

JupyterHub in Engineering Education



Peter D. Kazarinoff

Division of Engineering and Industrial Technology
Portland Community College

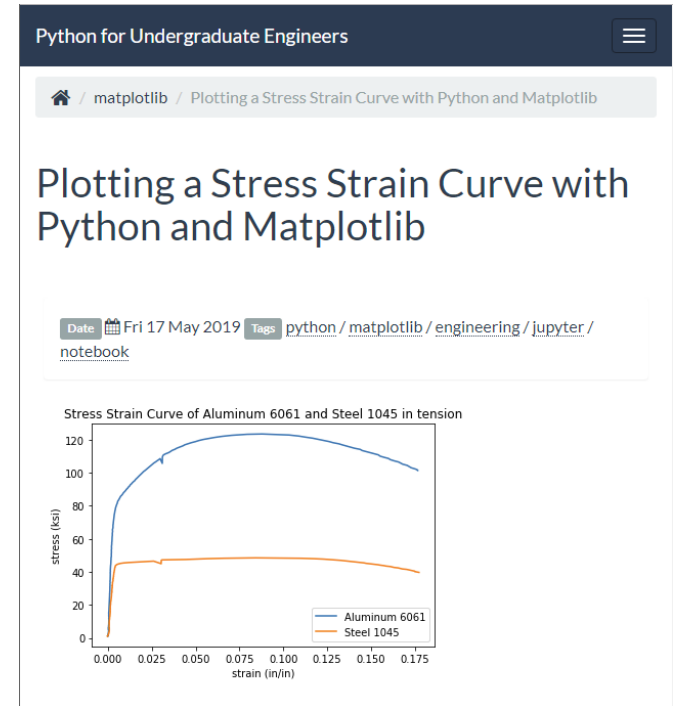
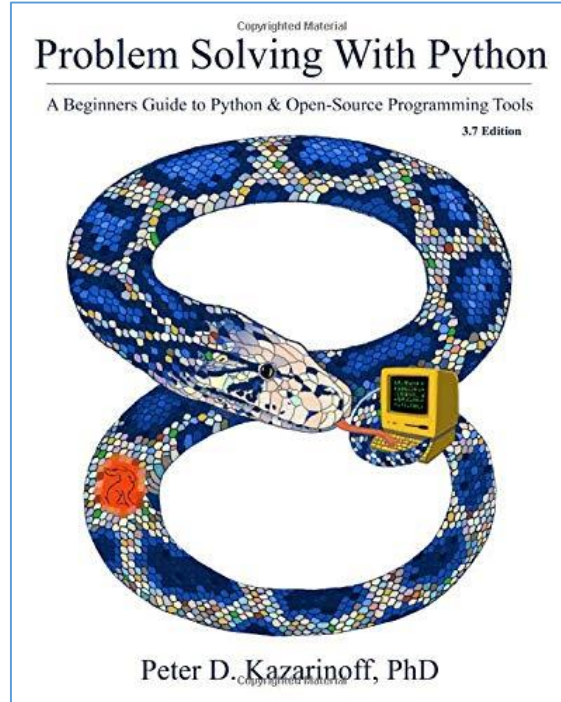
@pkazarinoff GitHub: ProfessorKazarinoff

[Slides: github.com/ProfessorKazarinoff/PyPDXWest-2019-10](https://github.com/ProfessorKazarinoff/PyPDXWest-2019-10)

Who is Peter?



