Jupyter Notebook Tutorial Presentation

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This is a Jupyter Notebook tutorial. Presented at CMPS263 Winter 2017.

The tutorial will include:

- Jupyter Notebook built-in commands
- Use code cell to help visualize data
- Use markdown cell to keep notes
- Export ipynb file to other format

1. Jupyter Notebook Built-in Commands

i. Use Jupyter as a terminal

In [1]:
```
pwd
```

Out[1]:
```
u'/home/wjh/Jupyter_tutorial'
```

In [2]:
```
ls
```

```
add_example.py
data-text.csv
Jupyter+Notebook+Handout.html
Jupyter Notebook Handout.ipynb
Jupyter+Notebook+Presentation.html
Jupyter Notebook Presentation.ipynb
Jupyter+Notebook+Presentation.py
Jupyter Notebook Presentation With Execution.ipynb
Jupyter with Matlab example.ipynb
README.md
Sample_im.jpg
test.py
```

ii View and run *.py file in Jupyter

Use

```
$ %pycat example.py
```

to view local *.py file.

Use

```
$ %run example.py
```

to run local *.py file.

```
In [3]: %pycat add_example.py
```

```
In [4]: %run add_example.py
7
```

iii. Jupyter can write Python code into file

Use

```
$ %writefile example.py
```

to write code or text into a file.

```
In [5]: ls
```

```
add_example.py
data-text.csv
Jupyter+Notebook+Handout.html
Jupyter Notebook Handout.ipynb
Jupyter+Notebook+Presentation.html
Jupyter Notebook Presentation.ipynb
Jupyter+Notebook+Presentation.py
Jupyter Notebook Presentation With Execution.ipynb
Jupyter with Matlab example.ipynb
README.md
Sample_im.jpg
test.py
```

In [6]:
```
%%writefile test.py
#encoding utf-8
import datetime

def print_time():
    print 'the time is:'
    print datetime.datetime.now()

print_time()
```

```
Overwriting test.py
```

In [7]:
```
%pycat test.py
```

iv. load .py file into Jupyter

Use

```
$ %load example.py
```

to load python file code into Jupyter

In [ ]:
```
%load test.py
```

In [8]:
```
# %load test.py
#encoding utf-8
import datetime

def print_time():
    print 'the time is:'
    print datetime.datetime.now()

print_time()
```

```
the time is:
2017-02-19 22:25:21.735196
```

v. Record the run time of the code

Use %%time to record time execution of a Python statement or expression.

In [9]:
```
%%time
import time
sum=0
for x in range(100):
    sum+=x
    time.sleep(0.01)
print sum
```

```
4950
CPU times: user 8 ms, sys: 0 ns, total: 8 ms
Wall time: 1.02 s
```

Use %%timeit to record average time execution of a Python statement or expression

In [10]:
```
%%timeit
import time
sum=0
for x in range(100):
    sum+=x
```

```
The slowest run took 16.04 times longer than the fastest. This could
 mean that an intermediate result is being cached.
100000 loops, best of 3: 3.22 µs per loop
```

2. Use code cell to help visualize data

Use matplotlib, pandas and other libraries with Jupyter to help visulaize data

i. Run simple Python code

In [11]:
```
1+2
```

Out[11]: 3

In [12]:
```
def add_1(x,y):
    return x+y+1
add_1(2,3)
```

Out[12]: 6

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

```
the time is:
2017-02-19 22:25:30.899188
```

