# 04-6 Python Jupyter Notebooks

CSI 500

What's a Jupyter Notebook?

- **What's Jupyter?**
  - Jupyter is a web-based application bundled with most modern Python distributions
  - It manages editing and running of "notebooks" in Python, R and about 40 additional languages

- **What's a Notebook?**
  - Technically, it's a file in a JSON-style language, usually with the *.ipynb extension
  - Defines a collection of "cells", each of which can contain code, graphics, and documentation

- **Why do we care?**
  - convenient way to organize code and data for a project
  - easy to share with colleagues

- **Where can I find out more?**
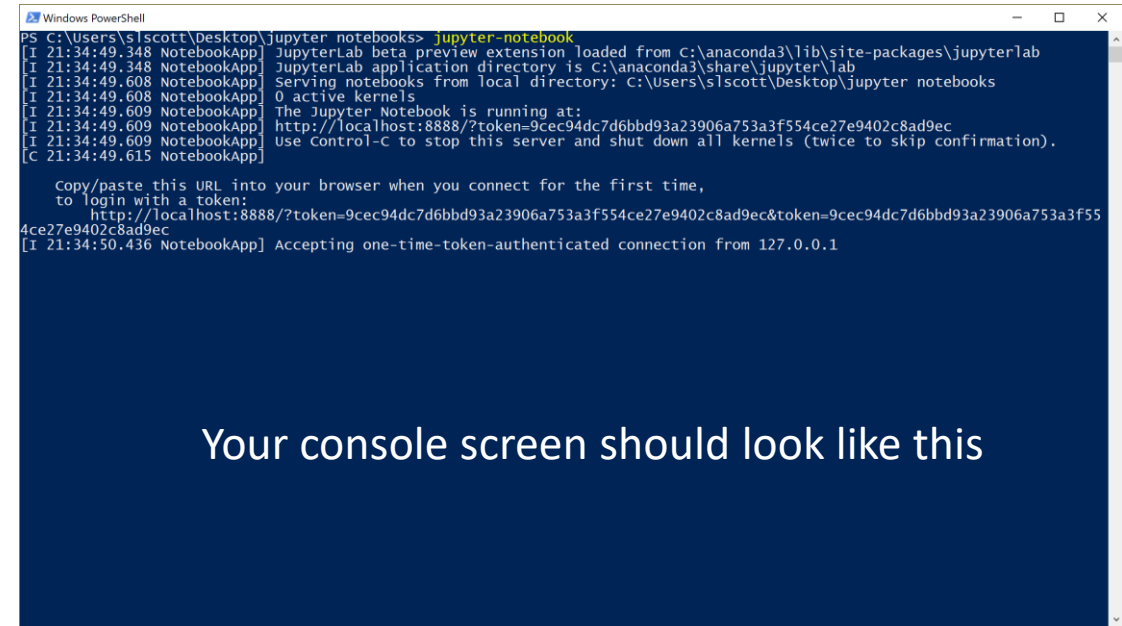 - see www.jupyter.org
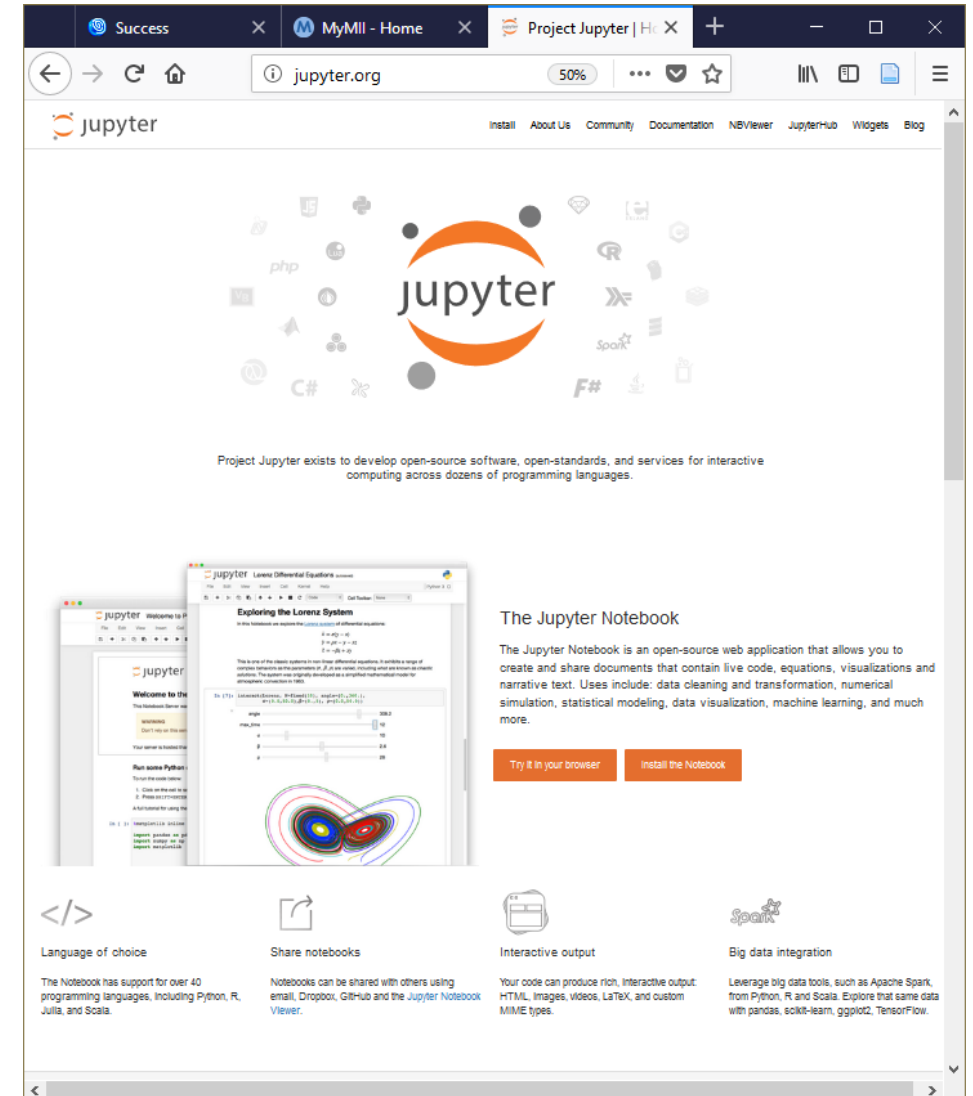
Some system config issues

