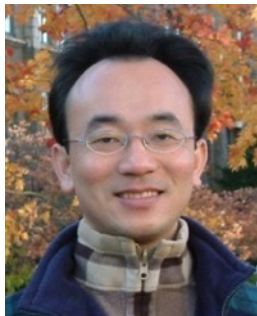


Data Structures

1141PAA04

ACC2, NTPU (U2004) (Fall 2025)

Wed 6, 7, 8, (14:10-17:00) (9:10-12:00) (B3F10)



Min-Yuh Day, Ph.D,
Professor and Director

Institute of Information Management, National Taipei University

<https://web.ntpu.edu.tw/~myday>

2025-10-01



Syllabus

Week Date Subject/Topics

1 2025/09/10 Introduction to Python for Accounting Applications

2 2025/09/17 Python Programming and Data Science

3 2025/09/24 Foundations of Python Programming

4 2025/10/01 Data Structures

5 2025/10/08 Control Logic and Loops

6 2025/10/15 Functions and Modules; Files and Exception Handling

7 2025/10/22 Data Analytics and Visualization with Python

8 2025/10/29 Self-Learning

Syllabus

Week Date Subject/Topics

9 2025/11/05 Midterm Project Report

10 2025/11/12 Obtaining Data From the Web with Python

11 2025/11/19 Statistical Analysis with Python

12 2025/11/26 Machine Learning with Python

13 2025/12/03 Text Analytics with Generative AI and Python

14 2025/12/10 Applications of Accounting Data Analytics with Python

15 2025/12/17 Applications of ESG Data Analytics with Python

16 2025/12/24 Final Project Report

Python

Data Structures

Outline

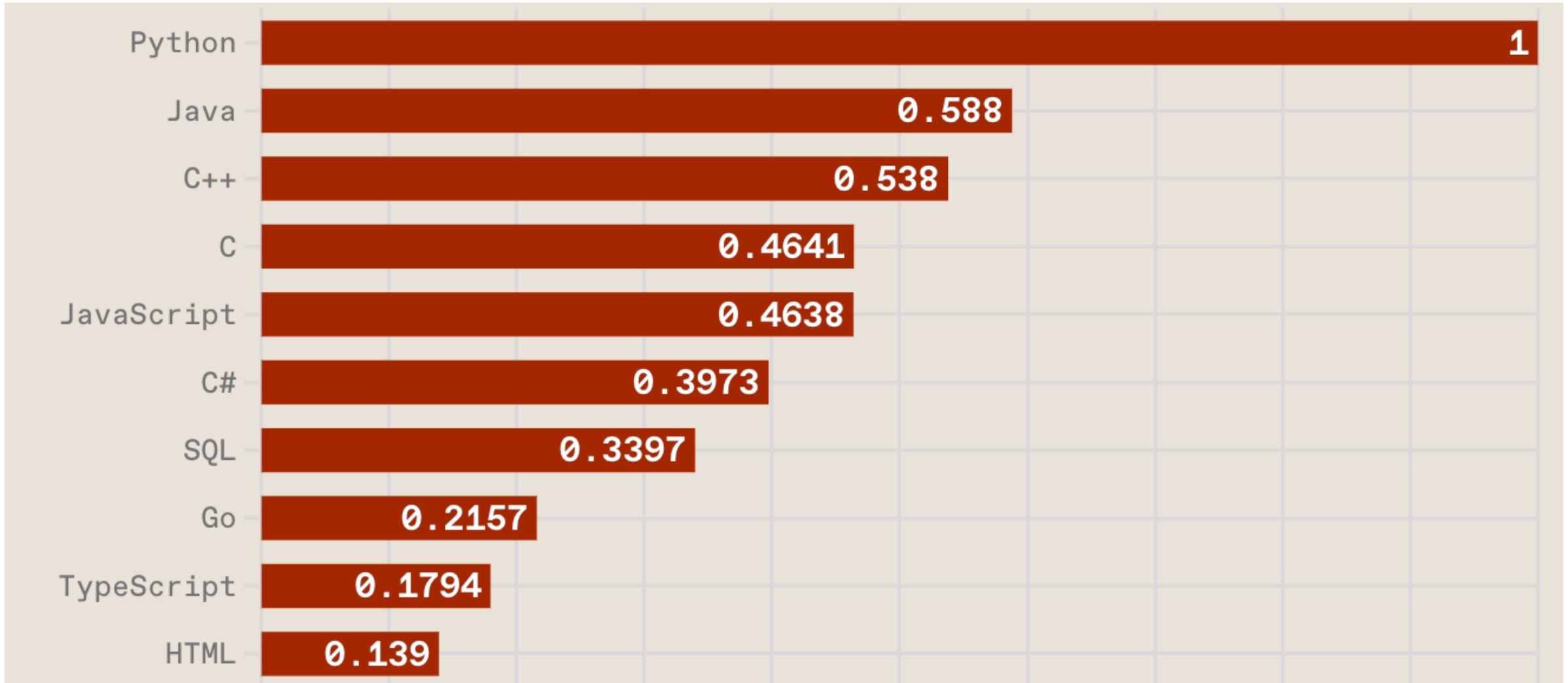
- **Python Lists []**
- **Python Tuples ()**
- **Python Sets {}**
- **Python Dictionaries {k:v}**