- Engineering Transfer
- 2-year Engineering Tech



Blog: pythonforundergradengineers.com

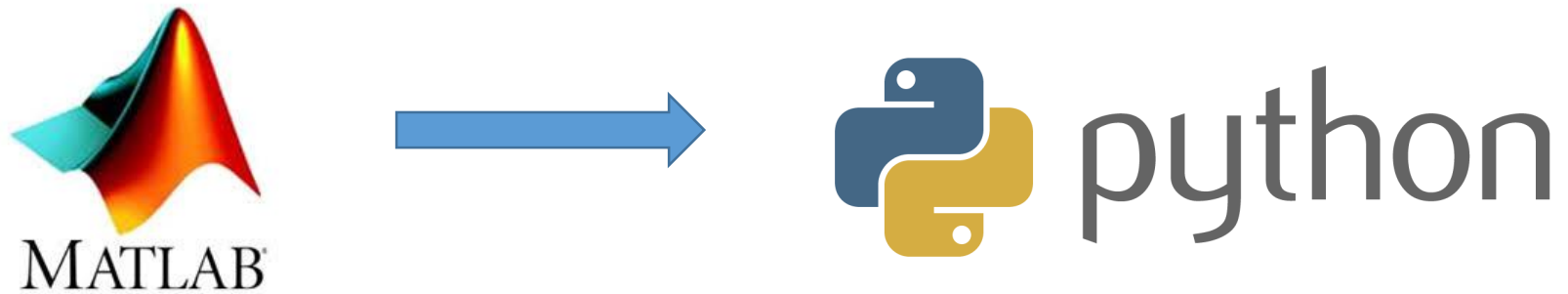
GitHub: github.com/ProfessorKazarinoff

Twitter: [@pkazarinoff](https://twitter.com/pkazarinoff)

- 6 in 10 of CC students experience food insecurity
- 3 in 10 CC students experience housing insecurity
- 1 in 10 of CC students is homeless



Moving from MATLAB to Python



Could save students \$25,000 in one year

Students use Desktops, Laptops, Chrombooks, Tablets and Phones





Jupyter Notebooks

```


Anaconda Prompt - jupyter notebook
[I 09:35:24.740 NotebookApp] Serving notebooks from local directory: C:\Users\peter.kazarinoff\Documents
[I 09:35:24.740 NotebookApp] The Jupyter Notebook is running at:
[I 09:35:24.741 NotebookApp] http://localhost:8888/?token=f0231ebbc26a7b8e6dbe1f0b6fa61b40e0062ece87728a1
[I 09:35:24.741 NotebookApp] Use Control-C to stop this server and shut down all kernels (twice to skip confirmation).
[C 09:35:24.749 NotebookApp]

To access the notebook, open this file in a browser:
file:///C:/Users/peter.kazarinoff/AppData/Roaming/jupyter/runtime/nbserver-9516-open.html
Or copy and paste one of these URLs:
http://localhost:8888/?token=f0231ebbc26a7b8e6dbe1f0b6fa61b40e0062ece87728a1_

```

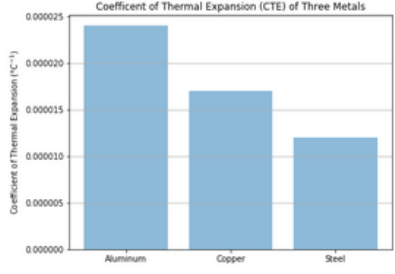
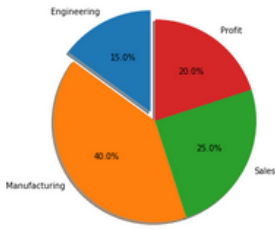
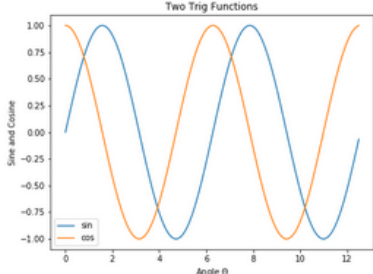
 **jupyter** Lab_8_Notes-Plotting_with_Python Last Checkpoint: 06/14/2018 (autosaved)  Logout

File Edit View Insert Cell Kernel Widgets Help Trusted Python 3



Notes Lab 8 - Plotting with Python

In this set of notes, you will learn how to build plots using Python and a package called **matplotlib**.



Static Jupyter Notebooks Online

Notebooks rendered on GitHub

The screenshot shows a GitHub repository for 'ENGR114' by 'Professorkazarinoff'. The repository has 1 watch, 8 stars, and 0 forks. The file 'Lab01-Circuit-Python.ipynb' is selected, showing its commit history and a preview. The preview displays the notebook's title 'Lab 01 - Circuit Python' and a 'Prelab' section with instructions to read the document and browse through the introduction to Circuit Python and the Circuit Playground Express using the links below.