ii. Use matplotlib to draw graph of data

Add

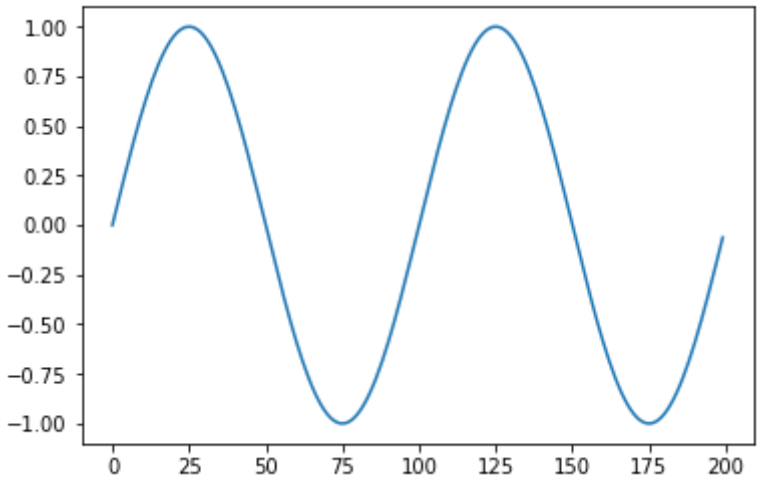
```
%matplotlib inline
```

to plot graph inside Jupyter

In [14]:
```
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np

Fs = 200
f = 2
sample = 200
x = np.arange(sample)
y = np.sin(2 * np.pi * f * x / Fs)
plt.plot(x, y)
```

Out[14]: `[<matplotlib.lines.Line2D at 0x7f64fdd9c410>]`



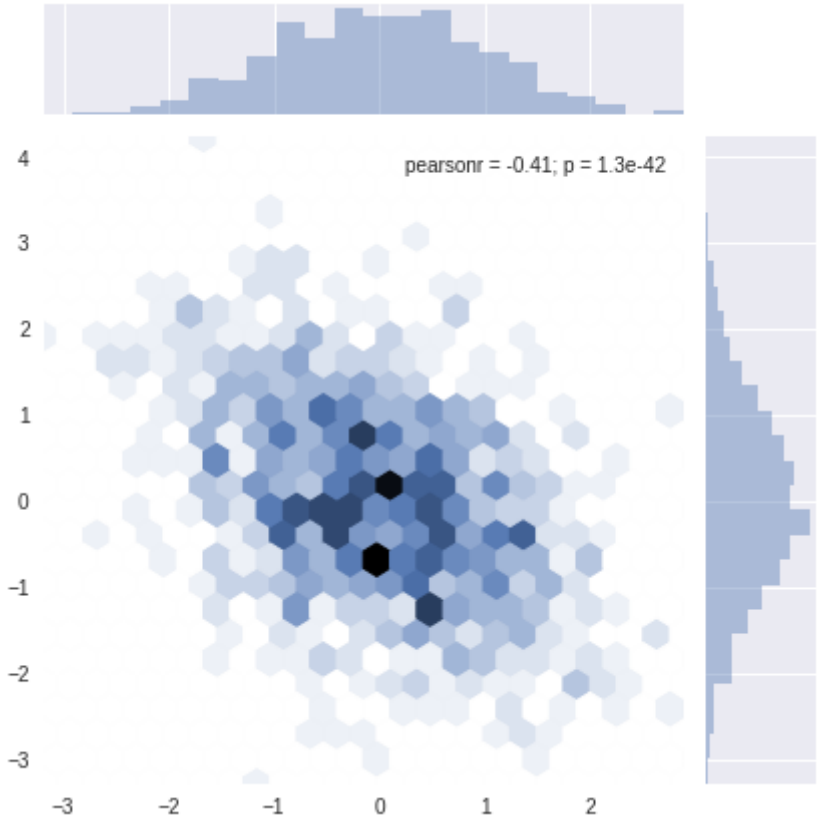
Seaborn (http://seaborn.pydata.org/index.html) is a plotting library for Python that uses matplotlib underneath the hood. It provides for a number of plotting types that don't exist in matplotlib.

The example used below is from here (https://github.com/welchr/csg-jupyter-tutorial/blob/master/csg_jupyter_tutorial.ipynb)

In [15]:
```
%matplotlib inline
import numpy as np
from scipy.stats import kendalltau
import seaborn as sns

rs = np.random.RandomState(20)
x = rs.normal(size=1000)
y = -.5 * x + rs.normal(size=1000)

ax = sns.jointplot(x, y, kind="hex")
```



iii. Use pandas to show the results of data frame

In [16]:
```
import numpy as np
import pandas

def get_df():
    data_frame = pandas.read_csv('data-text.csv', sep=',')
    return data_frame

get_df()
```

Out[16]:

	Indicator	PUBLISH STATES	Year	WHO region	World Bank income group	Country	Sex	Display Value
0	Life expectancy at birth (years)	Published	1990	Europe	High-income	Andorra	Both sexes	77
1	Life expectancy at birth (years)	Published	2000	Europe	High-income	Andorra	Both sexes	80
2	Life expectancy at age 60 (years)	Published	2012	Europe	High-income	Andorra	Female	28
3	Life expectancy at age 60 (years)	Published	2000	Europe	High-income	Andorra	Both sexes	23
4	Life expectancy at birth (years)	Published	2012	Eastern Mediterranean	High-income	United Arab Emirates	Female	78
5	Life expectancy at birth (years)	Published	2000	Americas	High-income	Antigua and Barbuda	Male	72
6	Life expectancy at age 60 (years)	Published	1990	Americas	High-income	Antigua and Barbuda	Male	17
7	Life expectancy at age 60 (years)	Published	2012	Americas	High-income	Antigua and Barbuda	Both sexes	22
8	Life expectancy at birth (years)	Published	2012	Western Pacific	High-income	Australia	Male	81

	Indicator	PUBLISH STATES	Year	WHO region	World Bank income group	Country	Sex	Display Value
9	Life expectancy at birth (years)	Published	2000	Western Pacific	High-income	Australia	Both sexes	80
10	Life expectancy at birth (years)	Published	2012	Western Pacific	High-income	Australia	Both sexes	83
11	Life expectancy at birth (years)	Published	2012	Europe	High-income	Austria	Female	83
12	Life expectancy at age 60 (years)	Published	2012	Europe	High-income	Austria	Female	25
13	Life expectancy at birth (years)	Published	2012	Europe	High-income	Belgium	Female	83
14	Life expectancy at birth (years)	Published	2000	Eastern Mediterranean	High-income	Bahrain	Male	73
15	Life expectancy at birth (years)	Published	1990	Eastern Mediterranean	High-income	Bahrain	Female	74
16	Life expectancy at age 60 (years)	Published	1990	Eastern Mediterranean	High-income	Bahrain	Male	17
17	Life expectancy at birth (years)	Published	2012	Americas	High-income	Bahamas	Male	72

	Indicator	PUBLISH STATES	Year	WHO region	World Bank income group	Country	Sex	Display Value
18	Life expectancy at age 60 (years)	Published	2000	Americas	High-income	Bahamas	Both sexes	21
19	Life expectancy at birth (years)	Published	1990	Americas	High-income	Barbados	Male	71
20	Life expectancy at age 60 (years)	Published	2012	Americas	High-income	Barbados	Female	25
21	Life expectancy at age 60 (years)	Published	2012	Americas	High-income	Barbados	Both sexes	23
22	Life expectancy at age 60 (years)	Published	1990	Western Pacific	High-income	Brunei Darussalam	Female	20
23	Life expectancy at age 60 (years)	Published	2000	Western Pacific	High-income	Brunei Darussalam	Female	22
24	Life expectancy at age 60 (years)	Published	2012	Western Pacific	High-income	Brunei Darussalam	Female	21
25	Life expectancy at birth (years)	Published	2000	Americas	High-income	Canada	Female	82
26	Life expectancy at age 60 (years)	Published	2000	Americas	High-income	Canada	Male	21

	Indicator	PUBLISH STATES	Year	WHO region	World Bank income group	Country	Sex	Display Value
27	Life expectancy at age 60 (years)	Published	1990	Americas	High-income	Canada	Female	24
28	Life expectancy at birth (years)	Published	1990	Europe	High-income	Switzerland	Male	74
29	Life expectancy at birth (years)	Published	2012	Europe	High-income	Switzerland	Both sexes	83
...	...	...	...	...	...	...	...	...
4626	Healthy life expectancy (HALE) at birth (years)	Published	2012	Europe	Upper-middle-income	Serbia	Female	67
4627	Healthy life expectancy (HALE) at birth (years)	Published	2012	Americas	Upper-middle-income	Suriname	Both sexes	66
4628	Healthy life expectancy (HALE) at birth (years)	Published	2012	Europe	High-income	Sweden	Both sexes	72
4629	Healthy life expectancy (HALE) at birth (years)	Published	2012	Africa	Lower-middle-income	Swaziland	Female	47
4630	Healthy life expectancy (HALE) at birth (years)	Published	2000	Africa	Upper-middle-income	Seychelles	Male	61