Python

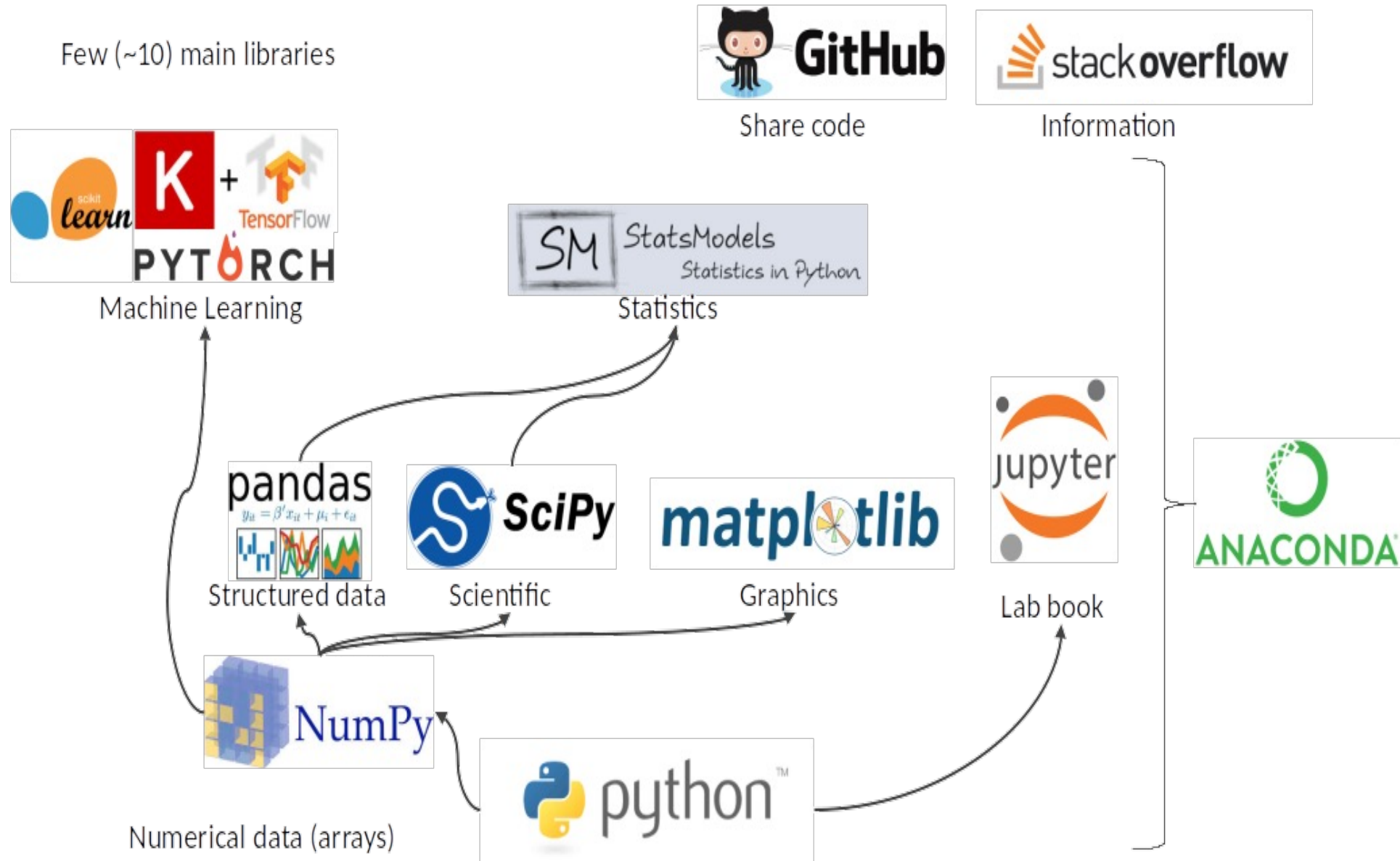
Programming

Top Programming Languages

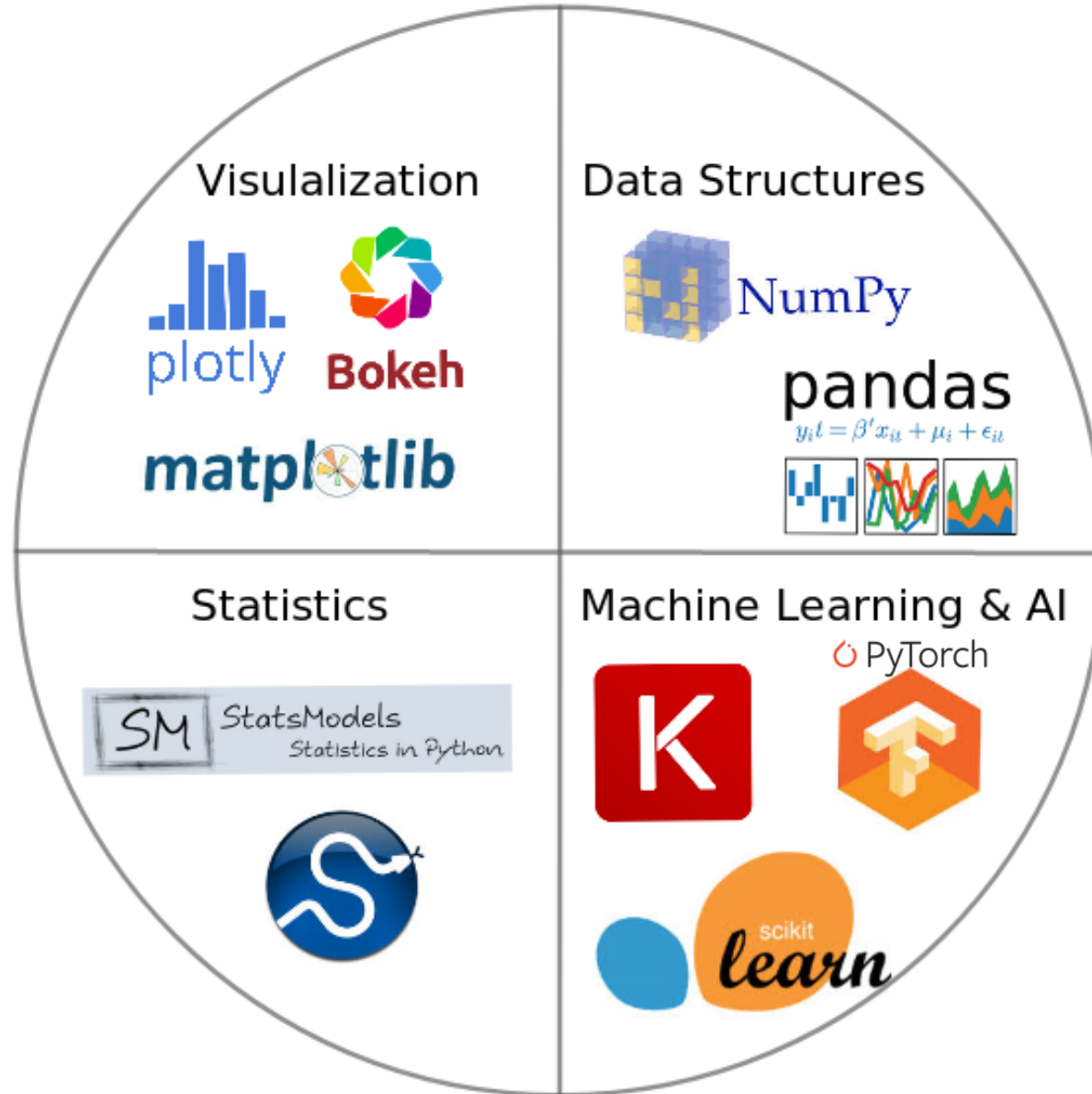


Python is an
interpreted,
object-oriented,
high-level
programming language
with
dynamic semantics.

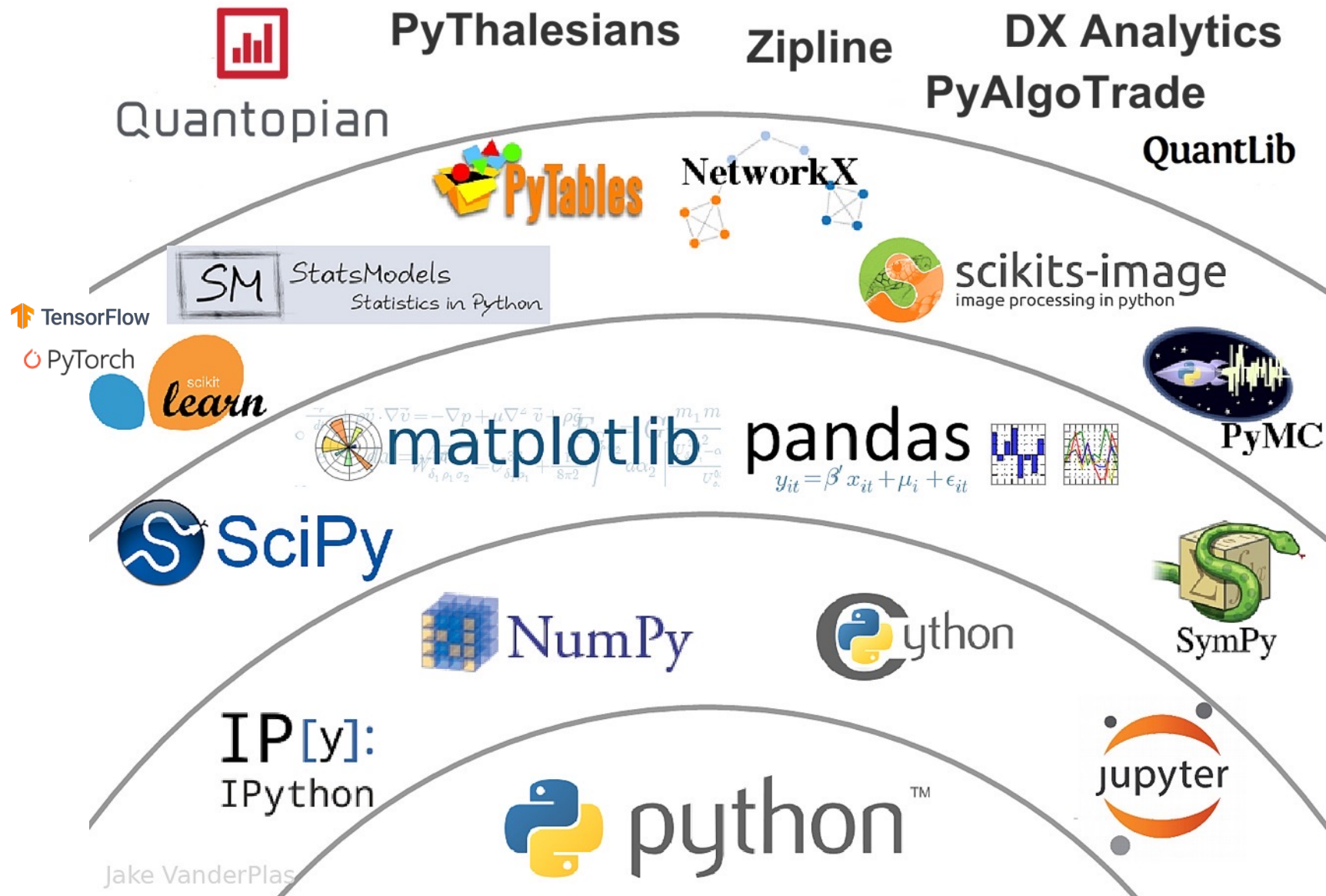
Python Ecosystem for Data Science



Python Ecosystem for Data Science



The Quant Finance PyData Stack



NumPy



NumPy

Base

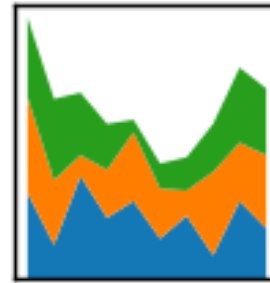
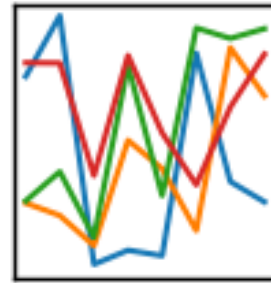
N-dimensional array
package

Python
matplotlib
matplotlib

Python Pandas

pandas

$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$



Python Tutorial

Python HOME

Python Intro
Python Get Started
Python Syntax
Python Comments
Python Variables
Python Data Types
Python Numbers
Python Casting
Python Strings
Python Booleans
Python Operators
Python Lists
Python Tuples
Python Sets
Python Dictionaries
Python If...Else
Python While Loops
Python For Loops
Python Functions

Python Tutorial

◀ Home

Next ▶

Learn Python

Python is a popular programming language.

