I.CapabilityDemos

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#
Jupyter Notebooks in Action
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Notebooks @ https://github.com/chritter/Talks/blob/master/VicPiMakers

0.1 Setting up Jupyter

- Notebook server start with `jupyter notebook`
- Jupyter Notebook App starts dashboard
- Port of choice
- separate configuration files
- GUI through browser
- Notebooks are in JSON format and human readable (metadata editable)
- Configuration: jupyter_notebook_config.py
- Support:
  - Chrome
  - Safari
  - Firefox

```
In [2]: %connect_info
```

```
{
  "shell_port": 57169,
  "iopub_port": 57170,
  "stdin_port": 57171,
  "control_port": 57172,
  "hb_port": 57173,
  "ip": "127.0.0.1",
  "key": "7129c1b9-3861abc347f06587e0025eef",
  "transport": "tcp",
  "signature_scheme": "hmac-sha256",
  "kernel_name": ""
}

Paste the above JSON into a file, and connect with:
    $> jupyter <app> --existing <file>
```

```
or, if you are local, you can connect with just:
    $> jupyter <app> --existing kernel-2b1ffd81-ea8d-4ffa-b20e-b1bb863c5d21.json
or even just:
    $> jupyter <app> --existing
if this is the most recent Jupyter kernel you have started.
```

0.2 Standard capabilities

0.2.1 Basic Python

- Only execution of one cell at a time
- Serves as analysis, analytics platform but not for software development
- Basic cell types are code cells and markdown cells

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

```
3
```

Standard markdown Markdown * Test `Test` ***Test***
and Latex
$\int_0^3 x^2 dx$

```
In [4]: import pandas as pd
        pd.DataFrame({'aa':[1,2,3],'bb':[2,3,4]})
```

```
Out[4]:    aa  bb
        0   1   2
        1   2   3
        2   3   4
```

0.2.2 Plotting

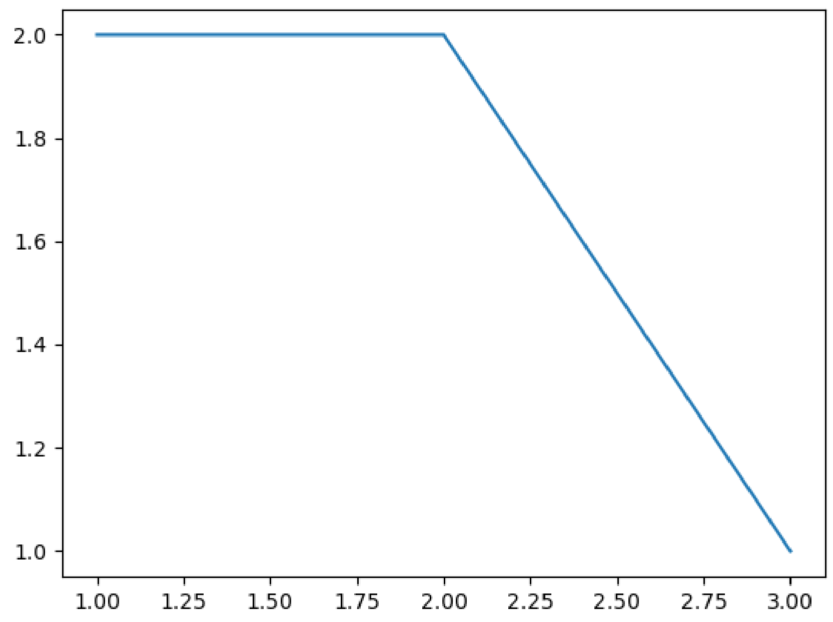
- Supports standard plotting capabilities of Python
- Supports different backends such as the interactive `nbagg` backend

```
In [5]: import matplotlib.pyplot as plt
        %matplotlib nbagg
```

```
In [6]: plt.plot([1,2,3],[2,2,1])
        plt.savefig('line_plot.png')
```

```
<IPython.core.display.Javascript object>
```

```
<IPython.core.display.HTML object>
```



