Introduction to Jupyter Notebook

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Unidata Python Workshop

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Overview

- Brief overview of Jupyter Notebook
  - What is it?
  - How do you use it?

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- Examples of basic Jupyter Notebook Usage.
- Discuss some Advanced Jupyter Notebook Uses.

Overview

- *We* will not be going too in-depth with what you can do in regards to using Jupyter Notebooks for actual science.

What is Jupyter Notebook?

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. (http://jupyter.org)

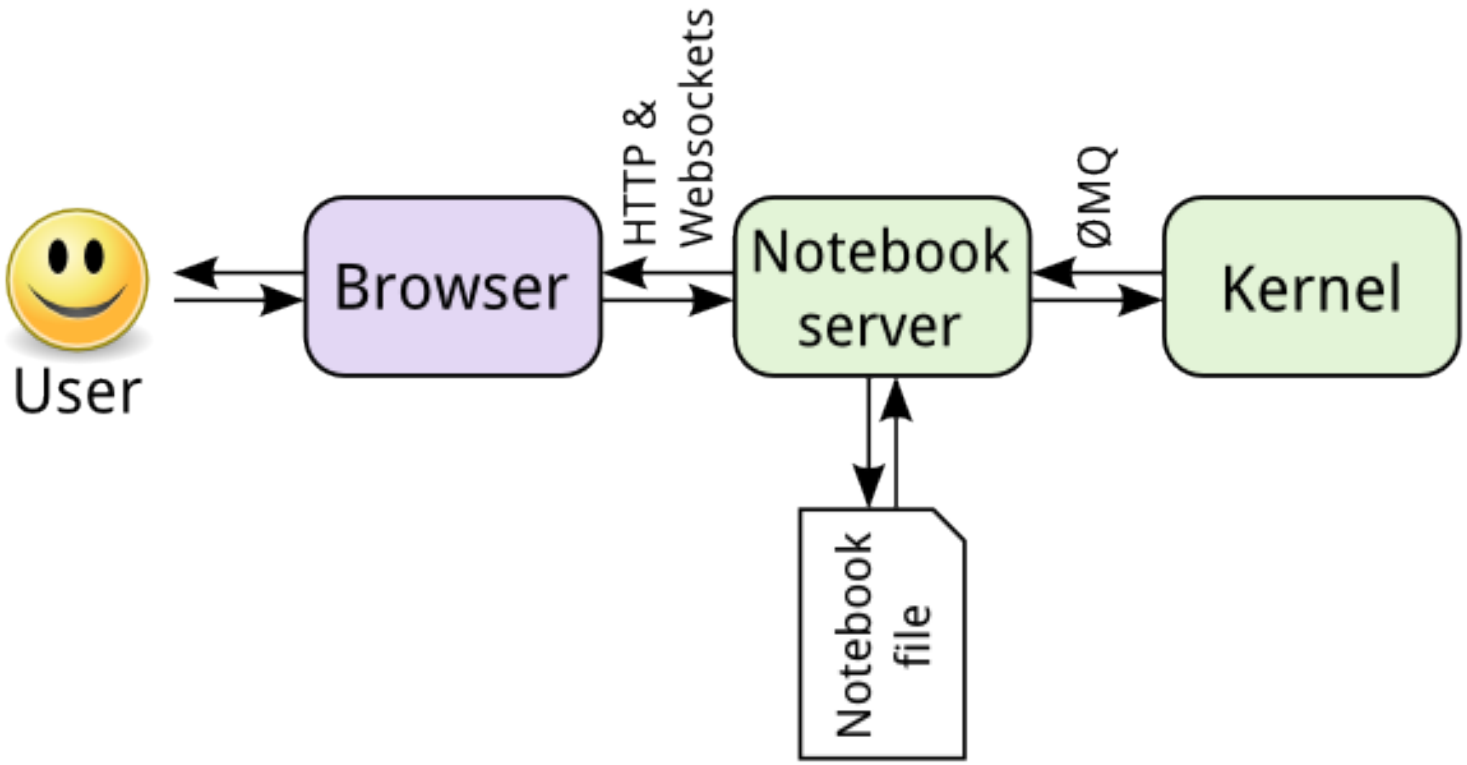
What is Jupyter Notebook?

Alternatively: Jupyter Notebook is an interactive computing environment that enables users to author notebook documents that include:

- Live code
- Interactive widgets
- Plots
- Narrative text
- Equations
- Images
- Video