Python can be used on a server to create web applications.

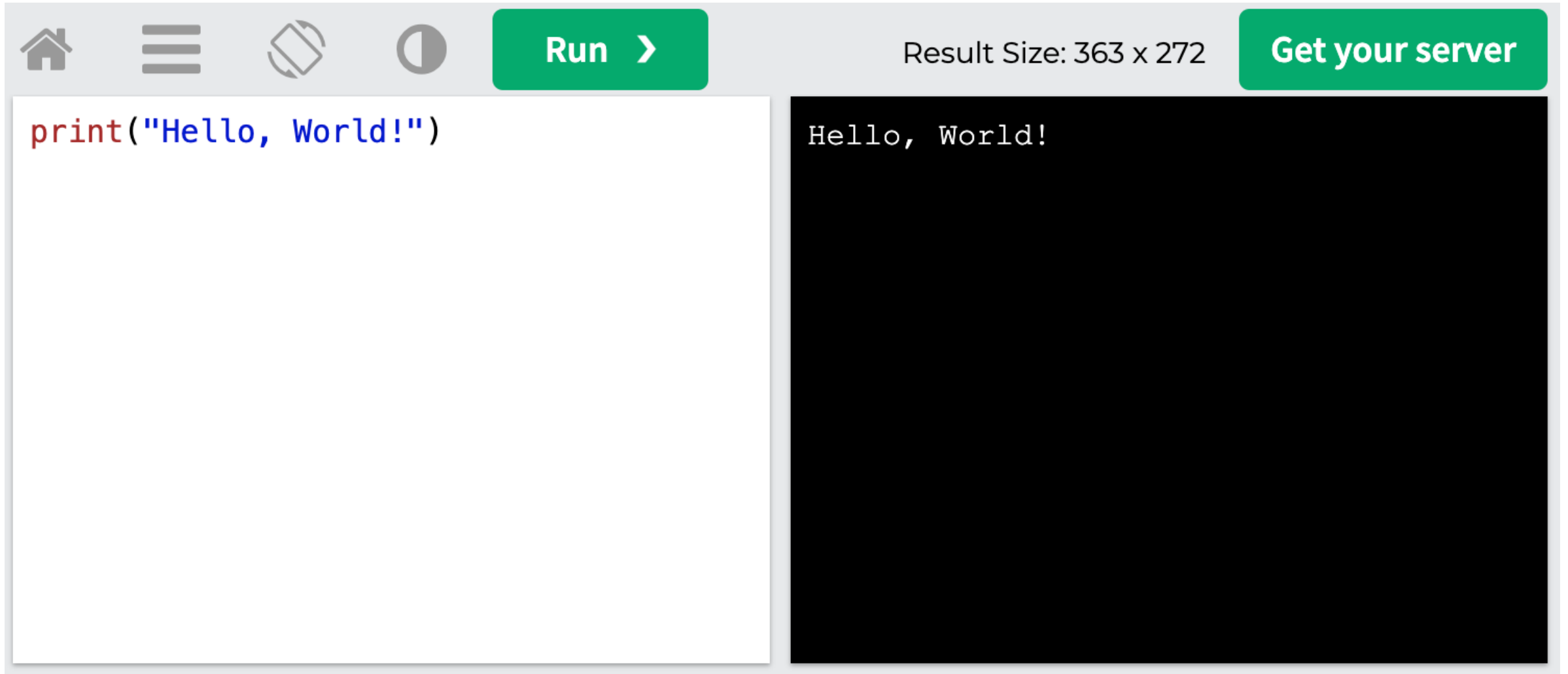
[Start learning Python now »](#)

Learning by Examples

With our "Try it Yourself" editor, you can edit Python code and view the result.

<https://www.w3schools.com/python/>

W3Schools Python: Try Python

A screenshot of the W3Schools Python 'Try Python' interface. The interface has a light gray header bar. On the left side of the header are four icons: a home icon, a menu icon (three horizontal lines), a refresh icon (a circular arrow), and a moon icon. In the center of the header is a green button with the text 'Run' and a right-pointing chevron. On the right side of the header, the text 'Result Size: 363 x 272' is displayed, followed by a green button with the text 'Get your server'. Below the header, there are two main panels. The left panel is a white text area containing the Python code `print("Hello, World!")`. The right panel is a black terminal window displaying the output 'Hello, World!' in white text.

LearnPython.org



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Get started learning Python with [DataCamp's](#) free [Intro to Python tutorial](#). Learn Data Science by completing interactive coding challenges and watching videos by expert instructors. [Start Now!](#)

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This site is generously supported by [DataCamp](#). DataCamp offers online interactive [Python Tutorials](#) for Data Science. Join **11 millions** other learners and get started learning Python for data science today!

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Welcome

Welcome to the LearnPython.org interactive Python tutorial.

Whether you are an experienced programmer or not, this website is intended for everyone who wishes to learn the Python programming language.

You are welcome to join our group on [Facebook](#) for questions, discussions and updates.

After you complete the tutorials, you can get certified at [LearnX](#) and add your certification to your LinkedIn profile.

Just click on the chapter you wish to begin from, and follow the instructions. Good luck!

<https://www.learnpython.org/>

Google's Python Class

Google for Education > Python

Search

English



Filter

Overview

Python Set Up

Python Intro

Strings

Lists

Sorting

Dicts and Files

Regular Expressions

Utilities

Lecture Videos

1.1 Introduction, strings

1.2 Lists and sorting

1.3 Dicts and files

2.1 Regular expr

2.2 Utilities

2.3 Utilities urllib

2.4 Conclusions

Python Exercises

Home > Products > Google for Education > Python

Was this helpful?

Google's Python Class

Welcome to Google's Python Class -- this is a free class for people with a little bit of programming experience who want to learn Python. The class includes written materials, lecture videos, and lots of code exercises to practice Python coding. These materials are used within Google to introduce Python to people who have just a little programming experience. The first exercises work on basic Python concepts like strings and lists, building up to the later exercises which are full programs dealing with text files, processes, and http connections. The class is geared for people who have a little bit of programming experience in some language, enough to know what a "variable" or "if statement" is. Beyond that, you do not need to be an expert programmer to use this material.

To get started, the Python sections are linked at the left -- [Python Set Up](#) to get Python installed on your machine, [Python Introduction](#) for an introduction to the language, and then [Python Strings](#) starts the coding material, leading to the first exercise. The end of each written section includes a link to the code exercise for that section's material. The lecture videos parallel the written materials, introducing Python, then strings, then first exercises, and so on. At Google, all this material makes up an intensive 2-day class, so the videos are organized as the day-1 and day-2 sections.

This material was created by [Nick Parlante](#) working in the engEDU group at Google. Special thanks for the help from my Google colleagues John Cox, Steve Glassman, Piotr Kaminski, and Antoine Picard. And finally thanks to Google and my director Maggie Johnson for the enlightened generosity to put these materials out on the internet for free under the [Creative Commons Attribution 2.5](#) license -- share and enjoy!

<https://developers.google.com/edu/python>

Google Colab

Hello, Colaboratory

File Edit View Insert Runtime Tools Help

CODE TEXT CELL COPY TO DRIVE

CONNECT EDITING

Table of contents Code snippets Files

- Getting Started
- Highlighted Features
 - TensorFlow execution
- GitHub
- Visualization
- Forms
- Examples
- Local runtime support

SECTION

Welcome to Colaboratory!

Colaboratory is a free Jupyter notebook environment that requires no setup and runs entirely in the cloud. See our [FAQ](#) for more info.

Getting Started

- [Overview of Colaboratory](#)
- [Loading and saving data: Local files, Drive, Sheets, Google Cloud Storage](#)
- [Importing libraries and installing dependencies](#)
- [Using Google Cloud BigQuery](#)
- [Forms, Charts, Markdown, & Widgets](#)
- [TensorFlow with GPU](#)
- [Machine Learning Crash Course: Intro to Pandas & First Steps with TensorFlow](#)

Highlighted Features

Seedbank

Looking for Colab notebooks to learn from? Check out [Seedbank](#), a place to discover interactive machine learning examples.