rendering images

0.2.3 Converting to other formats

- Use GUI `File` tab
- Command line via `nbconvert`

```
In [8]: %%bash
        jupyter nbconvert CapabilityDemos.ipynb --to python  #--to pdf
```

```
This application is used to convert notebook files (*.ipynb) to various other
formats.

WARNING: THE COMMANDLINE INTERFACE MAY CHANGE IN FUTURE RELEASES.

Options
-------

Arguments that take values are actually convenience aliases to full
Configurables, whose aliases are listed on the help line. For more information
on full configurables, see '--help-all'.

--debug
    set log level to logging.DEBUG (maximize logging output)
--generate-config
    generate default config file
-y
    Answer yes to any questions instead of prompting.
--execute
```

```
    Execute the notebook prior to export.
--allow-errors
    Continue notebook execution even if one of the cells throws an error and include the error m
--stdin
    read a single notebook file from stdin. Write the resulting notebook with default basename '
--stdout
    Write notebook output to stdout instead of files.
--inplace
    Run nbconvert in place, overwriting the existing notebook (only
    relevant when converting to notebook format)
--no-prompt
    Exclude input and output prompts from converted document.
--log-level=<Enum> (Application.log_level)
    Default: 30
    Choices: (0, 10, 20, 30, 40, 50, 'DEBUG', 'INFO', 'WARN', 'ERROR', 'CRITICAL')
    Set the log level by value or name.
--config=<Unicode> (JupyterApp.config_file)
    Default: ''
    Full path of a config file.
--to=<Unicode> (NbConvertApp.export_format)
    Default: 'html'
    The export format to be used, either one of the built-in formats, or a
    dotted object name that represents the import path for an `Exporter` class
--template=<Unicode> (TemplateExporter.template_file)
    Default: ''
    Name of the template file to use
--writer=<DottedObjectName> (NbConvertApp.writer_class)
    Default: 'FilesWriter'
    Writer class used to write the  results of the conversion
--post=<DottedOrNone> (NbConvertApp.postprocessor_class)
    Default: ''
    PostProcessor class used to write the results of the conversion
--output=<Unicode> (NbConvertApp.output_base)
    Default: ''
    overwrite base name use for output files. can only be used when converting
    one notebook at a time.
--output-dir=<Unicode> (FilesWriter.build_directory)
    Default: ''
    Directory to write output(s) to. Defaults to output to the directory of each
    notebook. To recover previous default behaviour (outputting to the current
    working directory) use . as the flag value.
--reveal-prefix=<Unicode> (SlidesExporter.reveal_url_prefix)
    Default: ''
    The URL prefix for reveal.js. This can be a a relative URL for a local copy
    of reveal.js, or point to a CDN.
    For speaker notes to work, a local reveal.js prefix must be used.
--nbformat=<Enum> (NotebookExporter.nbformat_version)
    Default: 4
    Choices: [1, 2, 3, 4]
    The nbformat version to write. Use this to downgrade notebooks.

To see all available configurables, use `--help-all`

Examples
--------

    The simplest way to use nbconvert is

    > jupyter nbconvert mynotebook.ipynb

    which will convert mynotebook.ipynb to the default format (probably HTML).

    You can specify the export format with `--to`.
    Options include ['asciidoc', 'custom', 'html', 'html_ch', 'html_embed', 'html_toc', 'html_wi

    > jupyter nbconvert --to latex mynotebook.ipynb

    Both HTML and LaTeX support multiple output templates. LaTeX includes
    'base', 'article' and 'report'.  HTML includes 'basic' and 'full'. You
    can specify the flavor of the format used.

    > jupyter nbconvert --to html --template basic mynotebook.ipynb

    You can also pipe the output to stdout, rather than a file

    > jupyter nbconvert mynotebook.ipynb --stdout

    PDF is generated via latex

    > jupyter nbconvert mynotebook.ipynb --to pdf

    You can get (and serve) a Reveal.js-powered slideshow

    > jupyter nbconvert myslides.ipynb --to slides --post serve

    Multiple notebooks can be given at the command line in a couple of
    different ways:

    > jupyter nbconvert notebook*.ipynb
    > jupyter nbconvert notebook1.ipynb notebook2.ipynb

    or you can specify the notebooks list in a config file, containing::

        c.NbConvertApp.notebooks = ["my_notebook.ipynb"]

    > jupyter nbconvert --config mycfg.py
```

```
[NbConvertApp] WARNING | pattern 'CapabilityDemos.ipynb' matched no files
```

0.2.4 Processing kernels

- A variety of kernels allow to run Python2/3, Bash, R, Scala: https://github.com/jupyter/jupyter/wiki/Jupyter-kernels
- `Kernel` menu
- `RNotebook.ipynb`