- You need to find out where jupyter is installed on your machine
  - c:\anaconda3\Scripts
  - c:\python36\Scripts
  - other possible locations
- You need to make sure the installation location is on your search path
  - PATH=blah_blah_blah;c:\anaconda3\Scripts
- You may need to run by explicitly specifying the location of the jupyter-notebook executable, such as this on Windows
  - c:\anaconda3\Scripts\jupyter-notebook
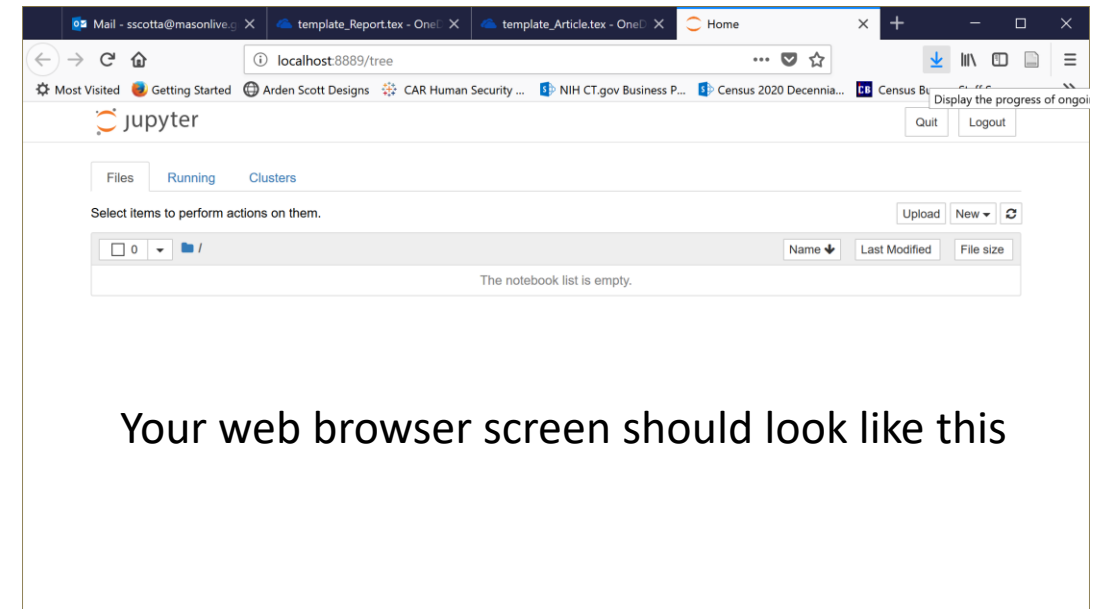
Let's make a notebook

- Open a terminal window on your OS
  - in Windows: go to your desktop. create a folder named "my-notebooks", start up a Windows Power shell.
  - on Mac: create a folder named "my-notebooks"on your desktop using Finder. Open a Terminal shell. type in "cd ~/Desktop/my-notebooks".
- Type in "jupyter-notebook", press enter
  - you may need to explicitly specify the full path to the jupyter-notebook executable
  - wait for some web stuff to happen
  - look at your screens