TensorFlow execution

Colaboratory allows you to execute TensorFlow code in your browser with a single click. The example below adds two matrices.

$$\begin{bmatrix} 1. & 1. & 1. \end{bmatrix} + \begin{bmatrix} 1. & 2. & 3. \end{bmatrix} = \begin{bmatrix} 2. & 3. & 4. \end{bmatrix}$$

Connect Google Colab in Google Drive

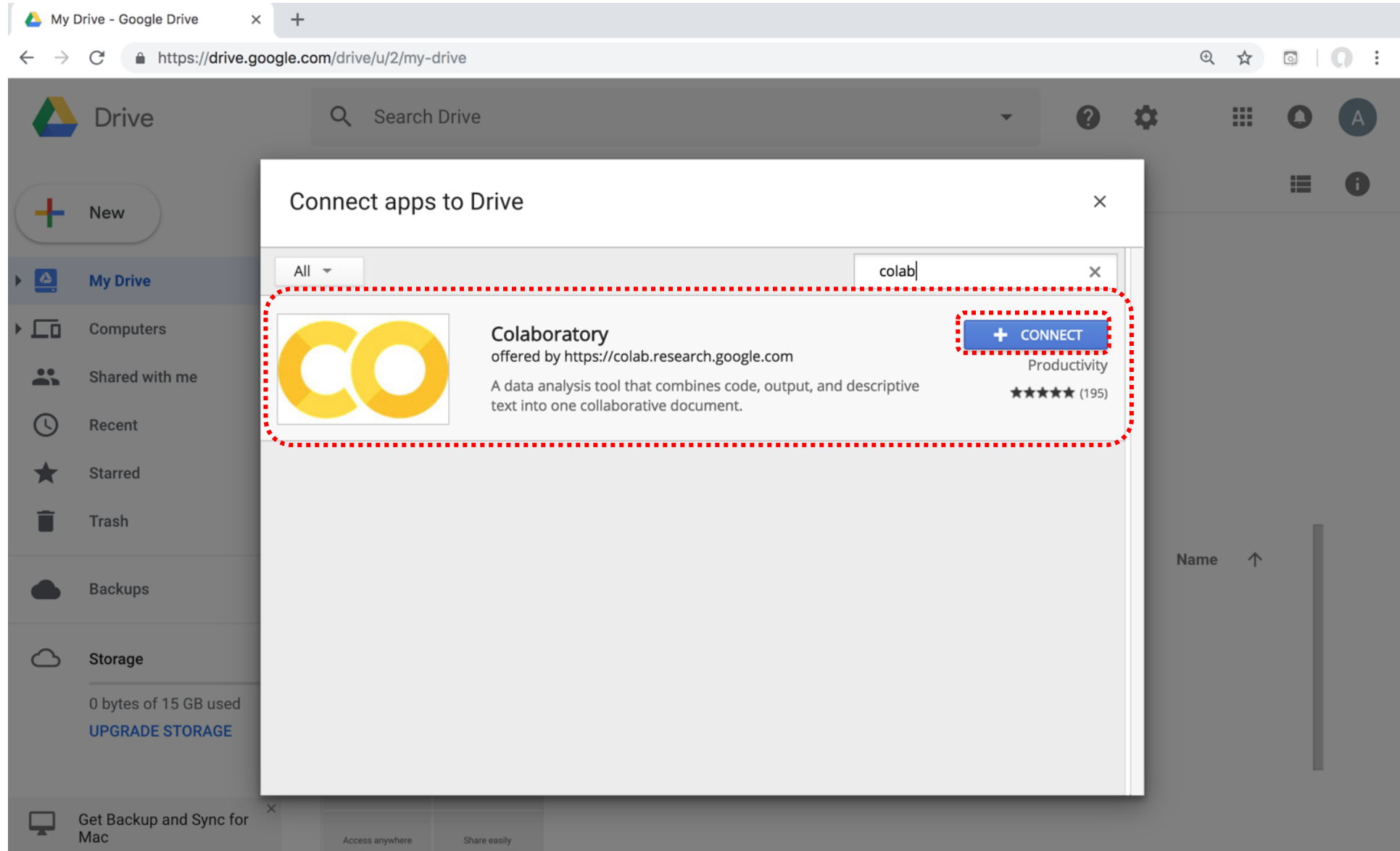
The screenshot shows the Google Drive web interface. At the top, the browser tab is labeled 'My Drive - Google Drive' and the address bar shows 'https://drive.google.com/drive/u/2/my-drive'. The Drive logo and a search bar are visible. On the left, the 'New' button is highlighted with a red dashed box. Below it, the 'My Drive' option in the sidebar is also highlighted with a red dashed box. A dropdown menu is open, showing options like 'New folder...', 'Upload files...', 'Upload folder...', 'Google Docs', 'Google Sheets', 'Google Slides', and 'More'. The 'More' option is highlighted with a red dashed box. A second dropdown menu is open from the 'More' option, showing 'Google Forms', 'Google Drawings', 'Google My Maps', 'Google Sites', and 'Connect more apps'. The 'Connect more apps' option is highlighted with a red dashed box. The main content area shows a list of files with a 'Name' header and an upward arrow. At the bottom, there is a banner for 'Get Backup and Sync for Mac'.

Google Colab

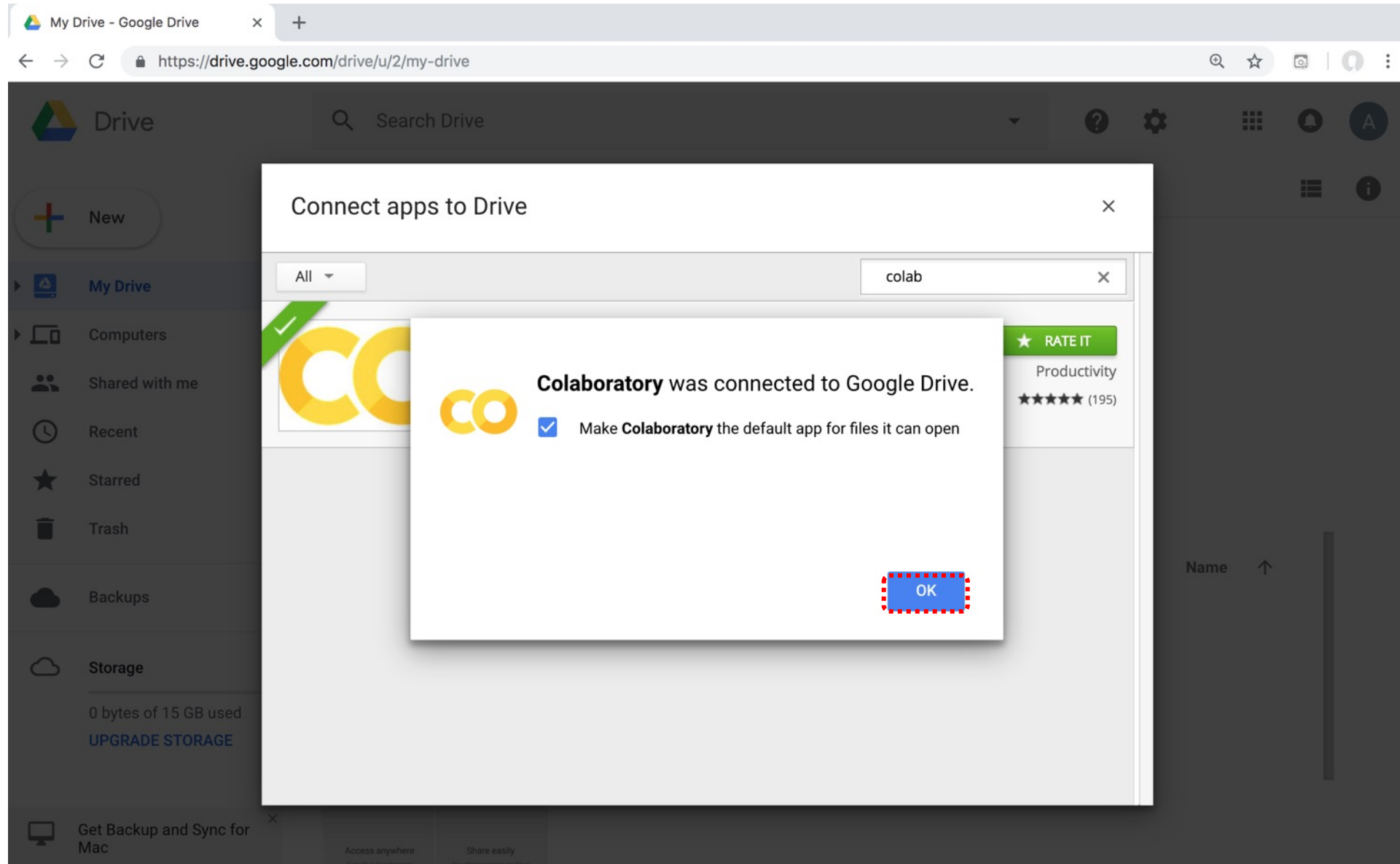
The screenshot shows the Google Drive web interface. A modal titled "Connect apps to Drive" is open in the center, displaying a grid of application cards. The "colab" app is highlighted with a red dashed border. The background interface includes a sidebar with navigation options like "My Drive", "Computers", "Shared with me", "Recent", "Starred", "Trash", "Backups", and "Storage". The top of the modal shows a search bar and a filter dropdown set to "All".