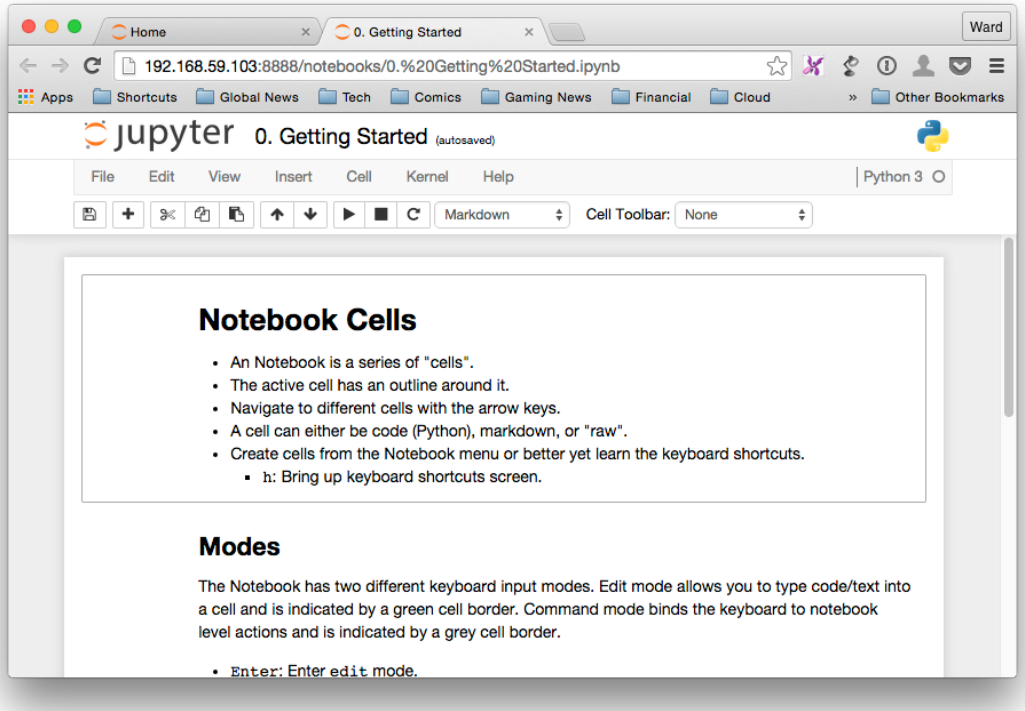
These documents provide a complete and self-contained record of a computation that can be converted to various formats and shared with others using email, Dropbox, version control systems (like git/GitHub) or nbviewer.jupyter.org.

Jupyter Notebook Components



Jupyter Notebook document

- A Jupyter Notebook is a collection of *cells*.



Jupyter Notebook document

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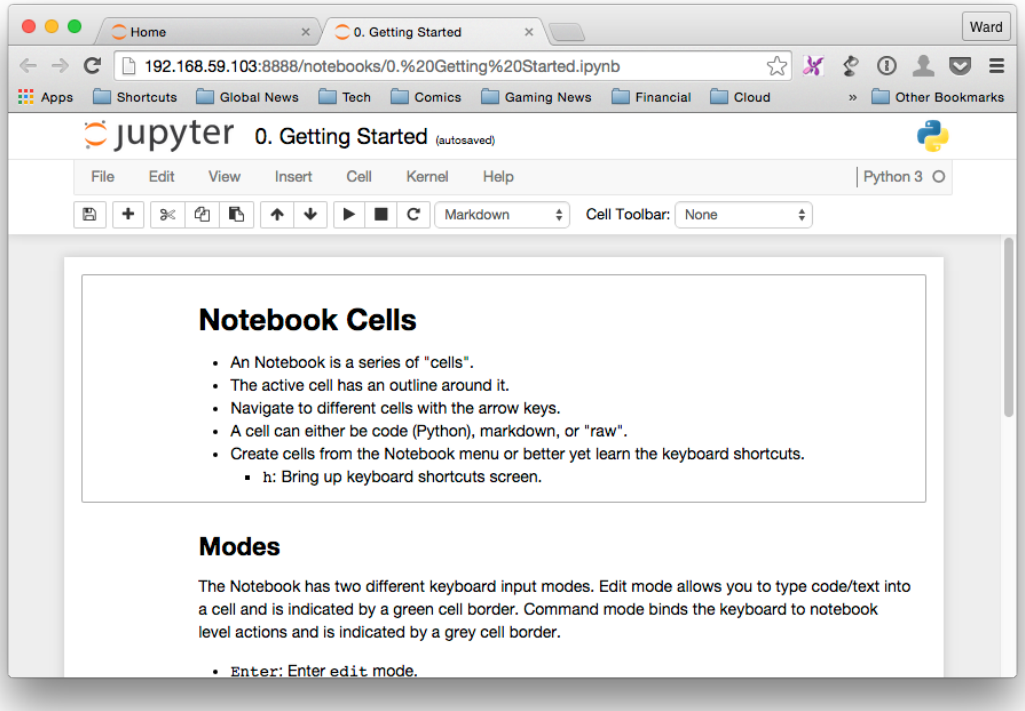
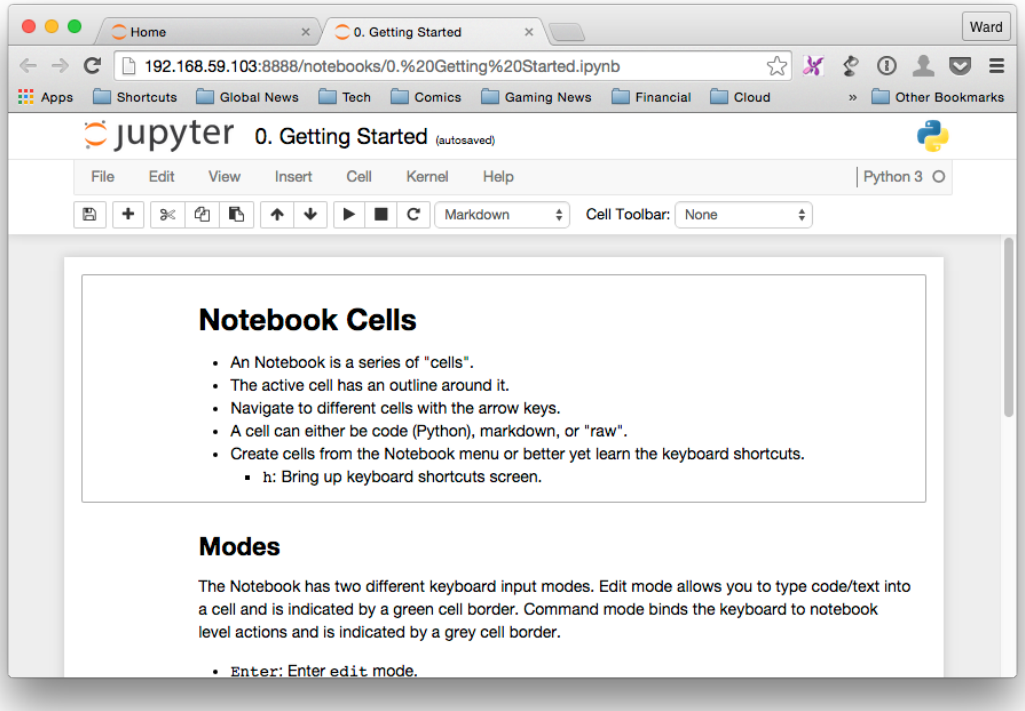
  - Markdown