Your console screen should look like this

Your web browser screen should look like this

Details of the Web Interface
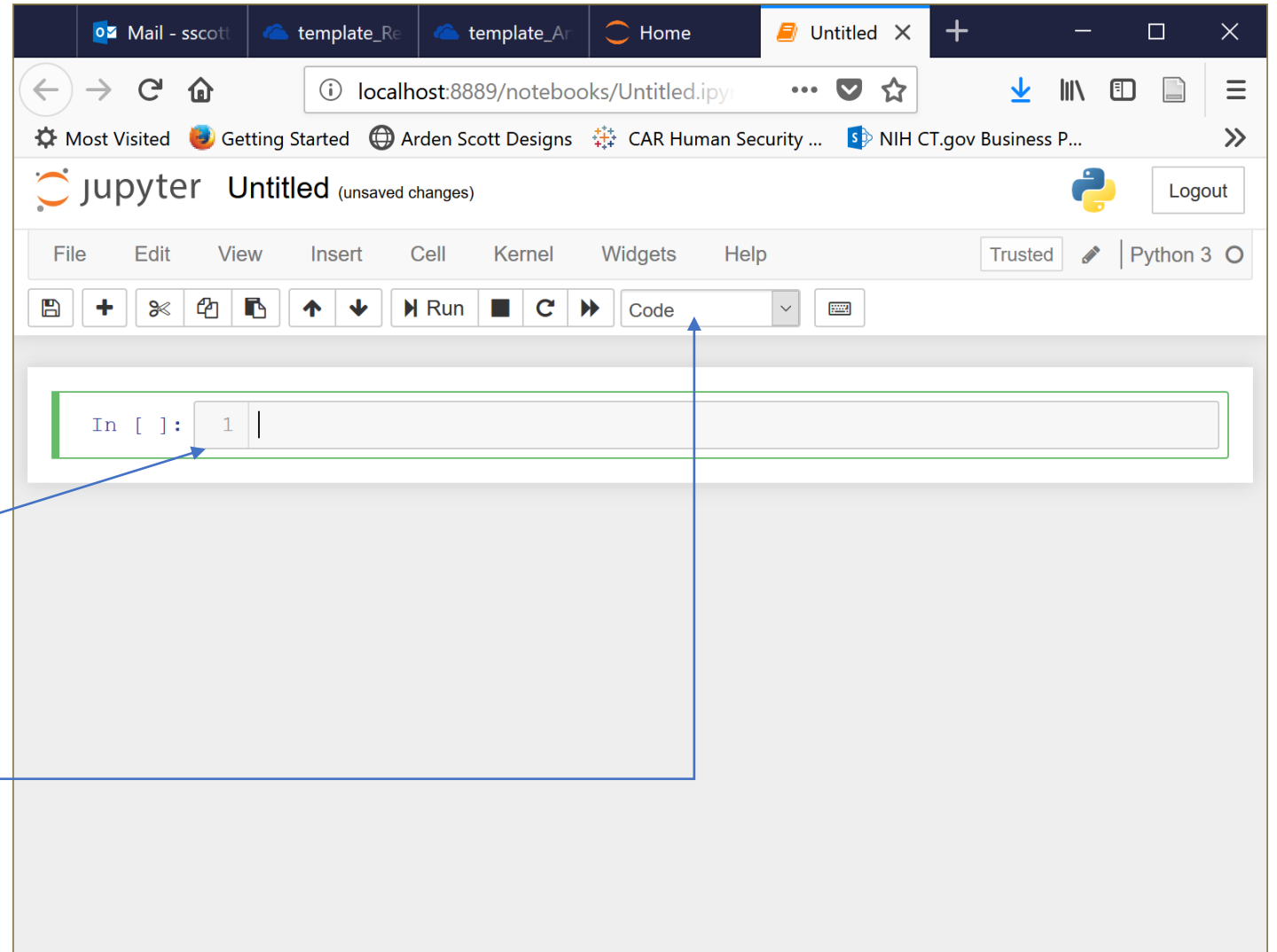
