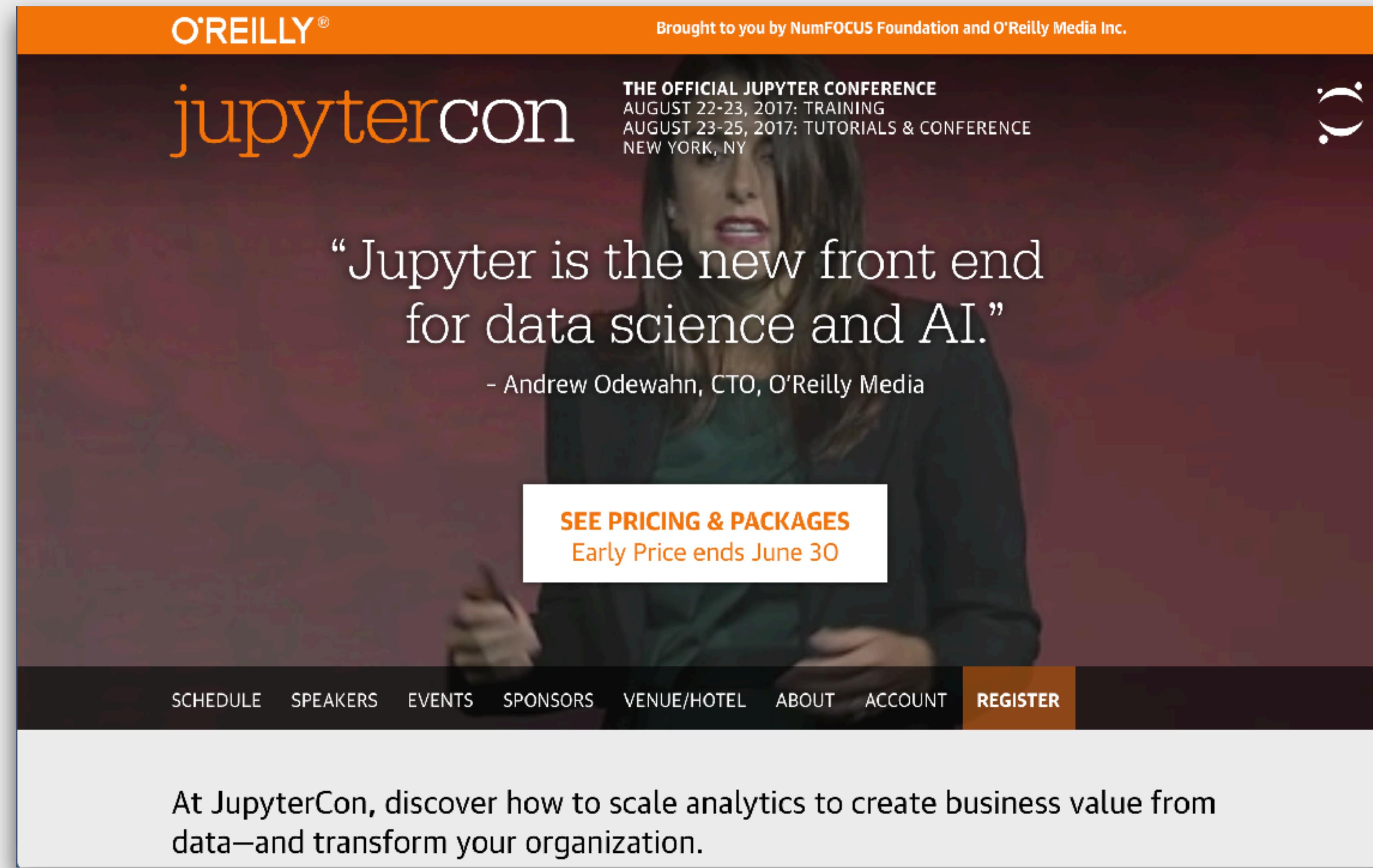
try.jupyter.org

Trending  
notebooks  
on GitHub

nbviewer

# JupyterCon, August 2017, NYC

<https://conferences.oreilly.com/jupyter/jup-ny>



The image shows the homepage of the JupyterCon conference website. At the top, the O'Reilly logo is on the left and a note says "Brought to you by NumFOCUS Foundation and O'Reilly Media Inc." On the right is a small circular logo with a stylized 'C'. The main title "jupytercon" is prominently displayed in large orange letters. Below it, event details are listed: "THE OFFICIAL JUPYTER CONFERENCE AUGUST 22-23, 2017: TRAINING AUGUST 23-25, 2017: TUTORIALS & CONFERENCE NEW YORK, NY". A quote from Andrew Odewahn follows: "Jupyter is the new front end for data science and AI." - Andrew Odewahn, CTO, O'Reilly Media. A call-to-action button in the center says "SEE PRICING & PACKAGES Early Price ends June 30". At the bottom, a navigation bar includes links for SCHEDULE, SPEAKERS, EVENTS, SPONSORS, VENUE/HOTEL, ABOUT, ACCOUNT, and a highlighted "REGISTER" button. A footer message encourages attendees to "discover how to scale analytics to create business value from data—and transform your organization."

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Brought to you by NumFOCUS Foundation and O'Reilly Media Inc.

jupytercon

THE OFFICIAL JUPYTER CONFERENCE  
AUGUST 22-23, 2017: TRAINING  
AUGUST 23-25, 2017: TUTORIALS & CONFERENCE  
NEW YORK, NY

“Jupyter is the new front end  
for data science and AI.”

- Andrew Odewahn, CTO, O'Reilly Media

SEE PRICING & PACKAGES  
Early Price ends June 30

SCHEDULE SPEAKERS EVENTS SPONSORS VENUE/HOTEL ABOUT ACCOUNT REGISTER

At JupyterCon, discover how to scale analytics to create business value from data—and transform your organization.

# WE'RE OPEN FOR YOU.



# Thank you

@willingcarol

[try.jupyter.org](http://try.jupyter.org)

[www.jupyter.org](http://www.jupyter.org)

[ipython.org](http://ipython.org)

[numfocus.org](http://numfocus.org)



# Attributions and recognition



- Kristen Thyng
- San Diego Python
- Demba Ba
- Project Jupyter team and community
- Photo credits on individual slides



# Thank you for participating!

- Please share your feedback through our 30-second evaluation:  
<http://sciencegateways.org/webinareval>
- Join us next month (August 9)

## **Interactive Best Practices: Job Management & Scheduling**

*Presented by Miron Livny and Todd Tannenbaum (Condor Project), Mark Miller (CIPRES), Sudhakar Pamidighantam (SEAggrid), and others*

- Upcoming opportunities for students/educators: <http://sciencegateways.org/engage/student-focused>