	Indicator	PUBLISH STATES	Year	WHO region	World Bank income group	Country	Sex	Display Value
4631	Healthy life expectancy (HALE) at birth (years)	Published	2000	Eastern Mediterranean	Lower-middle-income	Syrian Arab Republic	Female	64
4632	Healthy life expectancy (HALE) at birth (years)	Published	2012	Africa	Low-income	Chad	Female	44
4633	Healthy life expectancy (HALE) at birth (years)	Published	2000	South-East Asia	Lower-middle-income	Thailand	Male	59
4634	Healthy life expectancy (HALE) at birth (years)	Published	2000	South-East Asia	Lower-middle-income	Thailand	Female	65
4635	Healthy life expectancy (HALE) at birth (years)	Published	2000	Europe	Low-income	Tajikistan	Both sexes	56
4636	Healthy life expectancy (HALE) at birth (years)	Published	2012	Europe	Low-income	Tajikistan	Female	60
4637	Healthy life expectancy (HALE) at birth (years)	Published	2012	Western Pacific	Lower-middle-income	Tonga	Female	61
4638	Healthy life expectancy (HALE) at birth (years)	Published	2012	Americas	High-income	Trinidad and Tobago	Female	64

	Indicator	PUBLISH STATES	Year	WHO region	World Bank income group	Country	Sex	Display Value
4639	Healthy life expectancy (HALE) at birth (years)	Published	2012	Americas	High-income	Trinidad and Tobago	Both sexes	61
4640	Healthy life expectancy (HALE) at birth (years)	Published	2000	Eastern Mediterranean	Lower-middle-income	Tunisia	Male	63
4641	Healthy life expectancy (HALE) at birth (years)	Published	2012	Western Pacific	Upper-middle-income	Tuvalu	Male	57
4642	Healthy life expectancy (HALE) at birth (years)	Published	2000	Africa	Low-income	Uganda	Female	40
4643	Healthy life expectancy (HALE) at birth (years)	Published	2000	Europe	Lower-middle-income	Ukraine	Both sexes	60
4644	Healthy life expectancy (HALE) at birth (years)	Published	2012	Americas	Upper-middle-income	Uruguay	Male	65
4645	Healthy life expectancy (HALE) at birth (years)	Published	2012	Americas	Upper-middle-income	Uruguay	Female	70
4646	Healthy life expectancy (HALE) at birth (years)	Published	2012	Americas	Upper-middle-income	Uruguay	Both sexes	68

	Indicator	PUBLISH STATES	Year	WHO region	World Bank income group	Country	Sex	Display Value
4647	Healthy life expectancy (HALE) at birth (years)	Published	2000	Americas	Upper-middle-income	Saint Vincent and the Grenadines	Both sexes	61
4648	Healthy life expectancy (HALE) at birth (years)	Published	2012	Americas	Upper-middle-income	Venezuela (Bolivarian Republic of)	Both sexes	66
4649	Healthy life expectancy (HALE) at birth (years)	Published	2000	Western Pacific	Lower-middle-income	Vanuatu	Male	59
4650	Healthy life expectancy (HALE) at birth (years)	Published	2012	Western Pacific	Lower-middle-income	Samoa	Male	62
4651	Healthy life expectancy (HALE) at birth (years)	Published	2012	Western Pacific	Lower-middle-income	Samoa	Female	66
4652	Healthy life expectancy (HALE) at birth (years)	Published	2012	Eastern Mediterranean	Low-income	Yemen	Both sexes	54
4653	Healthy life expectancy (HALE) at birth (years)	Published	2000	Africa	Upper-middle-income	South Africa	Male	49
4654	Healthy life expectancy (HALE) at birth (years)	Published	2000	Africa	Low-income	Zambia	Both sexes	36

	Indicator	PUBLISH STATES	Year	WHO region	World Bank income group	Country	Sex	Display Value
4655	Healthy life expectancy (HALE) at birth (years)	Published	2012	Africa	Low-income	Zimbabwe	Female	51

4656 rows × 12 columns

3. Use markdown cell to keep notes

There is a example of a markdown below.

A First Level Headline

Use *word* to show *Italic*

Use **word** to show **bold**.