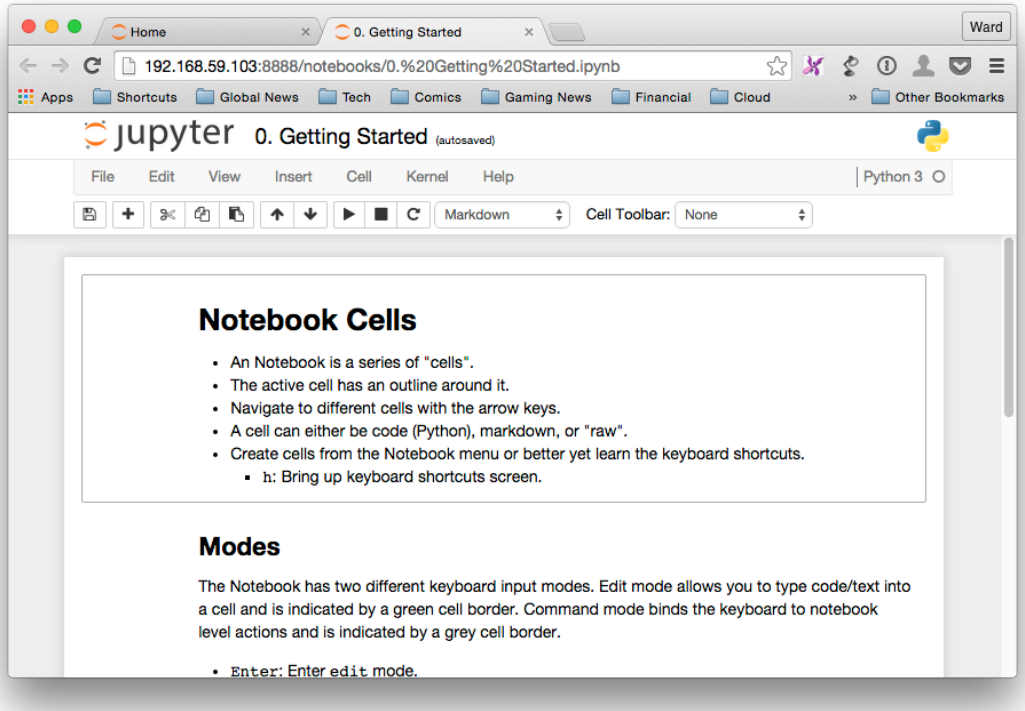
Jupyter Notebook document

- A Jupyter Notebook is a collection of *cells*.
  - Markdown
  - Code

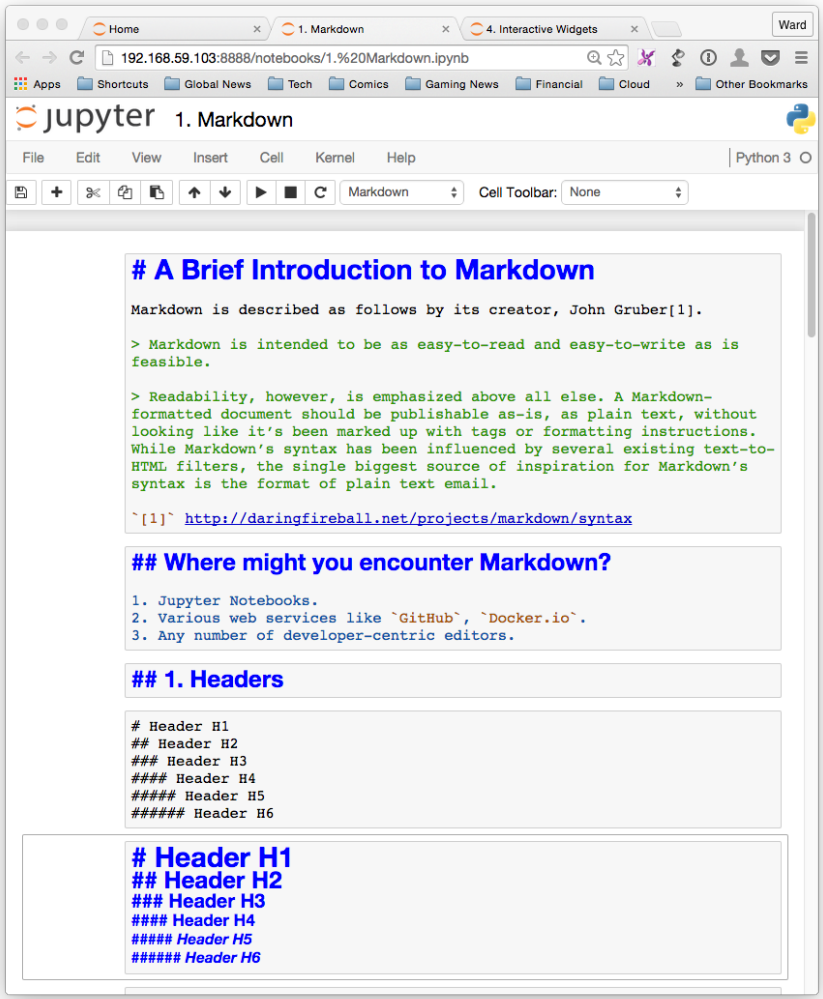