Branch: master ▾ ENGR114 / ENGR114-Labs / Lab01-Circuit_Python / Lab01-Circuit-Python.ipynb

Find file Copy path

SYAM107u8248 Edits to Lab 1 Circuit Python 6cb4c17 12 days ago

1 contributor

601 lines (600 sloc) | 20.9 KB

Raw Blame History

Lab 01 - Circuit Python

Prelab

Read this entire document. Browse through the introduction to Circuit Python and the Circuit Playground Express using the links below.

- <https://learn.adafruit.com/welcome-to-circuitpython>
- <https://learn.adafruit.com/adafruit-circuit-playground-express>

nbviewer

The screenshot shows the nbviewer website interface. The notebook 'matplotlib_example.ipynb' is rendered, displaying two input cells and a plot. The first cell imports numpy and matplotlib. The second cell creates a sine wave plot. The plot shows a sine wave oscillating between -1.00 and 1.00 over the range x = 0 to 12.

jupyter nbviewer

JUPYTER FAQ </> [Menu] [Refresh] [Download]

PyPDXWest-2019-10 / matplotlib_example.ipynb

```
In [1]: import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline

In [2]: x = np.arange(0, np.pi*4, 0.01)
y = np.sin(x)
plt.plot(x, y)
plt.show()
```

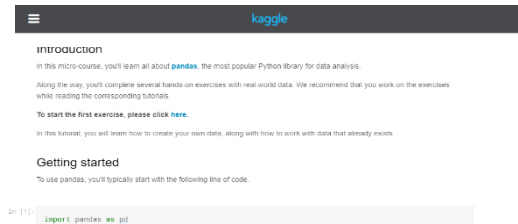
The plot shows a sine wave oscillating between -1.00 and 1.00 over the range x = 0 to 12. The x-axis is labeled from 0 to 12 in increments of 2. The y-axis is labeled from -1.00 to 1.00 in increments of 0.25.

Dynamic Jupyter Notebooks Online



Turn a Git repo into a collection of interactive notebooks

Kaggle Kernels

The image shows the Kaggle Kernels interface. At the top is a dark header with the Kaggle logo. Below it is a section titled "Introduction" with text about learning pandas. There is a link to start the first exercise. Below that is a "Getting started" section with a code cell containing `import pandas as pd`.

introduction

In this micro-course, you'll learn all about **pandas**, the most popular Python library for data analysis.

Along the way, you'll complete several hands-on exercises with real-world data. We recommend that you work on the exercises while reading the corresponding tutorials.

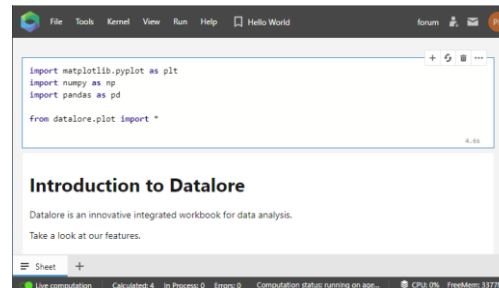
To start the first exercise, please click [here](#).

Getting started

To use pandas, you'll typically start with the following line of code.

```
import pandas as pd
```

JetBrains Datalore

The image shows the JetBrains Datalore interface. It has a dark theme with a menu bar at the top. A code editor in the center contains Python code for importing matplotlib, numpy, and pandas, and using Datalore's plot function. Below the code editor is a section titled "Introduction to Datalore" with a brief description of the platform.