Itemized lists look like:

- this one
- that one

Here's a numbered list:

1. first item
2. second item
3. third item

A Second Level Headline

You can add code block into the cell like this:

This is a python code block

```
import time
# Quick, count from 0 to 9!
for i in range(10):
    # wait for a while
    time.sleep(0.5)
    print i
```

This is a C++ code block

```
#include<iostream>
usig namespace std;
int main(){
cout<<"Hello World!"<<endl;
}
```

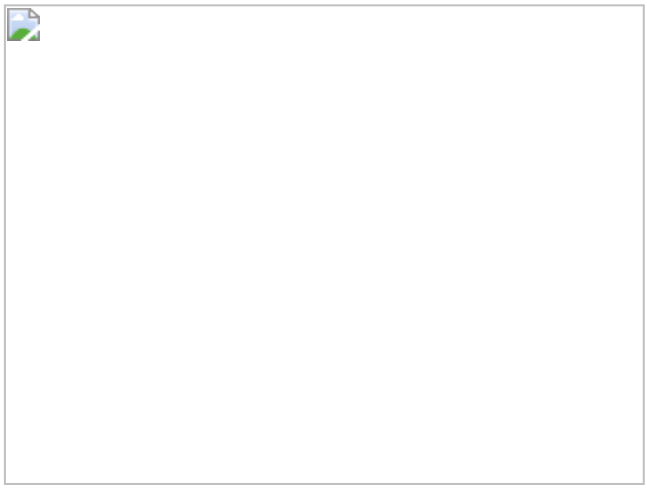
A Third Level Headline

Here's a link to a website (http://www.ucsc.edu), to a local file (./Sample_im.jpg).

Inline math equations go in like so: $\int_0^{+\infty} x^2 dx$. Display math should get its own line and be put in in double-dollarsigns:

$$\int_0^{+\infty} x^2 dx$$

Images can also be added into markdown cell



Markdown example used from here (http://www.unexpected-vortices.com/sw/rippledoc/quick-markdown-example.html#an-h2-header) with some edits

i. Basic Text edit

A First Level Headline

Use *word* to show *Italic*

Use **word** to show **bold**.

Itemized lists look like:

- this one
- that one

Here's a numbered list:

1. first item
2. second item
3. third item

ii. Code Block

Code block can be highlighted according to the language

This is a python code block

```
import time
# Quick, count from 0 to 9!
for i in range(10):
    # wait for a while
    time.sleep(0.5)
    print i
```

This is a C++ code block

```
#include<iostream>
usig namespace std;
int main(){
cout<<"Hello World!"<<endl;
}
```

iii. Links

Link to offline Pictures (./Sample_im.jpg)

Link to online website (http://www.ucsc.edu)

Another type of link http://www.ucsc.edu (http://www.ucsc.edu)

iv. Latex

Latex can also be used in Jupyter to write math expression

This is an expression as a single expression

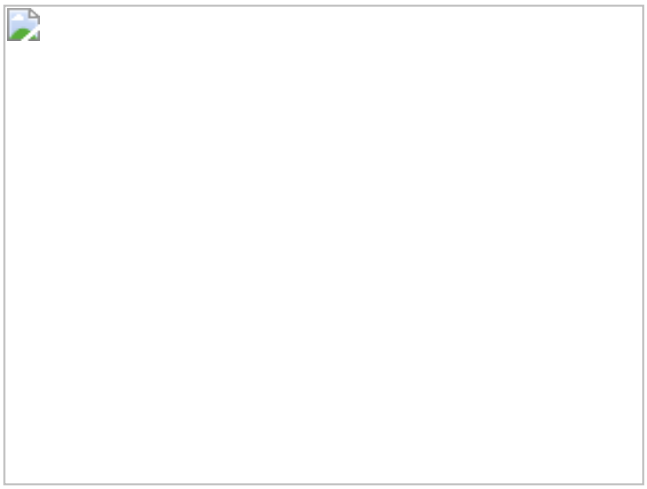
$$\int_0^2 x^2 dx$$

Inline expression is also supported, for example, $\int_0^2 x^2 dx$

v. Images

Images can be added like links.