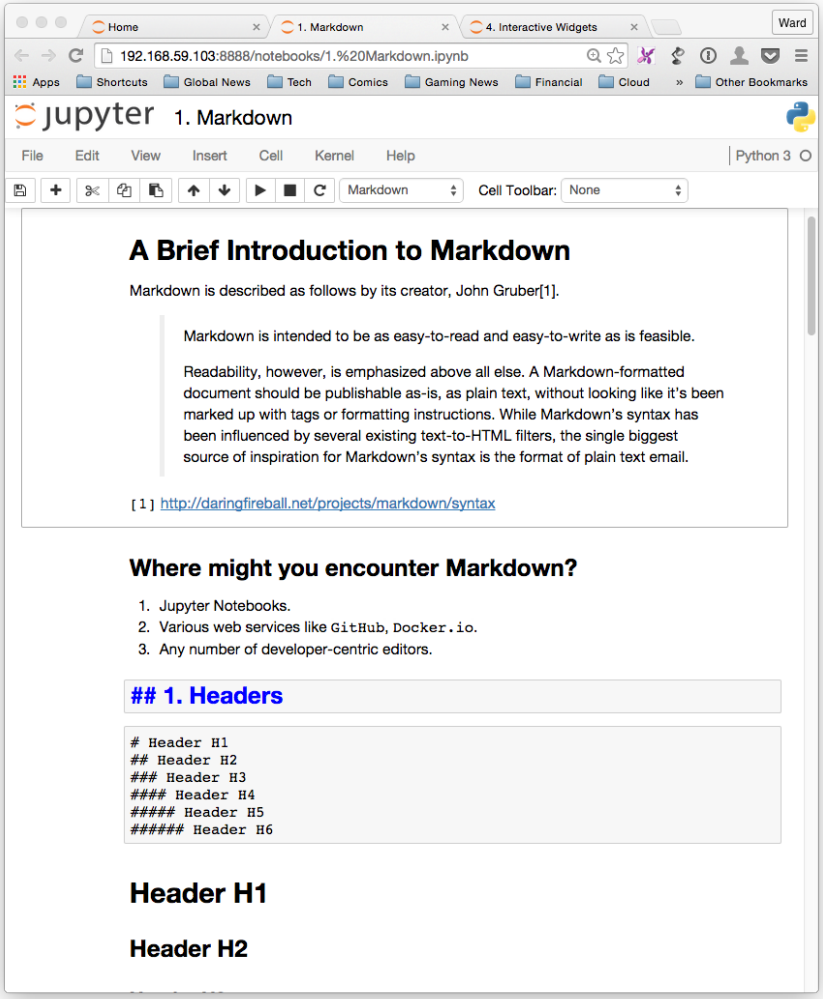
Jupyter Notebook document

- A Jupyter Notebook is a collection of *cells*.
  - Markdown
  - Code
  - “Raw” - Raw cells are left ‘as is’ and are not processed.