File Tools Kernel View Run Help Hello World forum

```
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
from datalore.plot import *
```

4.8s

Introduction to Datalore

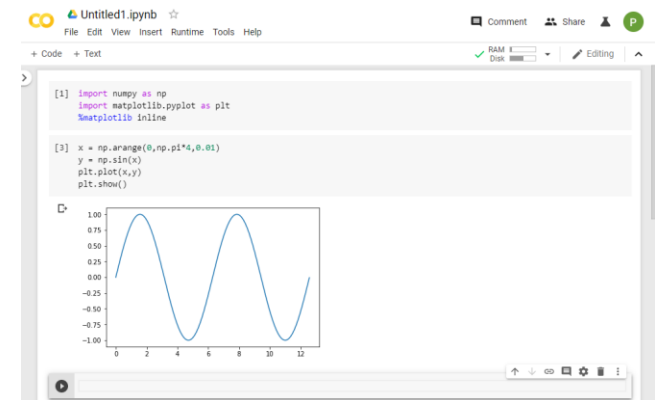
Datalore is an innovative integrated workbook for data analysis.

Take a look at our features.

Sheet +

Live computation Calculated 4 In Process 0 Errors 0 Computation status running on age... CPU 0% FreeMem: 3377MB

Google CoLab

The image shows the Google CoLab interface. It has a light theme with a menu bar at the top. A code editor in the center contains Python code for importing numpy and matplotlib, and plotting a sine wave. Below the code editor is a plot of a sine wave. The interface includes a toolbar with options for Code, Text, and a status bar showing RAM and Disk usage.

Google CoLab

Untitled1.ipynb

File Edit View Insert Runtime Tools Help

+ Code + Text

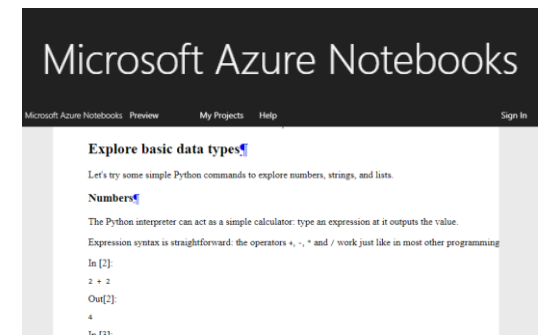
```
[1] import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline

[2] x = np.arange(0, np.pi*4, 0.01)
y = np.sin(x)
plt.plot(x, y)
plt.show()
```

1.00
0.75
0.50
0.25
0.00
-0.25
-0.50
-0.75
-1.00

0 2 4 6 8 10 12

Microsoft Azure Notebooks

The image shows the Microsoft Azure Notebooks interface. It has a dark header with the title "Microsoft Azure Notebooks" and navigation links for Preview, My Projects, Help, and Sign In. The main content area is titled "Explore basic data types" and contains text about exploring numbers, strings, and lists. It includes a section for "Numbers" with a sample Python calculation and its output.

Microsoft Azure Notebooks Preview My Projects Help Sign In

Explore basic data types

Let's try some simple Python commands to explore numbers, strings, and lists.