- The Files tab lists files in your folder, including notebooks
  - Right now, we don't have any notebooks
- Click on "New", and select Notebook Python 3
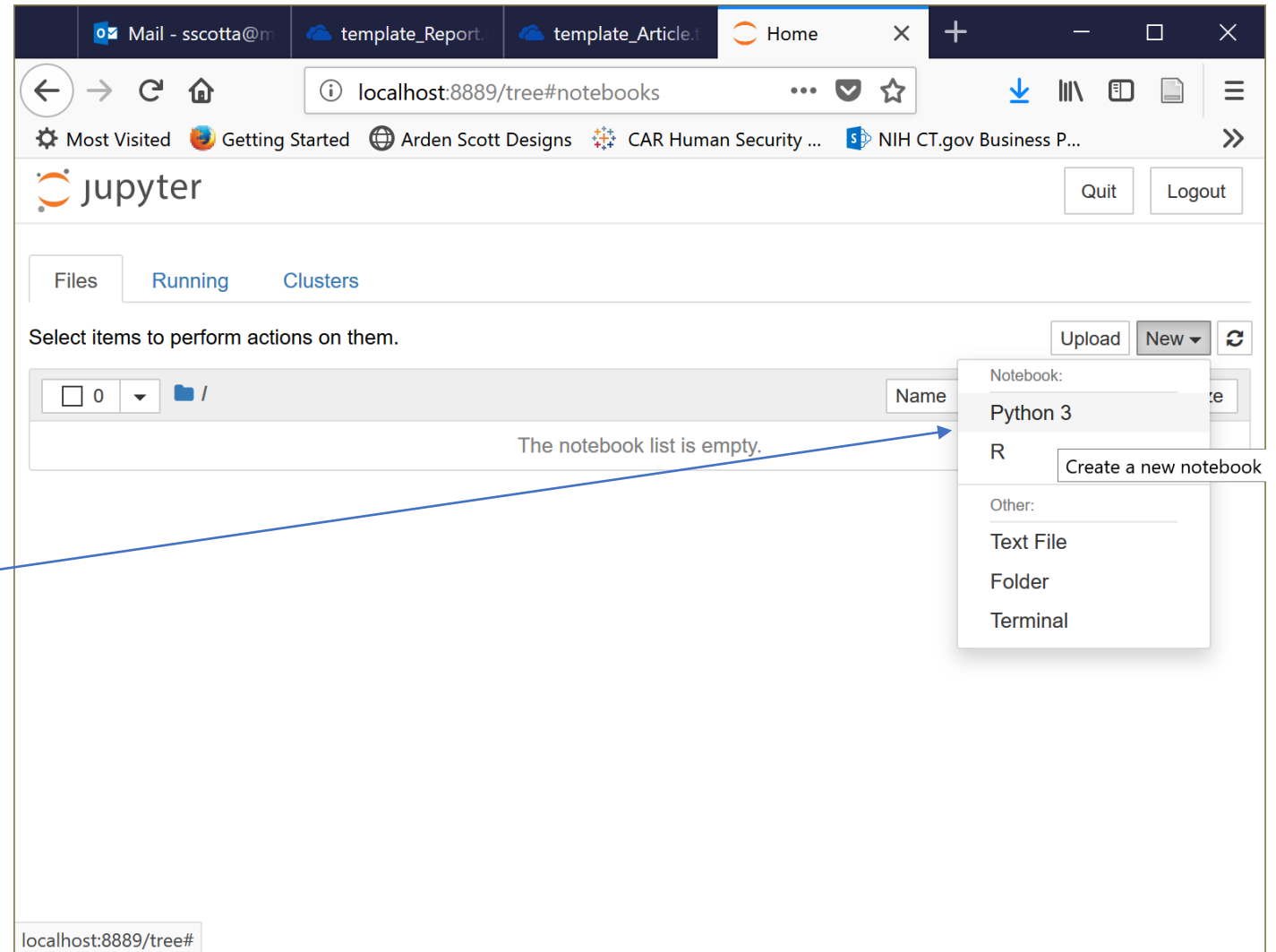
Our first notebook