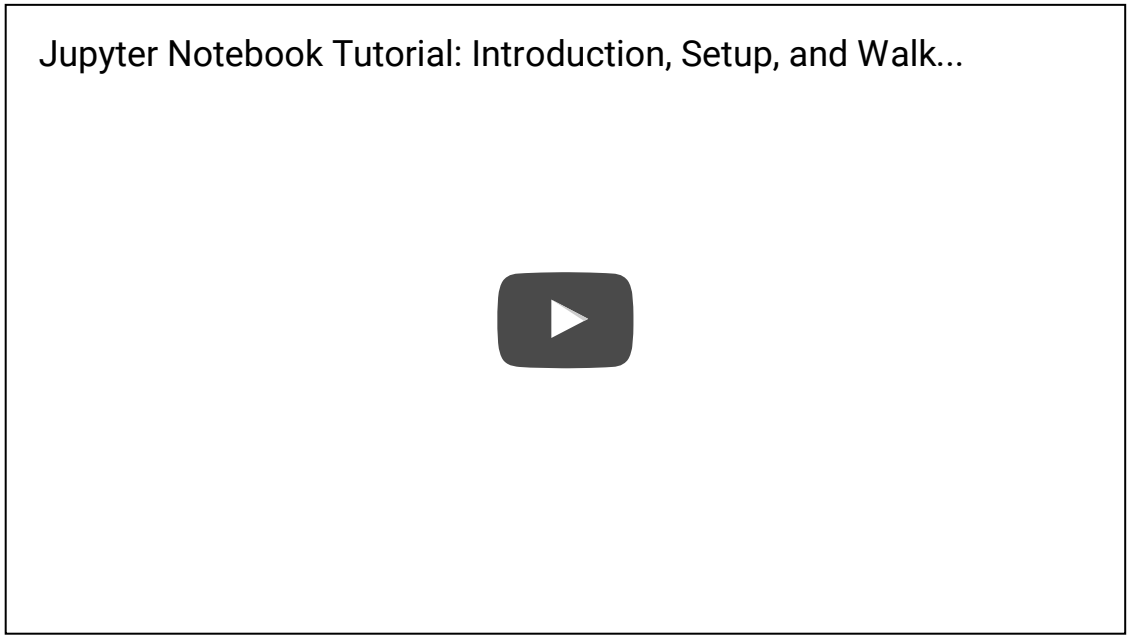
We can use HTML style to edit image size and position



vi. Video

We can also add videos in Jupyter

In [17]:
```
%%html
<iframe width="560" height="315" src="https://www.youtube.com/embed/H
W29067qVWk" frameborder="0" allowfullscreen></iframe>
```



4. Export *.ipynb file to other formats to share with others

i. Github

Github can load *.ipynb file, here is an example (https://github.com/jhwei/Jupyter_Tutorial/blob/master/Jupyter%20Notebook%20Presentation.ipynb)

ii. Export to other formats

Goto **File**->**Download as** to select the file format you want to export to.

Or you can type the following command in terminal

```
$ jupyter nbconvert --to FORMAT notebook.ipynb
```

- FORMAT means the file format you want to export to, such as, pdf, html
- you may need to install latex and other software depending on your computer
- please refer to the error to see if some software is missing if you don't succeed

iii. Several example output

- An example of html (./Jupyter+Notebook+Presentation.html)
- An example of pdf ()
- An example of py ()

5. Useful Resources

Offical Documentation https://jupyter.readthedocs.io/en/latest/index.html (https://jupyter.readthedocs.io/en/latest/index.html)

Markdown syntx Document from Github https://guides.github.com/features/mastering-markdown/ (https://guides.github.com/features/mastering-markdown/)

Jupyter with other programming languages https://github.com/jupyter/jupyter/wiki/Jupyter-kernels (https://github.com/jupyter/jupyter/wiki/Jupyter-kernels)

Some nice Jupyter examples http://nb.bianp.net/sort/views/ (http://nb.bianp.net/sort/views/)

Another good Jupyter tutorial https://github.com/welchr/csg-jupyter-tutorial (https://github.com/welchr/csg-jupyter-tutorial)

Turn Jupyter to presentation slides with RISE https://github.com/damianavila/RISE (https://github.com/damianavila/RISE)

Combine Jupyter with WordPress http://www.mianchen.com/wordpress-blogging-with-jupyter-notebook-in-five-simple-steps/ (http://www.mianchen.com/wordpress-blogging-with-jupyter-notebook-in-five-simple-steps/)