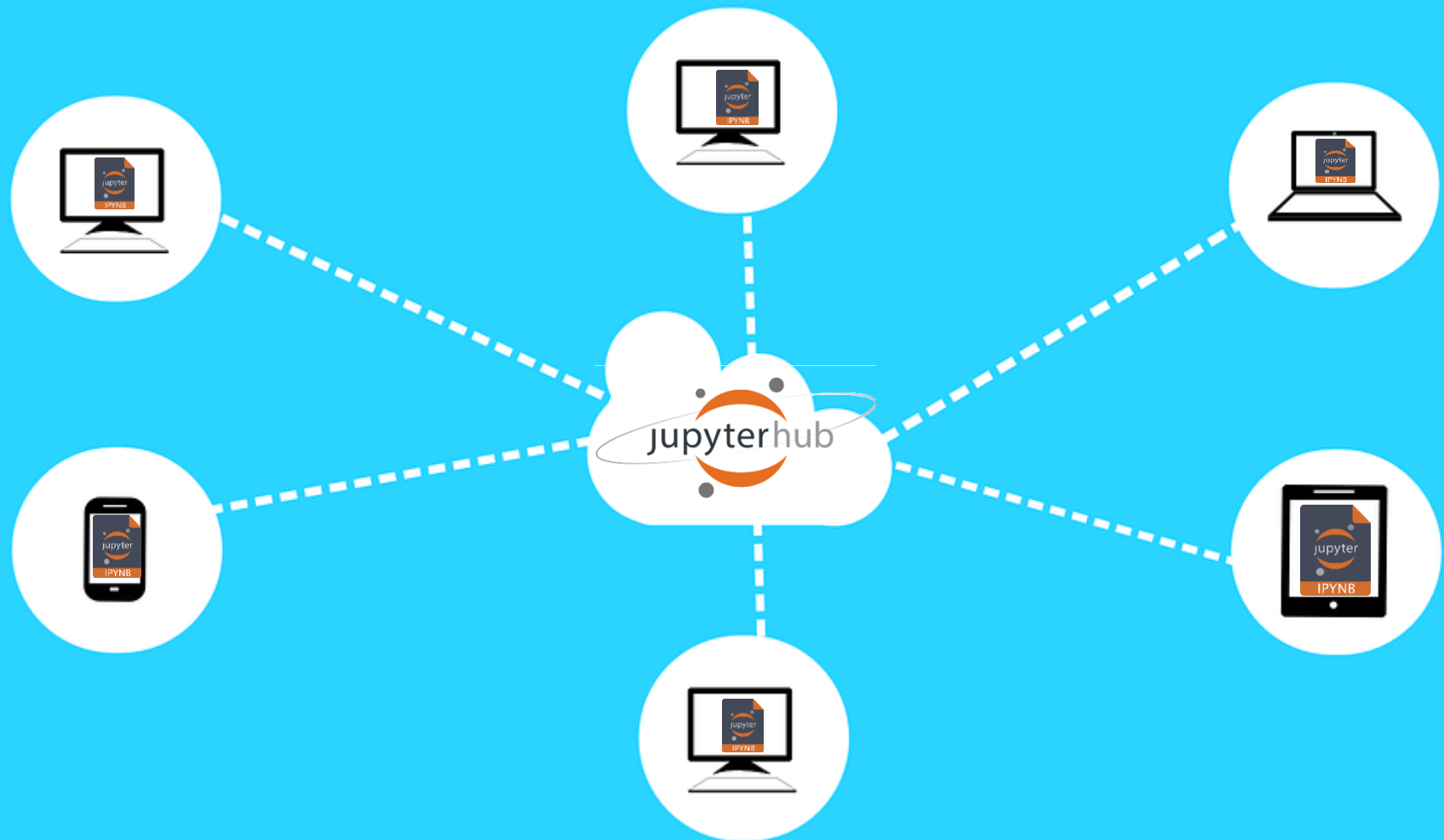
Numbers

The Python interpreter can act as a simple calculator: type an expression at it outputs the value.

Expression syntax is straightforward: the operators `+`, `-`, `*` and `/` work just like in most other programming

```
In [2]:
z + 2
Out[2]:
4
In [3]:
```


JupyterHub

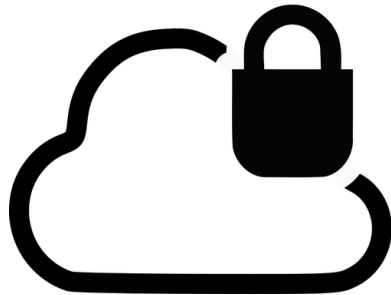


JupyterHub



Why use JupyterHub?

- You have your own OAuth and don't want to use additional usernames and passwords
- Your data is private and can't be shared in the public cloud
- Need custom packages, custom environment not available publically
- Share documents/data across users