- After a couple of seconds, Jupyter will create a new notebook
  - The prompt is waiting at the first "cell" for input
- Note that we are in "code" mode - later we'll use Markdown mode
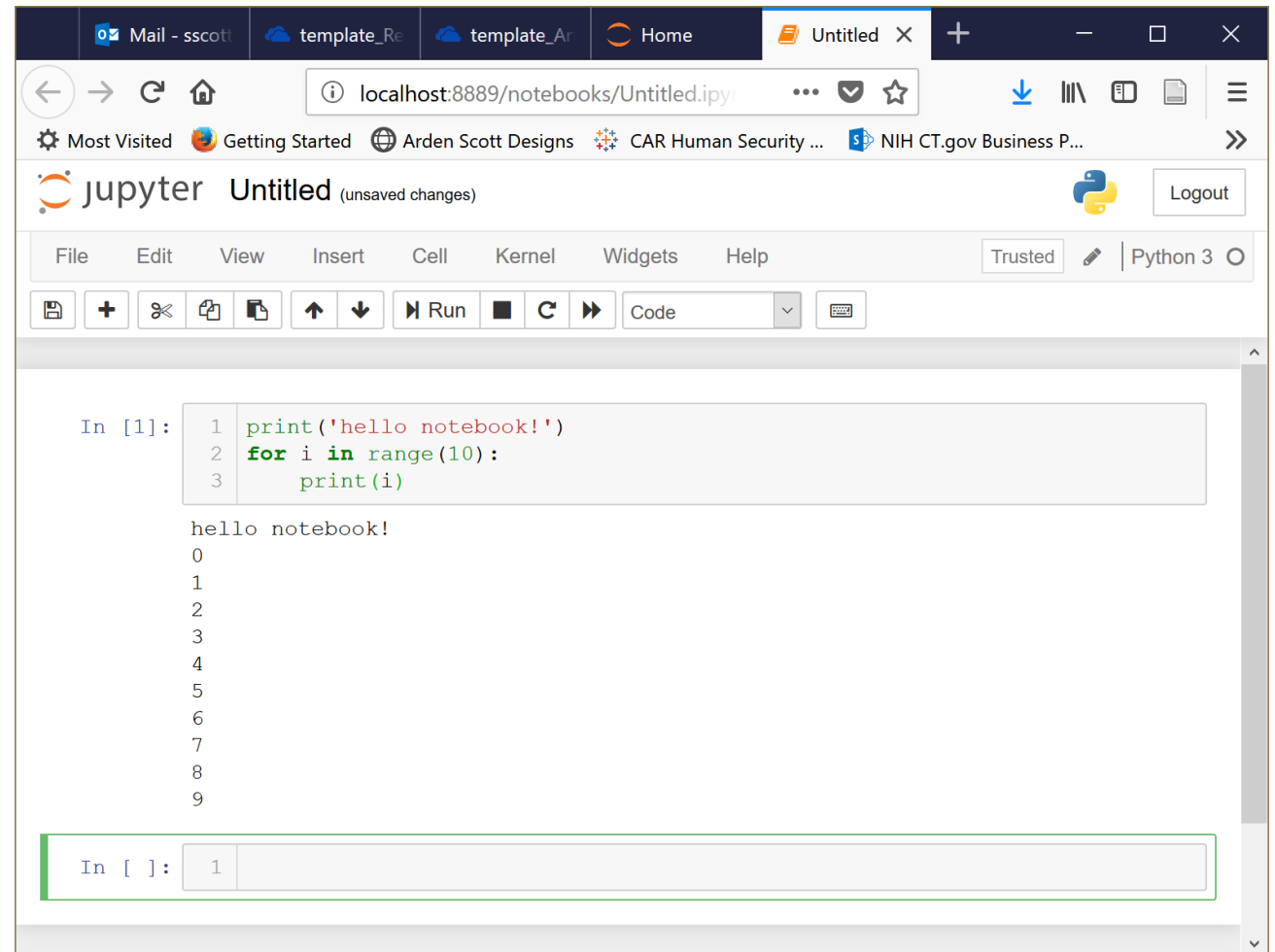
Let's type in some Python code