Markdown Cells





Code Cells

jupyter CompositeRadar (unsaved changes)

File Edit View Insert Cell Kernel Widgets Help | Python 3

Markdown | CellToolbar

```
data = np.ma.array(data, mask=data<=-30)
```

Create the Plot

In [ ]:

```
# Set up the projection for the LambertConformal projection we know we have
lcc = cartopy.crs.LambertConformal(central_longitude=lon_0, central_latitud
                                   standard_parallels=(lat_0, lat_1))

# Create a large figure and axes with this projection
fig = plt.figure(figsize=(24, 12))
ax = fig.add_subplot(1, 1, 1, projection=lcc)

# Limit to the bounds of the data we have
ax.set_extent([-129., -63., 22., 49.], cartopy.crs.Geodetic())

# Add some map features
ax.stock_img()
ax.coastlines(resolution='50m')
ax.add_feature(cartopy.feature.NaturalEarthFeature(category='cultural',
                                                   name='admin_1_states_pro
                                                   scale='50m', facecolor='
ax.add_feature(cartopy.feature.BORDERS, linewidth='2', edgecolor='black')
ax.gridlines()

# Convert the time to text and add as the title
time = dataset.variables["time"][:][0] / 1000.
title = dt.datetime.fromtimestamp(time).isoformat()
ax.set_title(title)

# Plot the data as an image, using the x and y values we have as the extent
# NOTE: This assumes equal-spaced points
cmap = ctables.registry.get_colortable('NWSReflectivityExpanded')
norm = mpl.colors.Normalize(vmin=-35, vmax=80)
cax = ax.imshow(data, extent=(x.min(), x.max(), y.min(), y.max()), cmap=cma
                norm=norm, origin="upper", transform=lcc)
plt.colorbar(cax);
```

Exercise

Using what was done above, plot the digital hybrid reflectivity (DHR):

- Look at http://thredds.ucar.edu/thredds/catalog/nexrad/composite/gini/catalog.html
- Instead of plotting over all of the U.S., limit to an area of interest
- DHR was chosen to keep the colormap from the NWS the same. Can also look at:
  - Echo Tops (EET)
  - Digital VIL (DVL)

jupyter CompositeRadar (unsaved changes)