Setting up JupyterHub



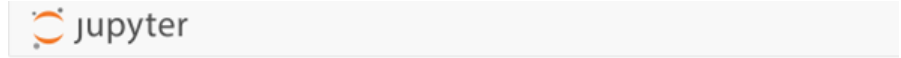
- VM (Digital Ocean, Linode, AWS, Google Cloud, Azure, or Local Server)
- Root access (can do it without, but it's more complicated)
- Install Python and JupyterHub
- Configuration file
- Domain name and SSL Cert
- Can use Nginx reverse proxy
- Authentication: PAM, GitHub, Google or other OAuth

```
peter@ubuntu-1804-jupyterhub: ~  
⚙ Authenticating with public key "rsa-key-20180516"  
Welcome to Ubuntu 18.04.3 LTS (GNU/Linux 4.15.0-65-generic x86_64)  
  
* Documentation:  https://help.ubuntu.com  
* Management:    https://landscape.canonical.com  
* Support:        https://ubuntu.com/advantage  
  
System information as of Tue Oct  8 16:28:38 UTC 2019  
  
System load:  0.0                Processes:            95  
Usage of /:   22.8% of 24.06GB    Users logged in:     0  
Memory usage: 26%                IP address for eth0: 165.22.157.61  
Swap usage:   0%  
  
* Canonical Livepatch is available for installation.  
- Reduce system reboots and improve kernel security. Activate at:  
  https://ubuntu.com/livepatch  
  
38 packages can be updated.  
0 updates are security updates.  
  
Last login: Thu Oct  3 16:18:08 2019 from 209.152.44.203  
(base) peter@ubuntu-1804-jupyterhub:~$
```

<https://jupyterhub.readthedocs.io/en/stable/>

Authentication

GitHub OAuth



PAM Authenticator (built into Linux)

Sign in

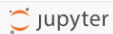
Username:


Password:

Sign In

Sign in with GitHub

Google OAuth



Portland Community College logo, featuring a stylized 'P' and 'C' inside a diamond shape.Go to PCC home

Sign in with your MyPCC account

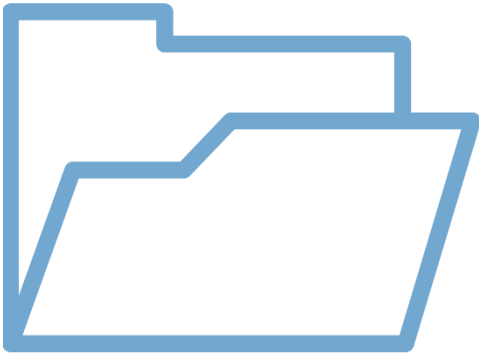
Sign in with Portland Community College

[Forgot your password?](#) [First time user?](#) [Need help logging in?](#)

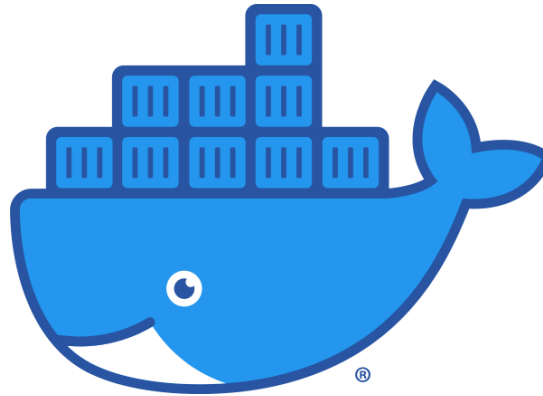
- Other OAuth Services:
BitBucket, GitLab, Globus, MediaWiki, Okpy, OpenShift, CILogon, AuthO