- At the cell one prompt, type in this code

```
print('hello notebook!')
for i n range(10):
    print(i)
```

- Then press the "run" button

- Jupyter runs our code, then opens a new cell below

Now let's do some Markdown

- We can embed text in cells
  - the ## character automatically creates a section heading in bold
  - we can enter normal text just like an editor

- Type in this code in cell 2

```
## Notes about this notebook
this is a notebook in Python
it has some code and text
```

- At the "code" chooser, select Markdown

- Press run
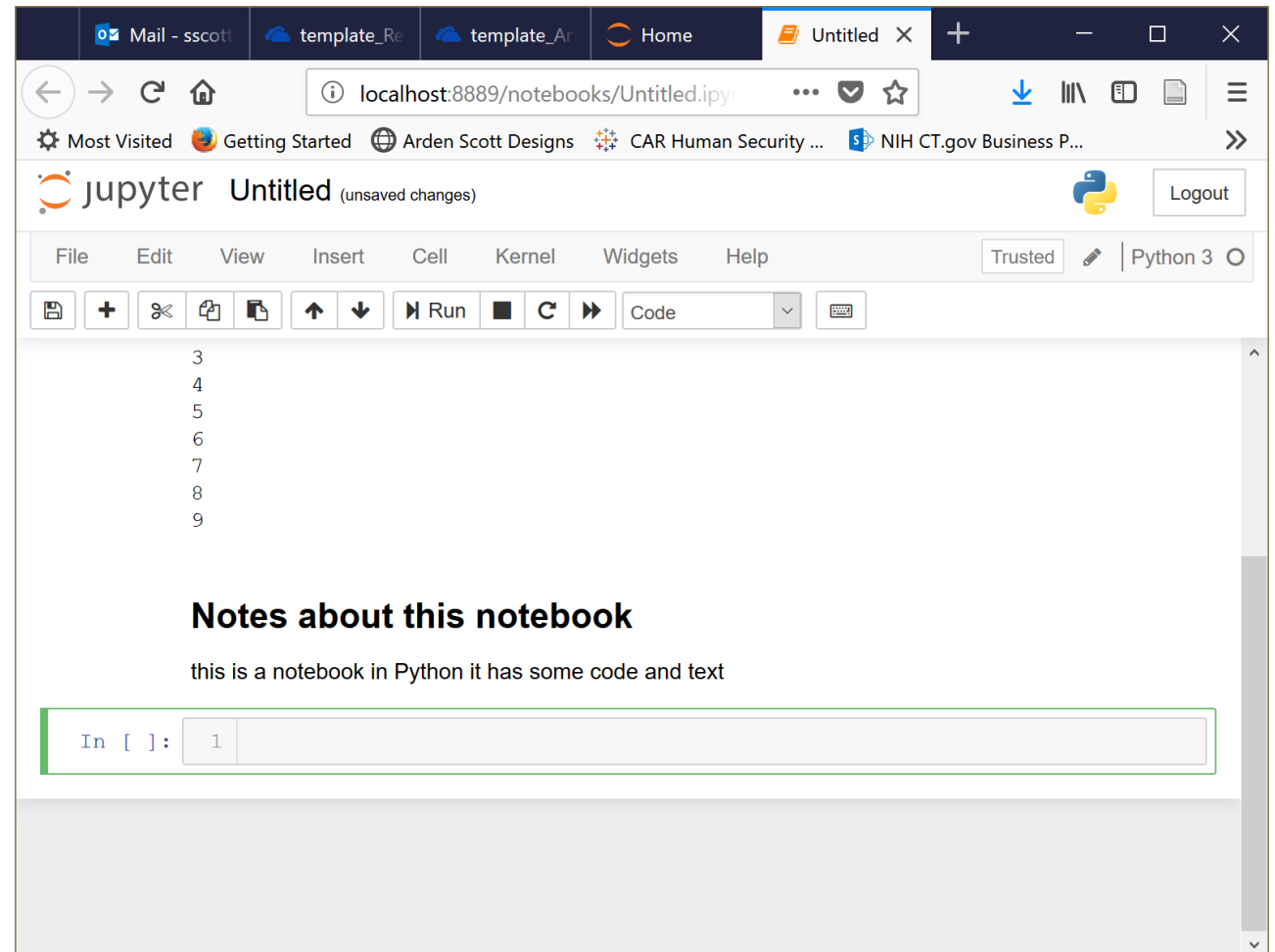
Now let's add some LaTex

- We can also include LaTex expressions in our Markdown text
  - Inline math expressions are done using double dollar signs such as $$ math stuff $$
  - More complicated expressions are done using an \equation block