File Edit View Insert Cell Kernel Widgets Help | Python 3

Code | CellToolbar

In [10]:

```
# Set up the projection for the LambertConformal projection we know we have
lcc = cartopy.crs.LambertConformal(central_longitude=lon_0, central_latitude=lat_0,
                                   standard_parallels=(lat_0, lat_1))

# Create a large figure and axes with this projection
fig = plt.figure(figsize=(24, 12))
ax = fig.add_subplot(1, 1, 1, projection=lcc)

# Limit to the bounds of the data we have
ax.set_extent([-129., -63., 22., 49.], cartopy.crs.Geodetic())

# Add some map features
ax.stock_img()
ax.coastlines(resolution='50m')
ax.add_feature(cartopy.feature.NaturalEarthFeature(category='cultural',
                                                   name='admin_1_states_provinces_lines',
                                                   scale='50m', facecolor='none'))
ax.add_feature(cartopy.feature.BORDERS, linewidth='2', edgecolor='black')
ax.gridlines()

# Convert the time to text and add as the title
time = dataset.variables["time"][:][0] / 1000.
title = dt.datetime.fromtimestamp(time).isoformat()
ax.set_title(title)

# Plot the data as an image, using the x and y values we have as the extents of the image
# NOTE: This assumes equal-spaced points
cmap = ctables.registry.get_colortable('NWSReflectivityExpanded')
norm = mpl.colors.Normalize(vmin=-35, vmax=80)
cax = ax.imshow(data, extent=(x.min(), x.max(), y.min(), y.max()), cmap=cmap,
                norm=norm, origin="upper", transform=lcc)
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```
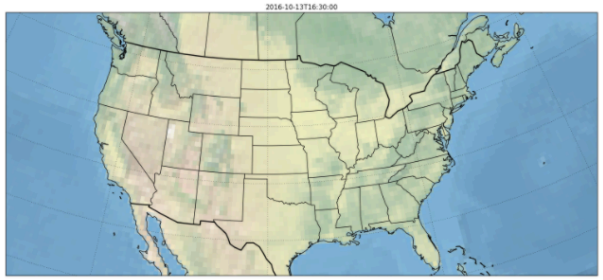
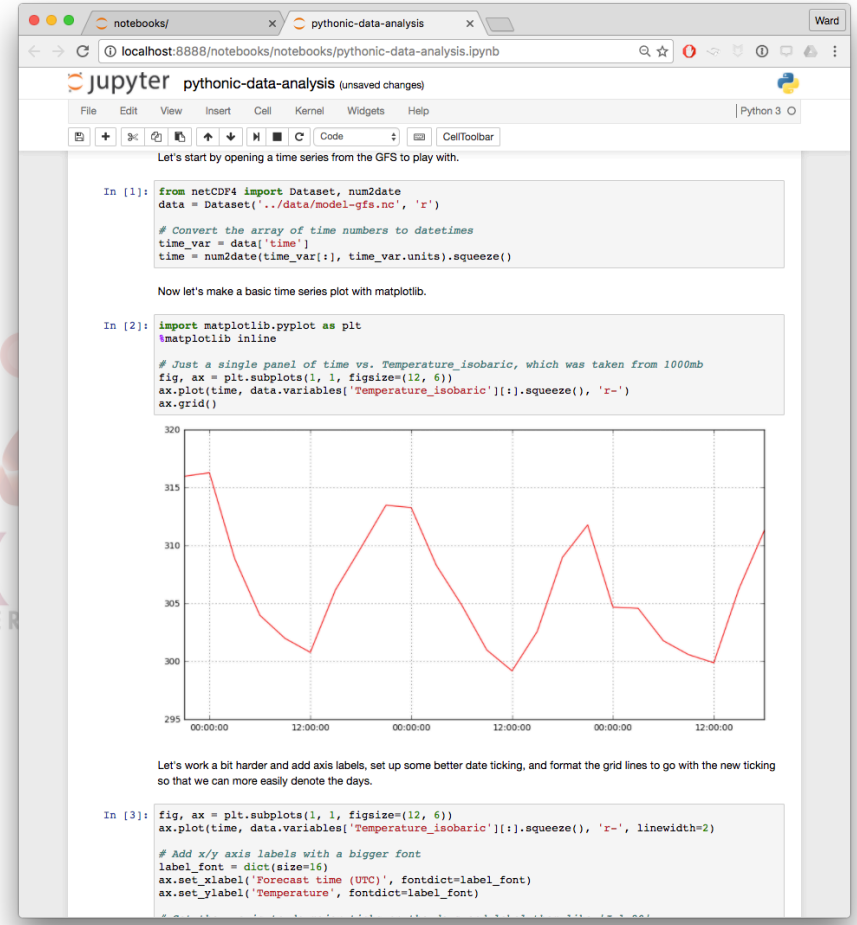



What does this get you?

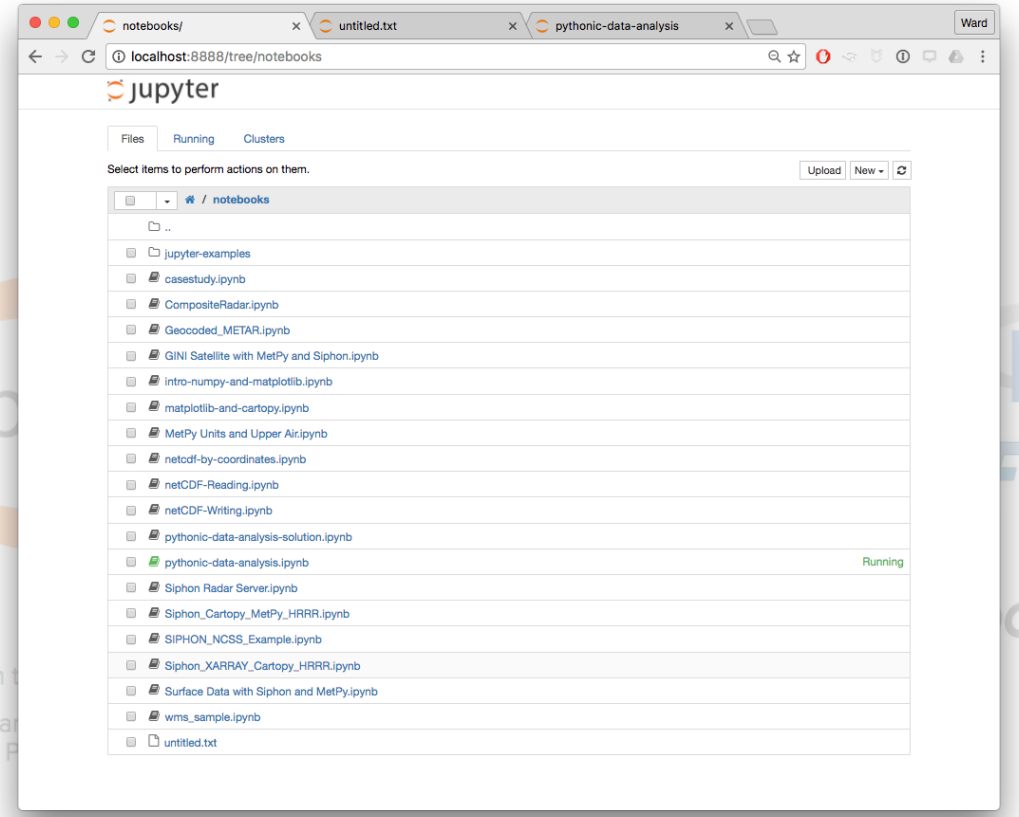
- A sharable document with embedded, reproducible experimental data analysis.



Evolved from the IPython Project

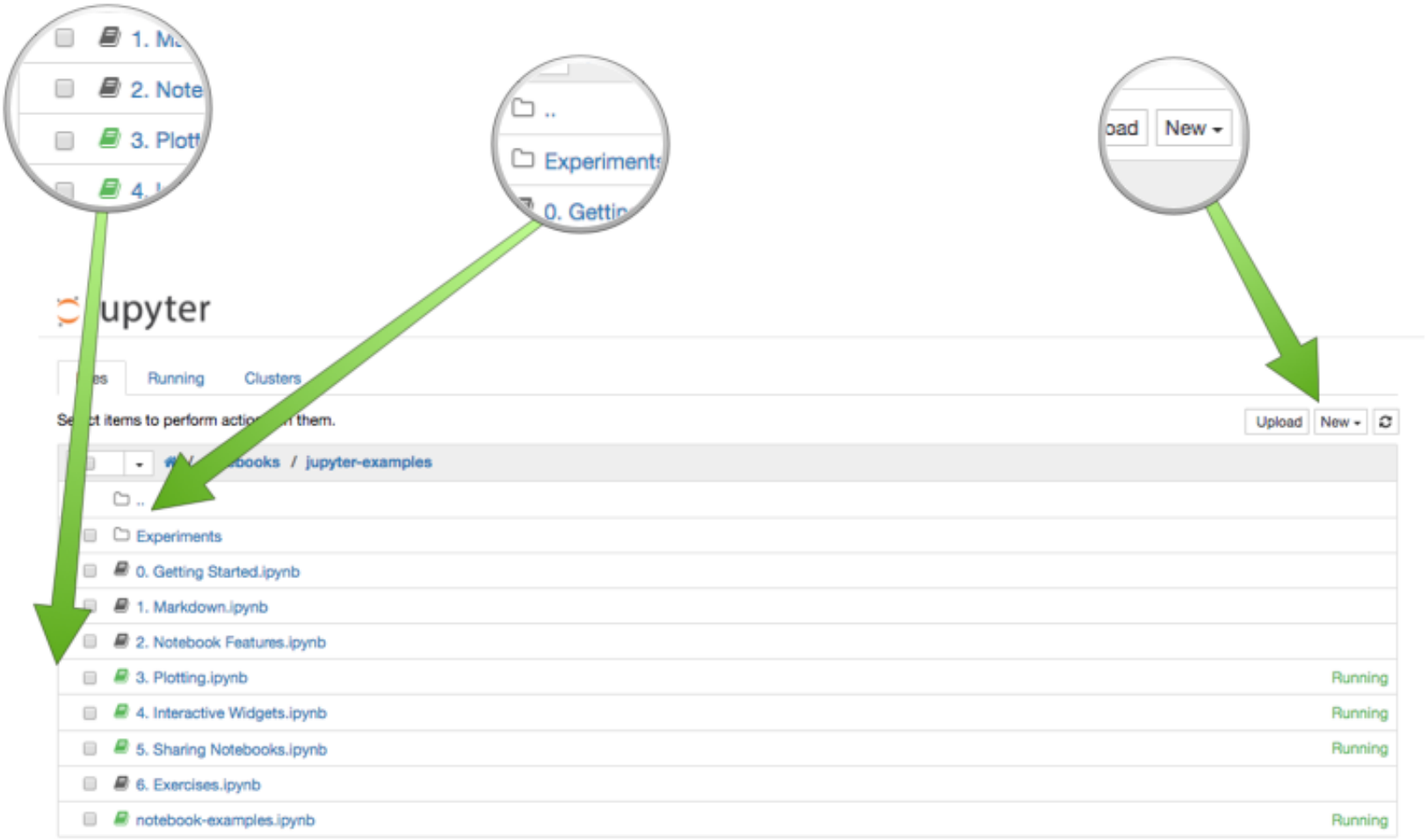
The language-agnostic parts of IPython are getting a new home in Project Jupyter

Jupyter Web Application



- The Jupyter Web application acts as a dashboard for collections of individual notebooks.

Jupyter Web Application



Installing Jupyter

- The easiest way to install Jupyter notebook is with a package manager like “miniconda”
  - http://conda.pydata.org/miniconda.html