Connect apps to Drive		
All		colab
 ZIP Extractor Extract ZIP files to Google Drive Extraction complete. View extracted files Share Extract another Test.zip	 LUMIN PDF The fast and simple PDF Viewer box	 cloudconvert
ZIP Extractor 307,585 users	Lumin PDF - Beautiful PDF Editor 289,310 users	CloudConvert 373,161 users
 Sejda	 DocHub Edit, Send & Sign PDFs	 Google Forms
Merge PDF - Split PDF - Sejda.com ★★★★★ (1106)	DocHub - Edit and Sign PDF Docu... 2,131,600 users	Google Forms 4,803,614 users

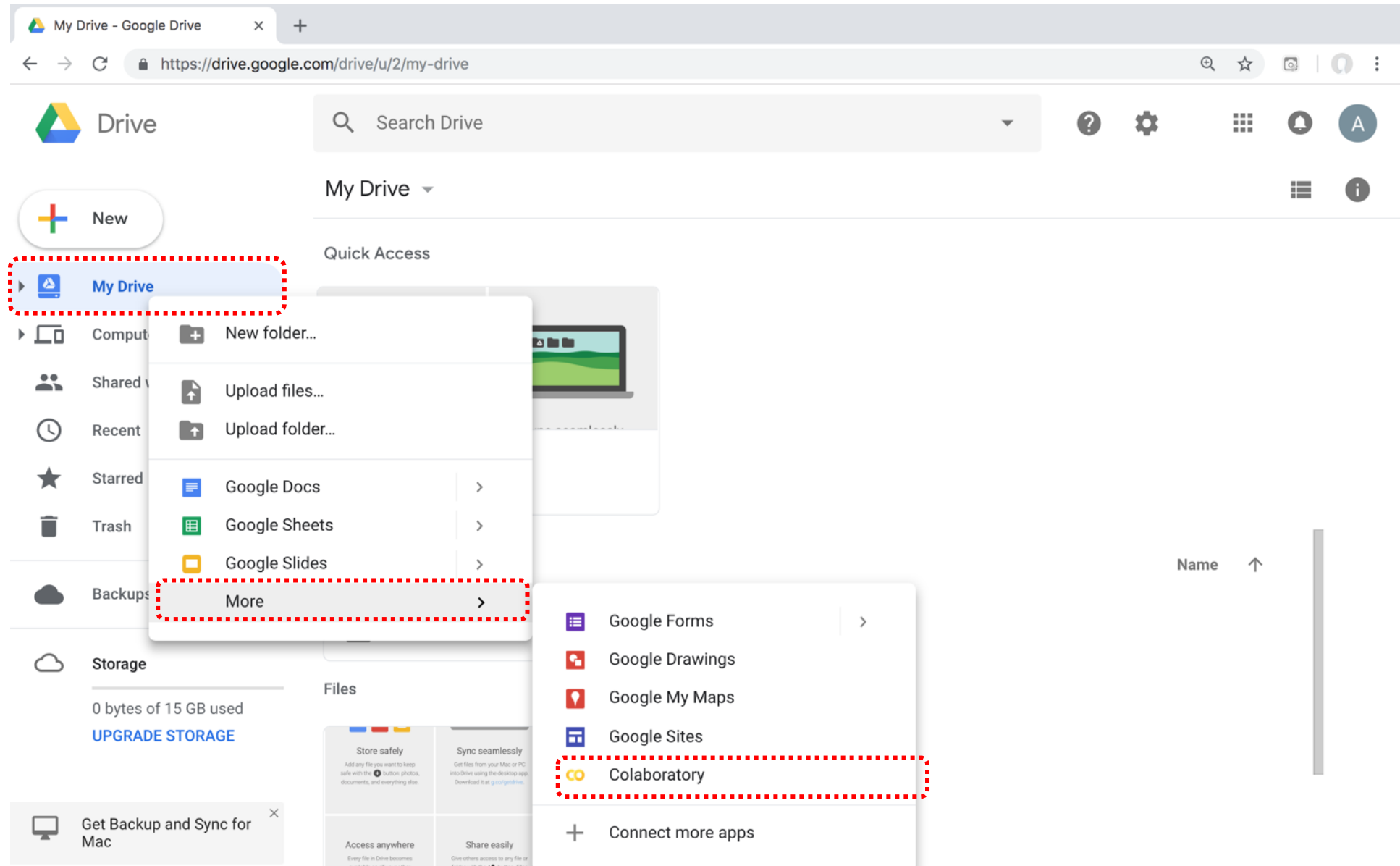
Google Colab



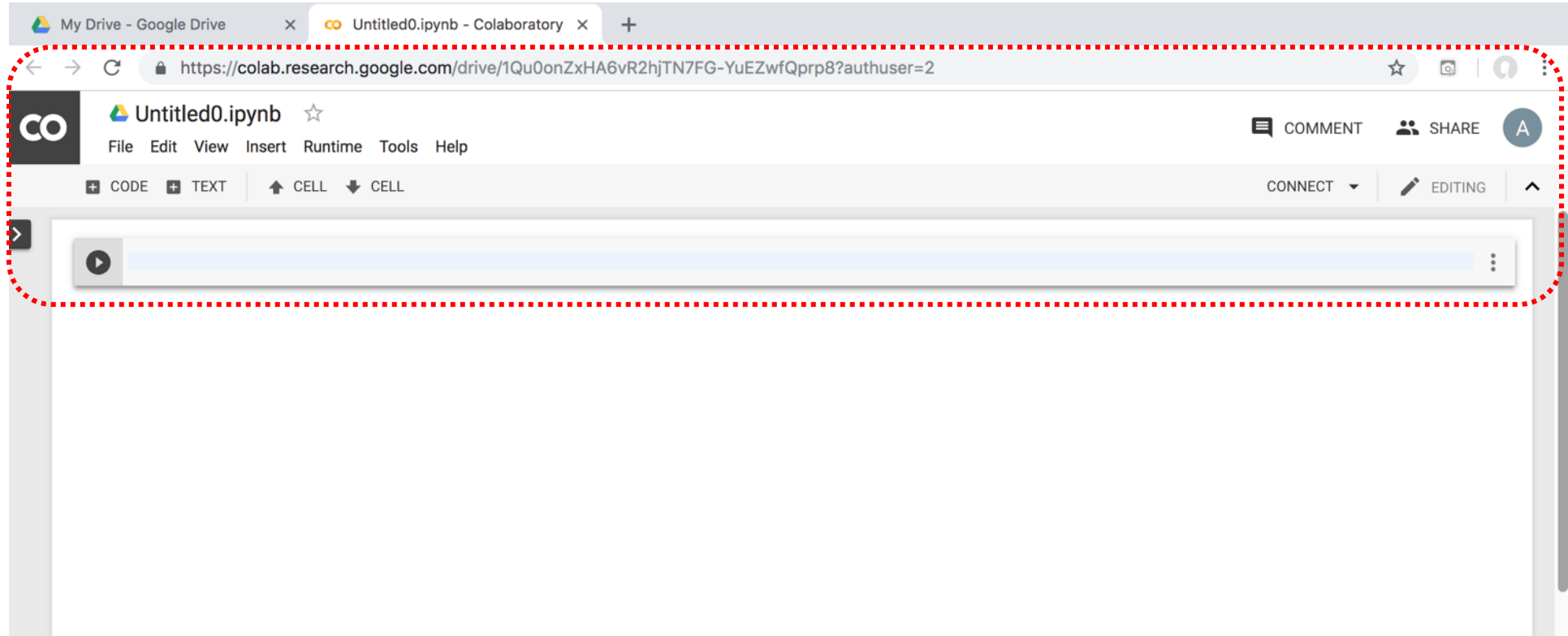
Connect Colaboratory to Google Drive



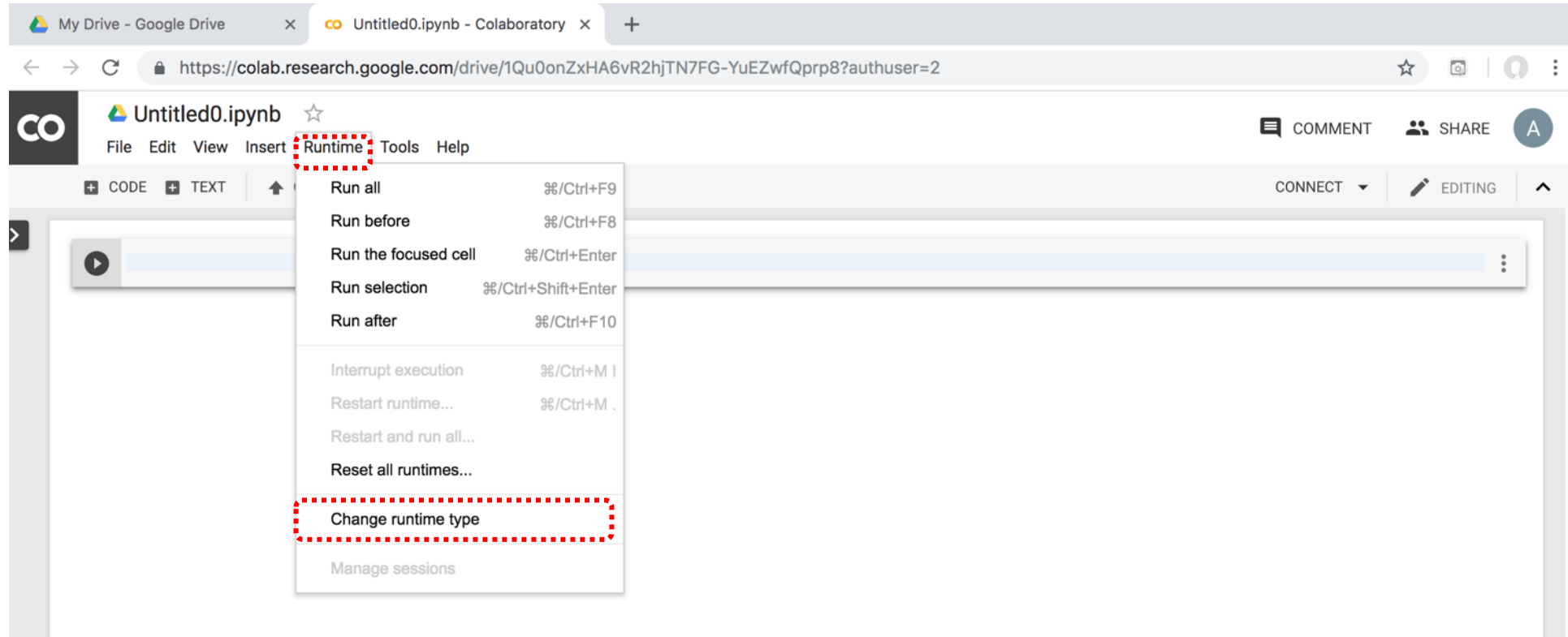
Google Colab



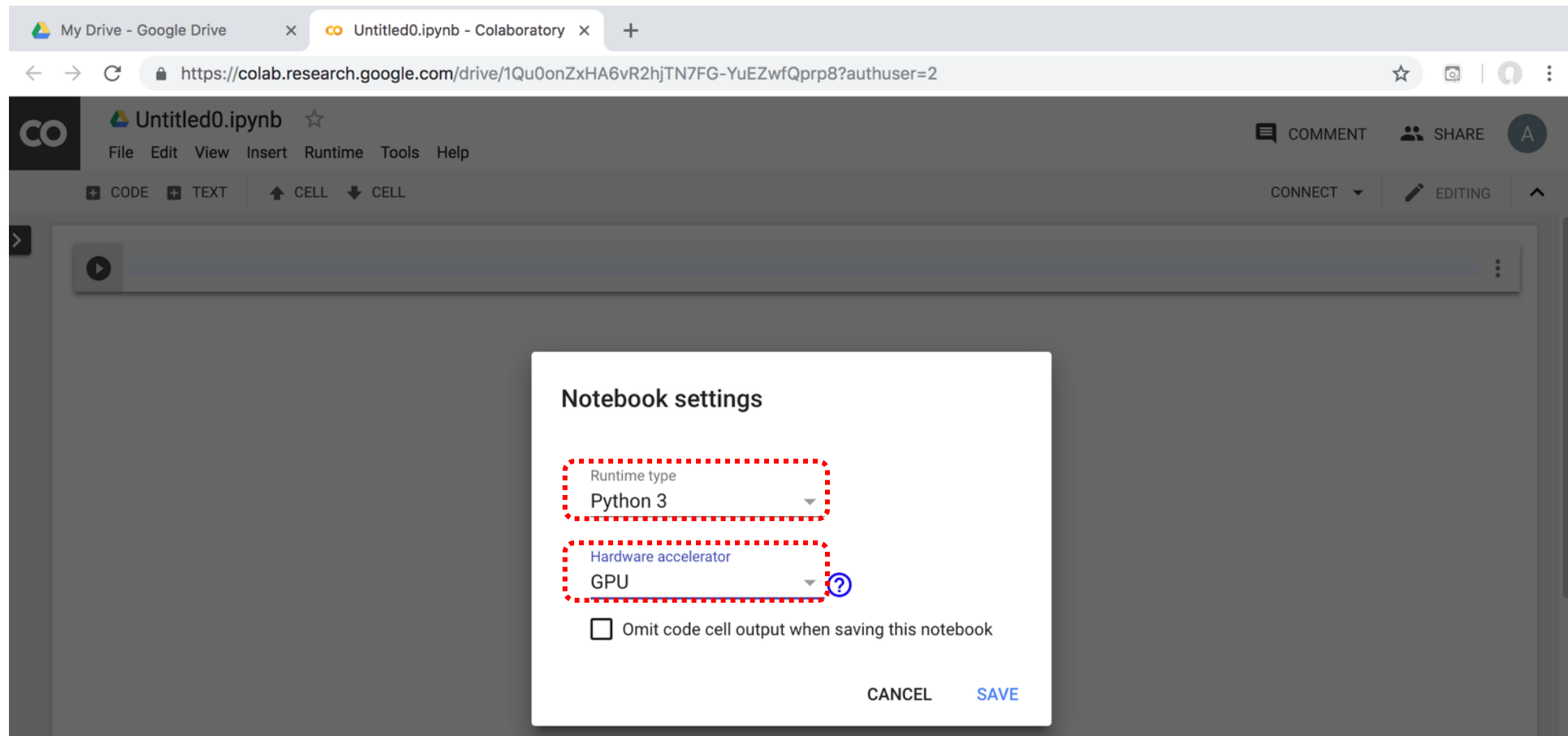
Google Colab



Google Colab



Run Jupyter Notebook Python3 GPU Google Colab



Google Colab Python Hello World

```
print('Hello World')
```



Python in Google Colab (Python101)

<https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT>

python101.ipynb - Colaboratory

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT?authuser=2#scrollTo=wsh36fLxDKC3

python101.ipynb

File Edit View Insert Runtime Tools Help

COMMENT SHARE

CODE TEXT CELL CELL

CONNECTED EDITING

```
1 # Future Value
2 pv = 100
3 r = 0.1
4 n = 7
5 fv = pv * ((1 + (r)) ** n)
6 print(round(fv, 2))
```

194.87

```
[11] 1 amount = 100
2 interest = 10 #10% = 0.01 * 10
3 years = 7
4
5 future_value = amount * ((1 + (0.01 * interest)) ** years)
6 print(round(future_value, 2))
```

194.87

```
[12] 1 # Python Function def
2 def getfv(pv, r, n):
3     fv = pv * ((1 + (r)) ** n)
4     return fv
5 fv = getfv(100, 0.1, 7)
6 print(round(fv, 2))
```

194.87

```
[13] 1 # Python if else
2 score = 80
3 if score >=60 :
4     print("Pass")
5 else:
6     print("Fail").
```