- Type this into Cell 3, choose Markdown, and press run
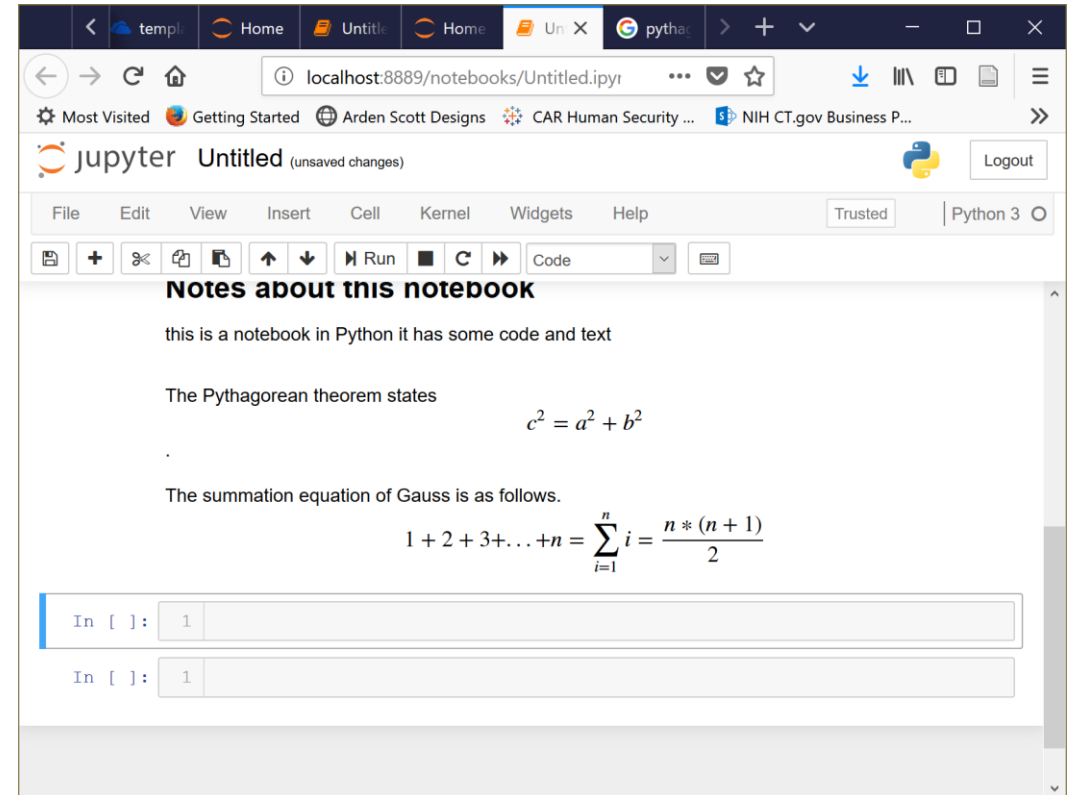

```
The Pythagorean theorem states $$c^2 = a^2 + b^2$$.

The summation equation of Gauss is as follows.
\begin{equation}
1 + 2 + 3 + ... + n = \sum_{i=1}^{n} i = \frac{n*(n+1)}{2}
\end{equation}
```
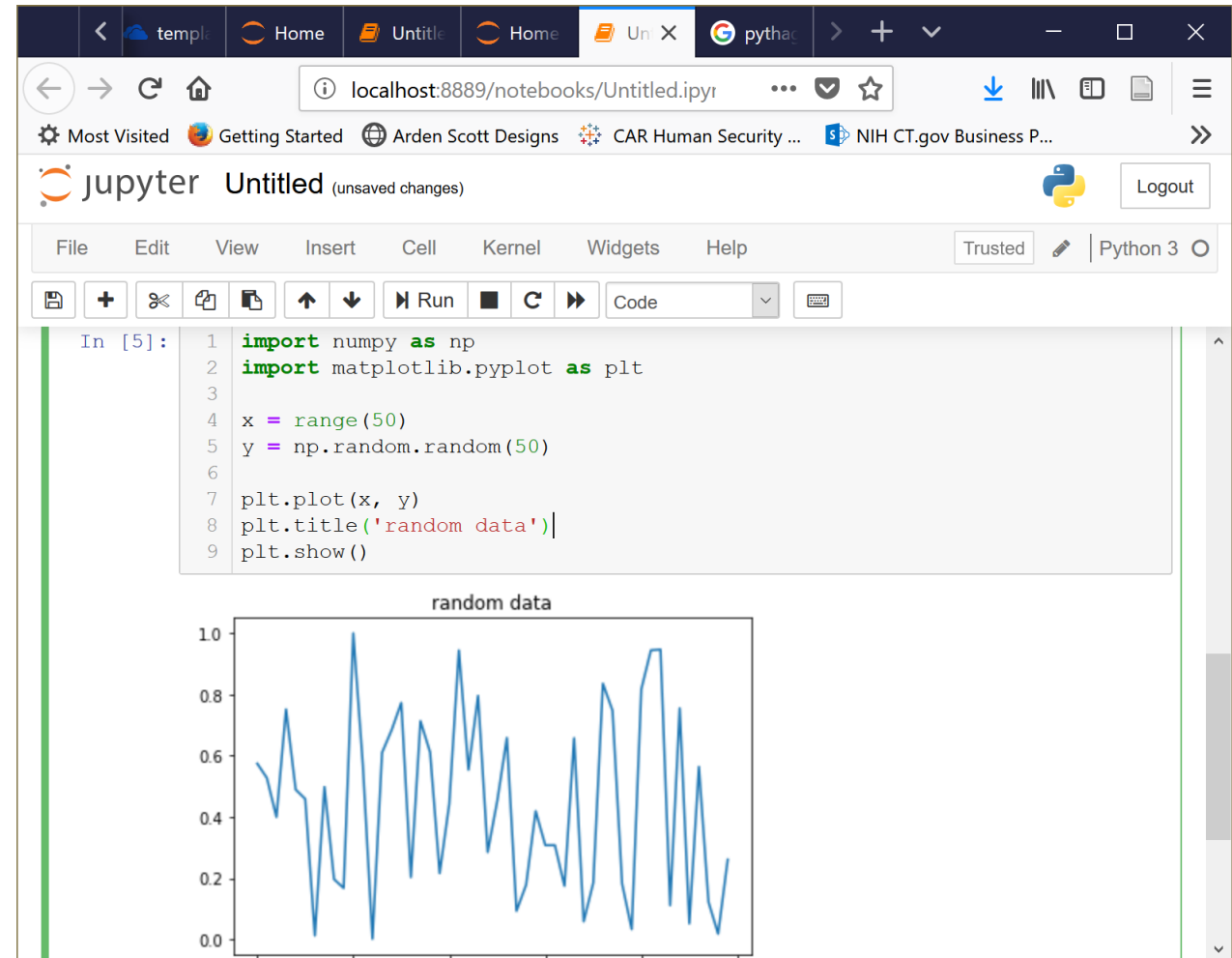
Now let's add a graphic