```
$ conda install jupyter
```

Using the Jupyter Web Application

- Once installed, `jupyter notebook` is is launched via the command line.

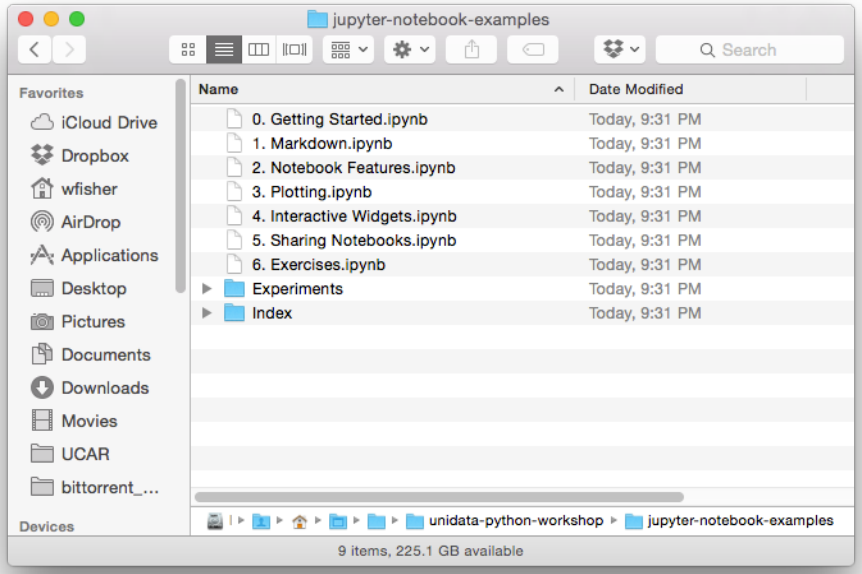
```
$ jupyter notebook
```

Using the Jupyter Web Application

- There are a number of command-line options for advanced usage.
  - Security-related options.
  - Working directory.
  - Default behavior.
  - etc.

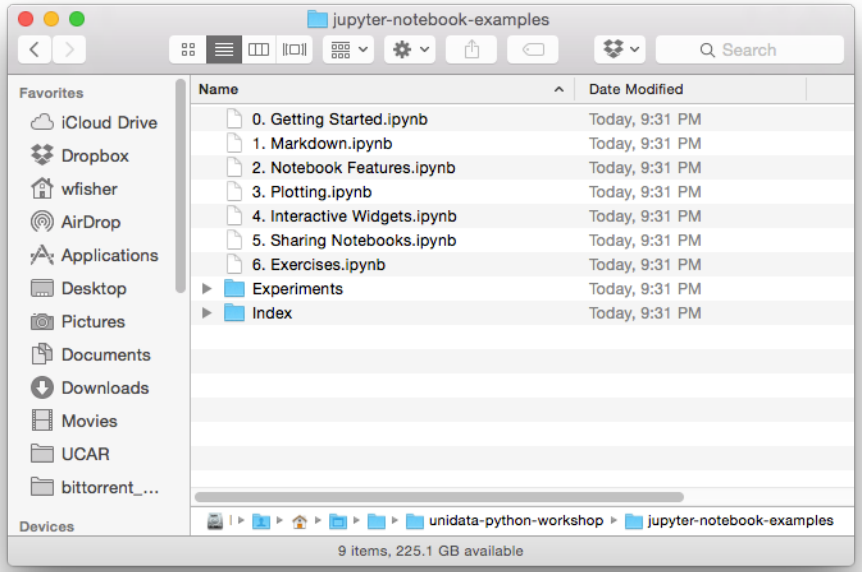
```
$ jupyter notebook [options]
```

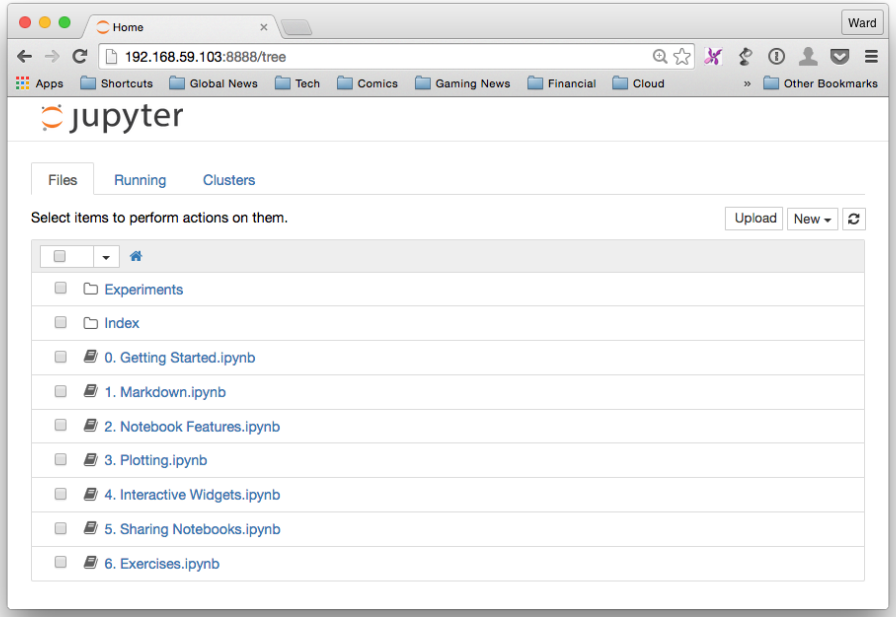
Using the Jupyter Web Application



- Notebooks are arranged by directory.
- Jupyter Notebook in invoked at the root of this directory structure.

Using the Jupyter Web Application





Using the Jupyter Web Application

Switching to the Browser.