Pass

<https://tinyurl.com/aintpuppython101>



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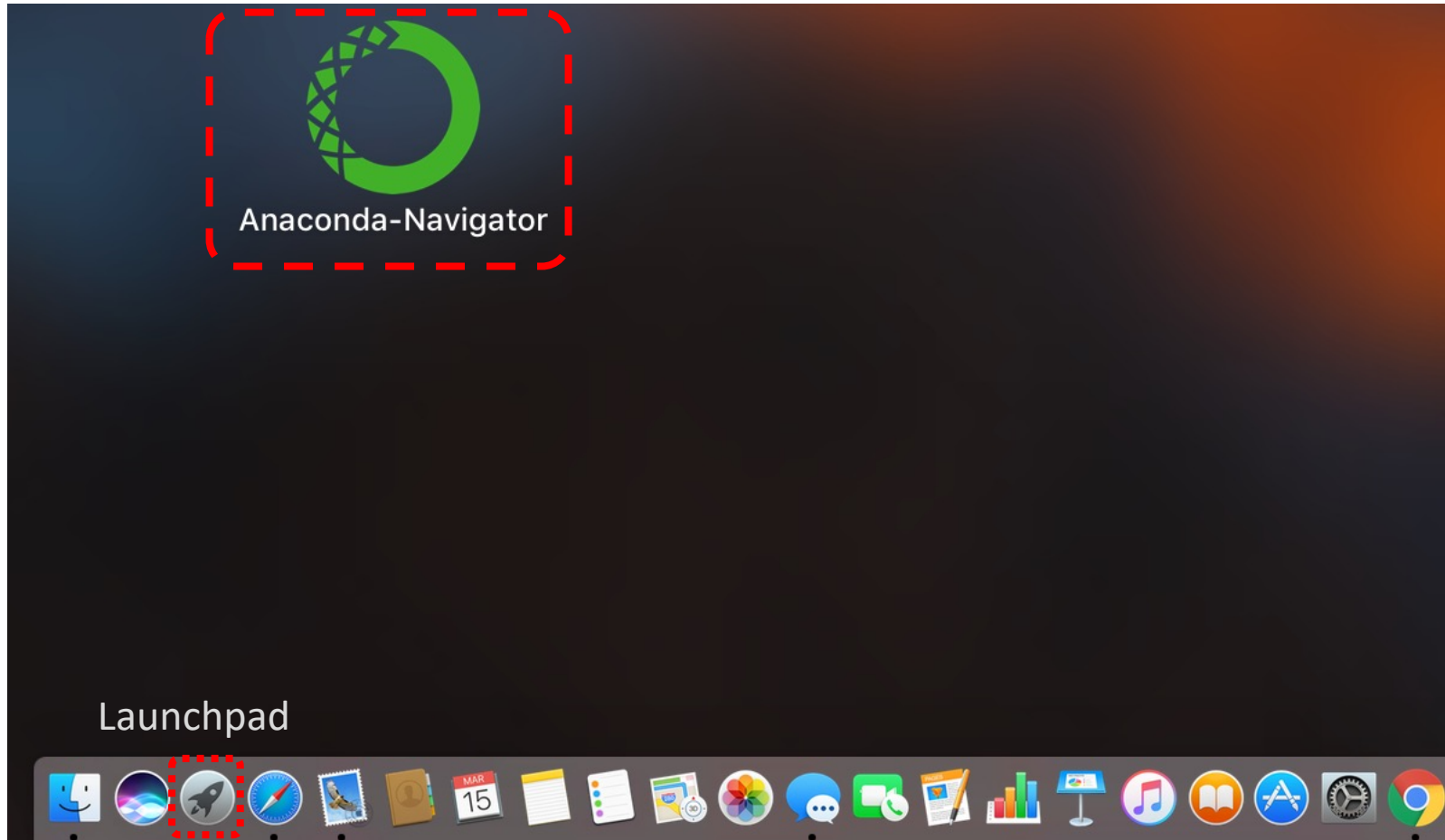




Python

HelloWorld

Anaconda-Navigator



Anaconda Navigator

ANACONDA NAVIGATOR

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Developer Blog

Feedback



Applications on base (root) Channels Refresh



jupyterlab

0.31.5

An extensible environment for interactive and reproducible computing, based on the Jupyter Notebook and Architecture.

Launch



jupyter notebook

5.4.0

Web-based, interactive computing notebook environment. Edit and run human-readable docs while describing the data analysis.

Launch



qtconsole

4.3.1

PyQt GUI that supports inline figures, proper multiline editing with syntax highlighting, graphical calltips, and more.

Launch



spyder

3.2.6

Scientific PYTHON Development EnviRonment. Powerful Python IDE with advanced editing, interactive testing, debugging and introspection features

Launch

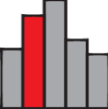


vscode

1.22.2

Streamlined code editor with support for development operations like debugging, task running and version control.

Launch



glueviz

0.12.4

Multidimensional data visualization across files. Explore relationships within and among related datasets.

Install

34

Jupyter Notebook

The screenshot displays the Jupyter Notebook web interface in a browser window. The address bar shows the URL `localhost:8888/tree/Documents/Data/BDA`. The page header includes the Jupyter logo and a "Logout" button. Below the header, there are tabs for "Files", "Running", and "Clusters", with "Files" being the active tab. A message "Select items to perform actions on them." is displayed above a list of files. The file list is currently empty, showing only a ".." entry. A red dashed box highlights the file list area. To the right of the file list, there are buttons for "Upload", "New", and a refresh icon. Below the file list, a message states "The notebook list is empty."

Home

localhost:8888/tree/Documents/Data/BDA

jupyter Logout

Files Running Clusters

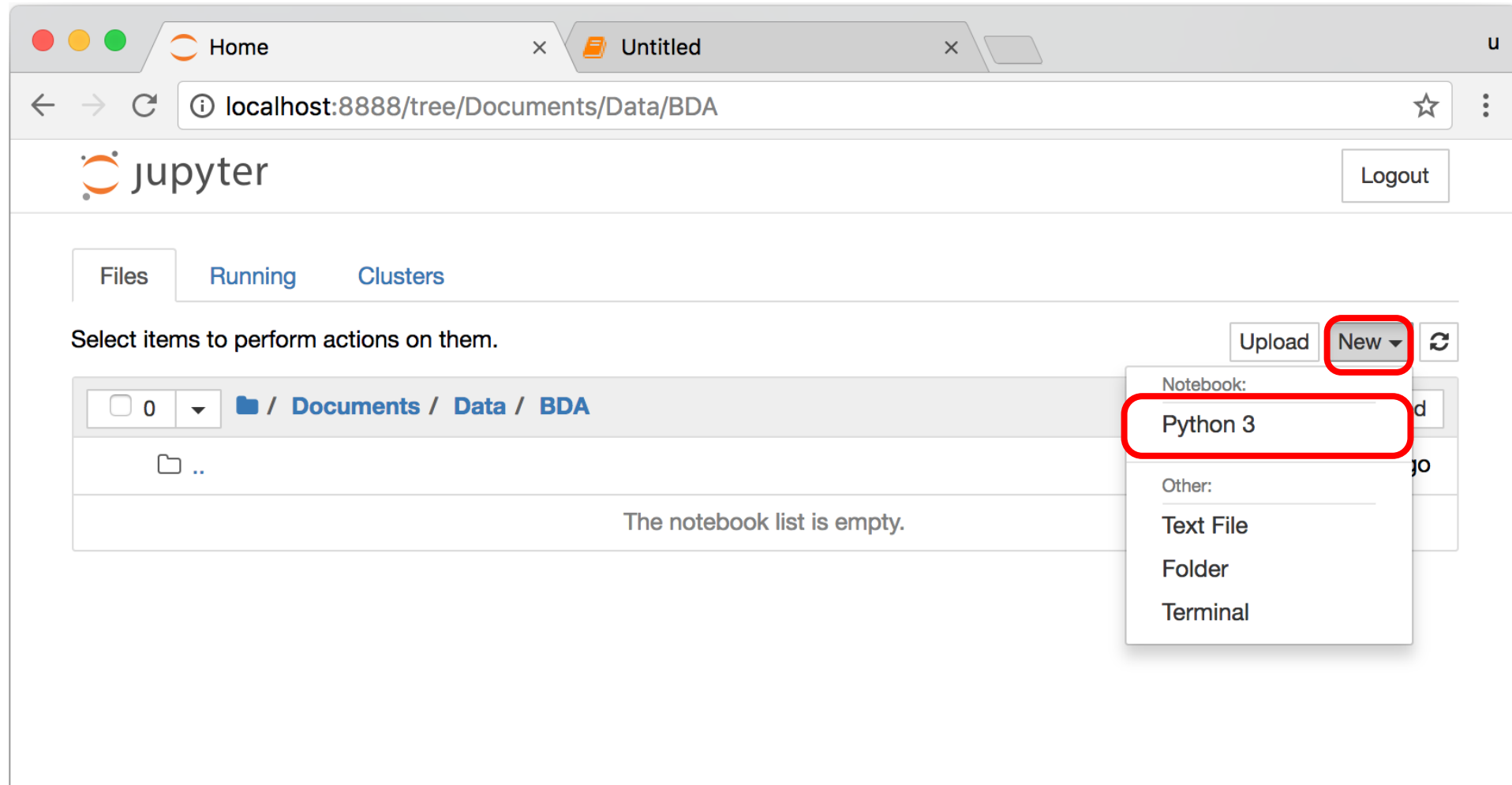
Select items to perform actions on them.