- go to cell #4

- type this in, choose "code", press run

```
import numpy as np
import matplotlib.pyplot as plt

x = range(50)
y = np.random.random(50)

plt.plot(x, y)
plt.title('random data')
plt.show()
```
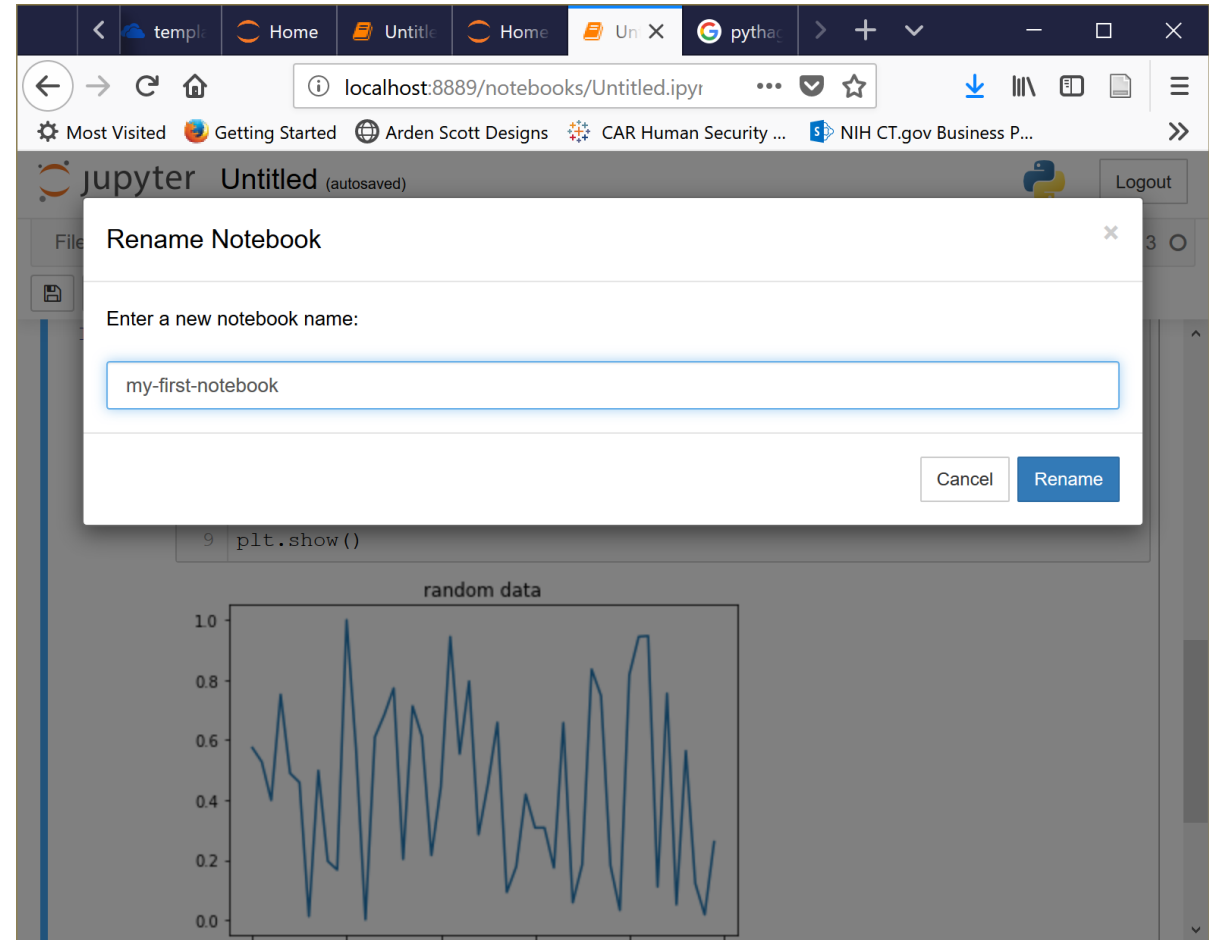
Save your work

- From the File menu, press save and checkpoint
  - Jupyter is quite robust about saving checkpoints
- From the File menu, press "rename"
  - Enter in the name "my-first-notebook"
- Your notebook is now saved as "my-first-notebook.ipynb"

Summary

- Python Jupyter notebooks are flexible and expressive
  - Allow clean integration of documentation and code
  - Easy to share with other researchers

- Designed as a collection of computational "cells"
  - each cell manages some part of the overall problem space
  - cells can include code, documentation (including full LaTex expressions)

- Easy to run just one cell
  - localize the analysis

- Easy to export for sharing
  - can export as notebook format or as HTML for use in a browser