Storage

VM File System



Docker

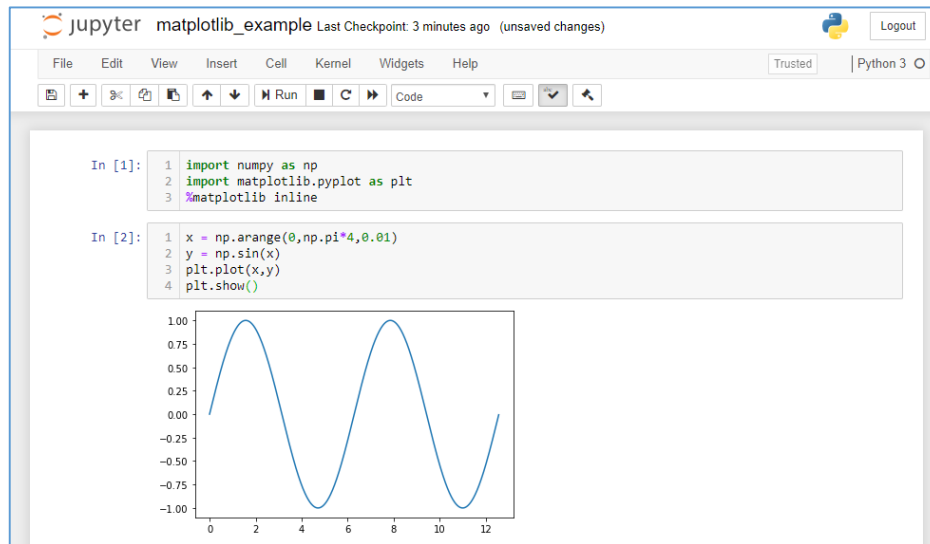


Kubernetes

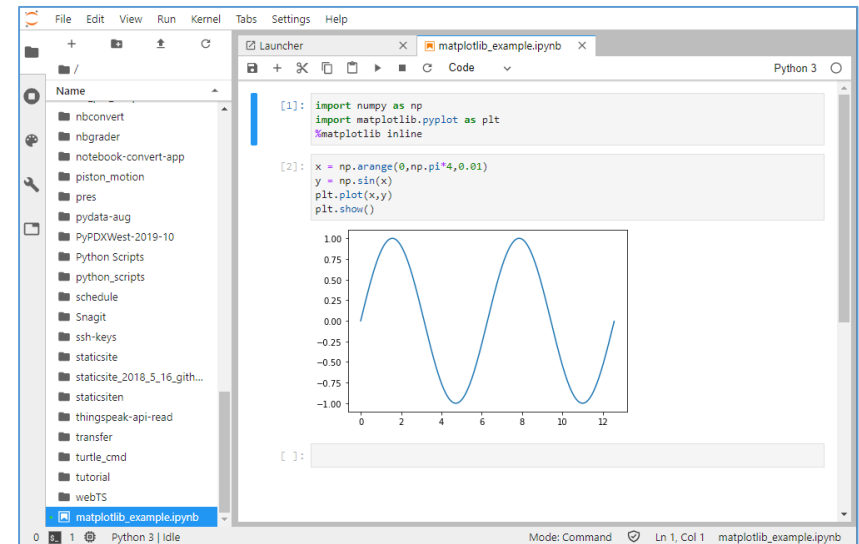


Classic Notebook or JupyterLab Interface

Classic Notebook Interface



New JupyterLab Interface



nbgitpuller Extension

Build a URL for your Users

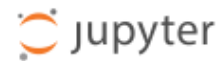
nbgitpuller link generator

JupyterHub URL	<input type="text" value="https://engr101lab.org"/>	
URL path	<input type="text" value="tree/ENGR101/course_materials"/>	optional
Repository URL	<input type="text" value="https://github.com/ProfessorKazarinoff/ENGR101"/>	
Git Branch	<input type="text" value="branch"/>	optional

Reset

<https://engr101lab.org/hub/user-redirect/git-pull?repo=https%3A%2F%2Fgithub.com%2FProfessorK>

GitHub Repo Pre-populates in user's file system



Files Running Clusters


Select items to perform actions on them.


<input type="checkbox"/> 0	/ ENGR101 / course_materials
<input type="checkbox"/>	..
<input type="checkbox"/>	assignments
<input type="checkbox"/>	notes


<https://jupyterhub.github.io/nbgitpuller/>

Try your own deployment:

<https://professorkazarinoff.github.io/jupyterhub-engr101/>

 JupyterHub-Deployment-ENGR101-2019Q1

 Search

 GitHub
4 Stars · 0 Forks

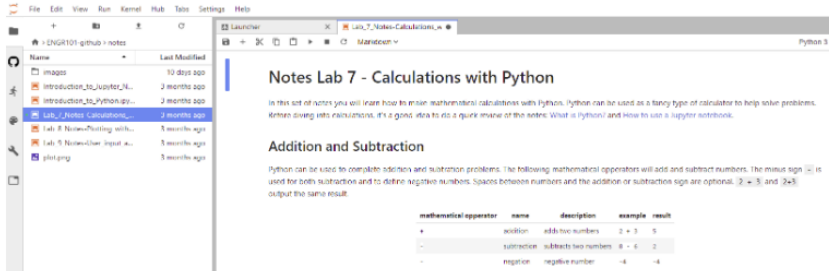
JupyterHub-Deployment-ENGR101-2019Q1

- Home
- What is JupyterHub?
- Set Up and Tools
- SSH Keys
- Server Setup
- Install JupyterHub
- DNS Routing
- SSL Certificates
- Cookie Secret and Proxy Auth Token
- Install Nginx
- Nginx Configuration
- JupyterHub Configuration
- System Service
- Add Users
- Google OAuth
- Custom Login Page
- Assignments on GitHub
- nbgitter Puller Plugin
- Extra Configuration
- Periodic Maintenance
- Optional Extras
- Useful Commands

What is JupyterHub?

JupyterHub is a server-hosted distributed Jupyter notebook environment. JupyterHub allows users to log into a server and write Python code within a web browser without any software installation on their local computer. Anywhere you have an internet connection, you can bring up a JupyterHub webpage and write/run Python code in a Jupyter notebook. The Jupyter notebook and JupyterLab interfaces that JupyterHub provides is the same Jupyter interface you run locally. Because JupyterHub runs in a web browser, it even works on tablets and phones.

Below is an image of a running JupyterHub server. The JupyterLab interface is shown.



mathematical operator	name	description	example	result
+	addition	add two numbers	2 + 3	5
-	subtraction	subtracts two numbers	8 - 6	2
-	negation	negative number	-4	-4

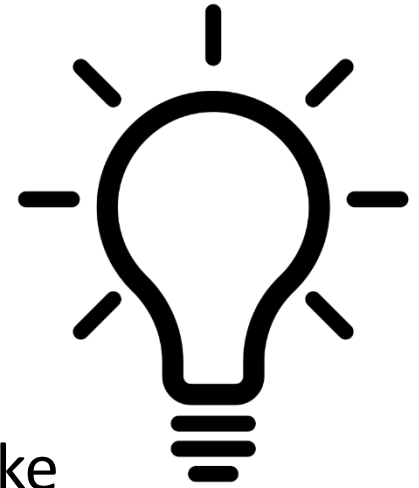
Page Contents

- Why JupyterHub?
- Summary
- Next Steps

Why JupyterHub?

Why **Jupyter Hub**? I am teaching an introductory engineering course this winter. In previous quarters, our college has taught MATLAB for three of the labs in this course. But this winter, my section is teaching **Python** and will cover the same concepts and learning outcomes.

Lessons Learned



- Authentication can be tricky. Linux does not like usernames with special characters
- A \$5/month server works with a few users. 25 users overloads a \$5/month server, use \$40/month server for a class.
- Custom log-in page is possible, but takes work (html and css)
- Use a cull idle servers script to save resources
- Document: You may want to spin up a new JupyterHub instance in the future.

Questions?



- Slides: github.com/ProfessorKazarinoff/PyPDXWest-2019-10
- My JupyterHub Deployment Docs:
<https://professorkazarinoff.github.io/jupyterhub-engr101>
- JupyterHub Docs:
<https://jupyterhub.readthedocs.io/en/stable/>
- Nbgitpuller Plugin:
<https://jupyterhub.github.io/nbgitpuller/>

I'm Looking for Guest Speakers!

- Share your experience with a community college class
- Email: peter.kazarinoff@pcc.edu or DM on Twitter @pkazarinoff

We are building a 2-year AI / Machine Learning Degree!

- Can you contribute expertise or talk us out of it?
- Email: peter.kazarinoff@pcc.edu or DM on Twitter @pkazarinoff