0.2.5 Shell commands

```
In [9]: !ls -ltr
```

```
total 2216
-rw-r--r--  1 christian  staff      49 24 Mar 08:32 utils.py
-rw-r--r--  1 christian  staff   50147 24 Mar 08:58 RNotebook.ipynb
-rw-r--r--  1 christian  staff    4160 24 Mar 10:18 CapabilityDemos.py
-rw-r--r--  1 christian  staff       4 24 Mar 10:46 test.txt
-rw-r--r--  1 christian  staff       0 24 Mar 10:47 untitled.txt
-rw-r--r--  1 christian  staff    2305 24 Mar 11:02 II. OtherApplications.ipynb
-rw-r--r--  1 christian  staff    7695 29 Mar 09:32 III. JupyterLab.ipynb
-rw-r--r--  1 christian  staff  149353 29 Mar 09:33 I. CapabilityDemos.ipynb
-rw-r--r--@ 1 christian  staff  368032 29 Mar 09:34 I.+CapabilityDemos (1).html
-rw-r--r--@ 1 christian  staff  252674 29 Mar 09:34 II.+OtherApplications.html
-rw-r--r--@ 1 christian  staff  257636 29 Mar 09:35 III.+JupyterLab.html
-rw-r--r--  1 christian  staff    1262 29 Mar 09:36 TestNotebookDependency.ipynb
-rw-r--r--  1 christian  staff   13215 29 Mar 09:36 line_plot.png
```

0.2.6 Notebook magic

```
In [10]: %%
         #Other magic commands available:
         a = [i for i in range(100000000)]
```

```
ERROR:root:Cell magic `%%` not found.
```

Default kernel for notebook plus kernel can be switched via magic commands

0.2.7 Executing external code

```
In [11]: %run utils.py
```

```
In [12]: !cat utils.py
```

```
def test_func():
    print('executed test_func')
```

```
In [13]: test_func()
```

```
executed test_func
```

0.2.8 Security

- Trusted notebooks: signature in notebook metadata ensures safe execution

  `jupyter trust mynotebook.ipynb`

- Password protection through jupyter_notebook_config.py

```
In [14]: #from notebook.auth import passwd
         #passwd()
```

0.2.9 Workflow

- Create notebook/project (github?)
- Create reproducable analysis (beware of random numbers)
- Add layouts, organization
- Publish/Share

0.2.10 Deploying Notebooks

- Viewer for notebooks @ https://nbviewer.jupyter.org/
- Run your own Jupyter server in the cloud.
- Rendering on GitHub

0.2.11 Presenting results

- https://damianavila.github.io/RISE/
- https://github.com/Anaconda-Platform/nbpresent#install

0.2.12 Reading from other Jupyter notebooks

Disadvantage: Notebooks are typically separate workflows.

```
In [15]: import json
```

```
In [16]: f1 = open('TestNotebookDependency.ipynb')
         lines=f1.readlines()
         f1.close()

         str_dum = ''
         for l in lines:
             str_dum +=l
```

```
In [17]: d = json.loads(str_dum)

In [18]: d['cells']

Out[18]: [{'cell_type': 'markdown',
           'metadata': {},
           'source': ['# Test for I. CapabilityDemos.ipynb']},
          {'cell_type': 'code',
           'execution_count': 5,
           'metadata': {'collapsed': True},
           'outputs': [],
           'source': ['time = 3. #s\n', 'distance = 5. #m']},
          {'cell_type': 'code',
           'execution_count': 6,
           'metadata': {},
           'outputs': [{'data': {'text/plain': ['1.6666666666666667']},
             'execution_count': 6,
             'metadata': {},
             'output_type': 'execute_result'}],
           'source': ['velocity = distance/time #m/s\n', 'velocity']},
          {'cell_type': 'code',
           'execution_count': None,
           'metadata': {'collapsed': True},
           'outputs': [],
           'source': []}]

In [19]: for cell in d['cells']:
             if len(cell['source'])>0:
                 if 'velocity' in cell['source'][-1]:
                     print(cell['outputs'][0]['data']['text/plain'])

['1.6666666666666667']
```

0.2.13 Youtube

```
In [20]: from IPython.display import YouTubeVideo

In [21]: #https://www.youtube.com/watch?v=Iuj9vLOvVJo
         YouTubeVideo("Iuj9vLOvVJo")

   Out[21]:
```

0.2.14 Widgets

- Interactive widgets (buttons, levels etc.) at http://jupyter.org/widgets
- Easy integration with existing code, e.g. functions

```
In [22]: from ipywidgets import interactive
         def myfunction(x):
             return x
         w = interactive(myfunction, x= "Hello World ");
         from IPython.display import display
         display(w)
```

```
interactive(children=(Text(value='Hello World ', description='x'), Output()), _dom_classes=('wid
```

- Building complex widgets: http://nugrid.github.io/NuPyCEE/webinterface.html

0.2.15 Notebook Extensions

- Community adds new extensions
- Many extensions available but beware of compatibility