Upload New ↕ ↻

☐ 0	▼	/ Documents / Data / BDA	Name ▼	Last Modified
☐	▼	..		seconds ago
The notebook list is empty.				

Jupyter Notebook

New Python 3



print("hello, world")

The screenshot shows a web browser window with two tabs: 'Home' and 'HelloWorld'. The address bar shows the URL `localhost:8888/notebooks/Documents/Data/BDA/HelloWorld.ipynb`. The Jupyter Notebook interface is titled 'jupyter HelloWorld (autosaved)' and includes a 'Logout' button. The top menu bar contains 'File', 'Edit', 'View', 'Insert', 'Cell', 'Kernel', 'Widgets', and 'Help'. Below the menu is a toolbar with icons for saving, adding, deleting, and running cells. The 'Run' button, represented by a play icon, is highlighted with a red rectangle. The main area of the notebook displays a code cell with the prompt `In [1]:` followed by the code `print("hello, world")`. The code is highlighted with a red rectangle. Below the code, the output `hello, world` is visible. A second, empty code cell with the prompt `In [ ]:` is shown below the first one.





Python

Programming

Python Hello World

print("Hello World")

```
print("Hello World")
```

Python Syntax

comment

```
# comment
```

Python Syntax

Indentation

the spaces at the beginning of a code line
4 spaces

```
score = 80
if score >= 60 :
    print("Pass")
```

Python Variables

```
# Python Variables
```

```
x = 2
```

```
price = 2.5
```

```
word = 'Hello'
```

```
word = 'Hello'
```

```
word = "Hello"
```

```
word = '''Hello'''
```

Python Variables

```
x = 2  
y = x + 1
```

python_version()

```
# comment  
from platform import python_version  
print("Python Version:", python_version())
```

Python Version: 3.10.12

Python Data Types

```
x = "Hello World"    #str
x = 2                 #int
x = 2.5               #float
x = 7j                #complex
```

Python Data Types

```
x = ["apple", "banana", "cherry"] #list
x = ("apple", "banana", "cherry") #tuple
x = range(6) #range
x = {"name" : "Tom", "age" : 20} #dict
x = {"apple", "banana", "cherry"} #set
x = frozenset({"apple", "banana", "cherry"})
#frozenset
```

Python Data Types

```
x = True #bool
x = b"Hello" #bytes
x = bytearray(5) #bytearray
x = memoryview(bytes(5)) #memoryview
x = None #NoneType
```

Python Casting

```
x = str(3) # x will be '3'
y = int(3) # y will be 3
z = float(3) # z will be 3.0
print(x, type(x))
print(y, type(y))
print(z, type(z))
```

```
3 <class 'str'>
3 <class 'int'>
3.0 <class 'float'>
```

Python Numbers

```
x = 2 # int
y = 3.4 # float
z = 7j #complex
print(x, type(x))
print(y, type(y))
print(z, type(z))
```

```
2 <class 'int'>
3.4 <class 'float'>
7j <class 'complex'>
```

Python Arithmetic Operators

Operator Name Example

+ Addition $7 + 2 = 9$

- Subtraction $7 - 2 = 5$

* Multiplication $7 * 2 = 14$

/ Division $7 / 2 = 3.5$

// Floor division $7 // 2 = 3$ (Quotient)

% Modulus $7 \% 2 = 1$ (Remainder)

** Exponentiation $7 ** 2 = 49$

Python Basic Operators

```
print('7 + 2 =', 7 + 2)
print('7 - 2 =', 7 - 2)
print('7 * 2 =', 7 * 2)
print('7 / 2 =', 7 / 2)
print('7 // 2 =', 7 // 2)
print('7 % 2 =', 7 % 2)
print('7 ** 2 =', 7 ** 2)
```

7 + 2 = 9
7 - 2 = 5
7 * 2 = 14
7 / 2 = 3.5
7 // 2 = 3
7 % 2 = 1
7 ** 2 = 49

Python Booleans: True or False

```
# Python Booleans: True or False  
print(3 > 2)  
print(3 == 2)  
print(3 < 2)
```

Python BMI Calculator

```
# BMI Calculator in Python
height_cm = 170
weight_kg = 60
height_m = height_cm/100
BMI = (weight_kg/(height_m**2))

print("Your BMI is: " + str(round(BMI,1)))
```

Your BMI is: 20.8

Future value
of a specified
principal amount,
rate of interest, and
a number of years

How much is your \$100 worth after 7 years?

```
# How much is your $100 worth after 7 years?  
fv = 100 * 1.1 ** 7  
print('fv = ', round(fv, 2))  
# output = 194.87
```

```
fv = 194.87
```

Future Value

```
# Future Value  
pv = 100  
r = 0.1  
n = 7  
fv = pv * ((1 + (r)) ** n)  
print(round(fv, 2))
```

194.87

Future Value

```
# Future Value
amount = 100
interest = 10 #10% = 0.01 * 10
years = 7

future_value = amount * ((1 + (0.01 * interest)) ** years)
print(round(future_value, 2))
```

194.87

Python

Data Structures

Python Data Structures

- Python Lists `[]`
- Python Tuples `()`
- Python Sets `{}`
- Python Dictionaries `{k:v}`

Python Data Structures

```
fruits = ["apple", "banana", "cherry"] #lists []
colors = ("red", "green", "blue") #tuples ()
animals = {'cat', 'dog'} #sets {}
person = {"name" : "Tom", "age" : 20} #dictionaries {}
```

Python Data Types

```
x = ["apple", "banana", "cherry"] #list
x = ("apple", "banana", "cherry") #tuple
x = {"name" : "Tom", "age" : 20} #dict
x = {"apple", "banana", "cherry"} #set
```

Python Collections

- There are four collection data types in the Python programming language
- List []
 - a collection which is ordered and changeable. Allows duplicate members.
- Tuple ()
 - a collection which is ordered and unchangeable. Allows duplicate members.
- Set {}
 - a collection which is unordered, unchangeable, and unindexed. No duplicate members.
- Dictionary {k:v}
 - a collection which is ordered and changeable. No duplicate members.

Python Dictionaries {k:v}

- **As of Python version 3.7, dictionaries are ordered.**
- **In Python 3.6 and earlier, dictionaries are unordered.**

Lists []

```
x = [60, 70, 80, 90]
print(len(x))
print(x[0])
print(x[1])
print(x[-1])
```

4
60
70
90

Lists []

- **len():** how many items
- **type():** data type
- **list()** constructor: creating a new list

Python List Methods

• Method	Description
• <code>append()</code>	Adds an element at the end of the list
• <code>clear()</code>	Removes all the elements from the list
• <code>copy()</code>	Returns a copy of the list
• <code>count()</code>	Returns the number of elements with the specified value
• <code>extend()</code>	Add the elements of a list (or any iterable), to the end of the current list
• <code>index()</code>	Returns the index of the first element with the specified value
• <code>insert()</code>	Adds an element at the specified position
• <code>pop()</code>	Removes the element at the specified position
• <code>remove()</code>	Removes the item with the specified value
• <code>reverse()</code>	Reverses the order of the list
• <code>sort()</code>	Sorts the list

Tuples ()

A **tuple** in Python is a collection that **cannot be modified**.
A tuple is defined using **parenthesis**.

```
x = (10, 20, 30, 40, 50)
print(x[0])           10
print(x[1])           20
print(x[2])           30
print(x[-1])          50
```

Sets {}

```
animals = {'cat', 'dog'}  
print('cat' in animals)      True  
print('fish' in animals)     False  
animals.add('fish')  
print('fish' in animals)     True  
print(len(animals))          3  
animals.add('cat')  
print(len(animals))          3  
animals.remove('cat')  
print(len(animals))          2
```

Dictionary {key : value}

Python Dictionary

Key → Value

'EN' → 'English'

'FR' → 'French'

```
k = { 'EN': 'English', 'FR': 'French' }  
print(k['EN'])
```

English

Python Data Structures

```
fruits = ["apple", "banana", "cherry"] #lists []
colors = ("red", "green", "blue") #tuples ()
animals = {'cat', 'dog'} #sets {}
person = {"name" : "Tom", "age" : 20} #dictionaries {}
```

Summary

- **Python Lists []**
- **Python Tuples ()**
- **Python Sets {}**
- **Python Dictionaries {k:v}**

References

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