SETTING UP AND USING GOOGLE COLABORATORY FOR DEEP LEARNING APPLICATIONS

What is Google Colab?

- It is a **free cloud service** for the implementation and maintenance of **Jupyter Notebooks** online.
- Unlike Google Cloud, it supports the usage of **GPU** and **TPU** (Tensorflow Processing Units) for free.
- It currently supports scripts written in **Python 2.7** and **Python 3.6**.
- Provides a robust interface which allows easy access to anyone interested in developing Deep Learning applications using popular libraries such as **PyTorch**, **TensorFlow**, **Keras,** and **OpenCV.**

Google Colab System Specifications:

- The default size of **free Google Drive** is **15 GB**. This would act as your mount drive.
- There are **2 Intel Xeon CPUs** and each of it has **1 core** in it. And, it has a **RAM** size of **~12.6 GB**
- Size of the **GPU** is **~15 GB**
- Size of **TPU** is ~ **64 GB (8 cores, 8 GB each)**
- Google's **data privacy policy** can be viewed here
- **FAQs** on Google Colab can be viewed here

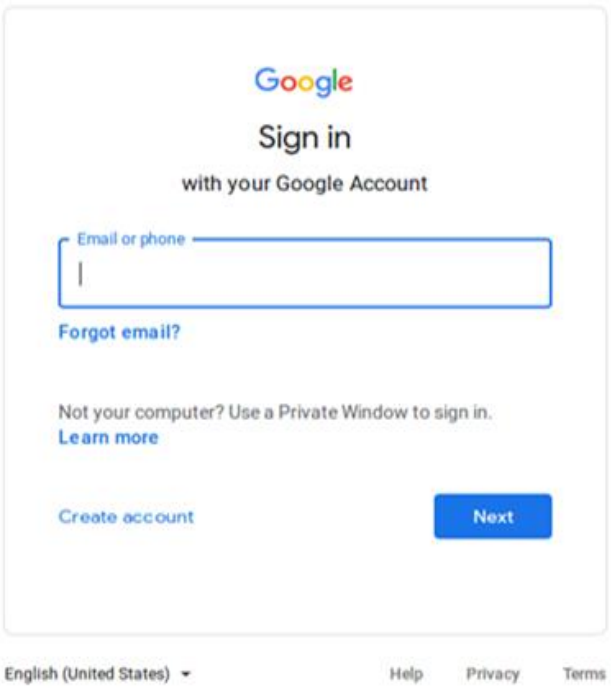
Pre-Requisites:

Google Account (MANDATORY):

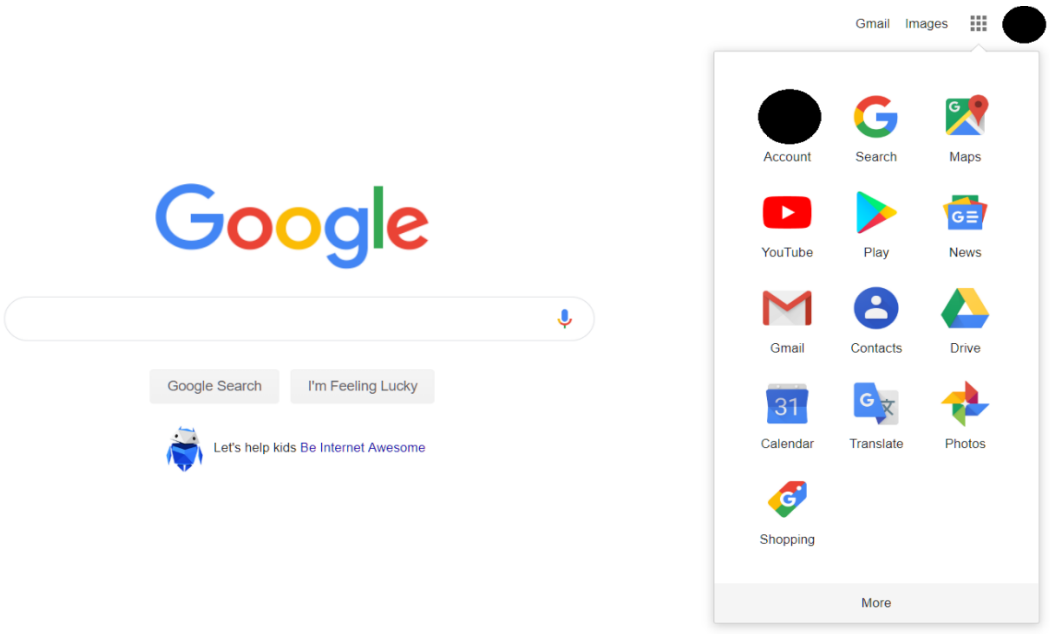
- If you already have a Google account, you can continue to Step 1 and go through with the Google Colab setup.
- Otherwise, you can refer to ***Section 1*** in the ***Appendix section given at the end of the document.***

STEPS TO START USING GOOGLE COLAB

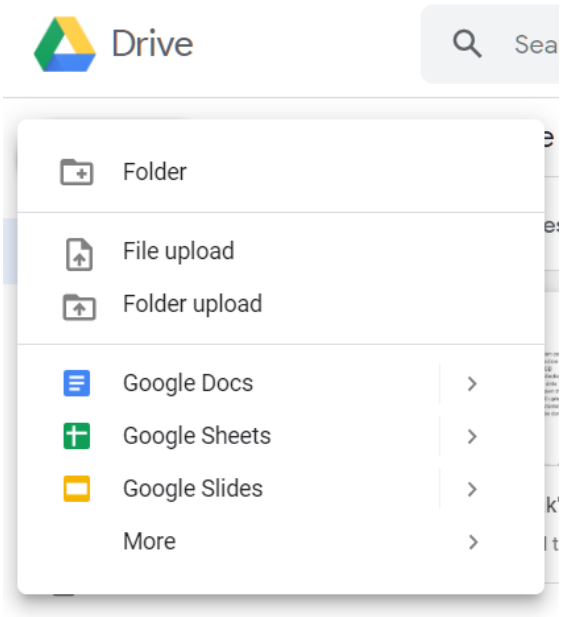
STEP 1: Sign in to your Google Account using the Link given below:
https://accounts.google.com/ServiceLogin/identifier?hl=en&passive=true&continue=https%3A%2F%2Fwww.google.com%2F&flowName=GlifWebSignIn&flowEntry=ServiceLogin



STEP 2: After login, you would be redirected to the default Google home page. Navigate to **Google Drive** from the menu on the right side as shown below:

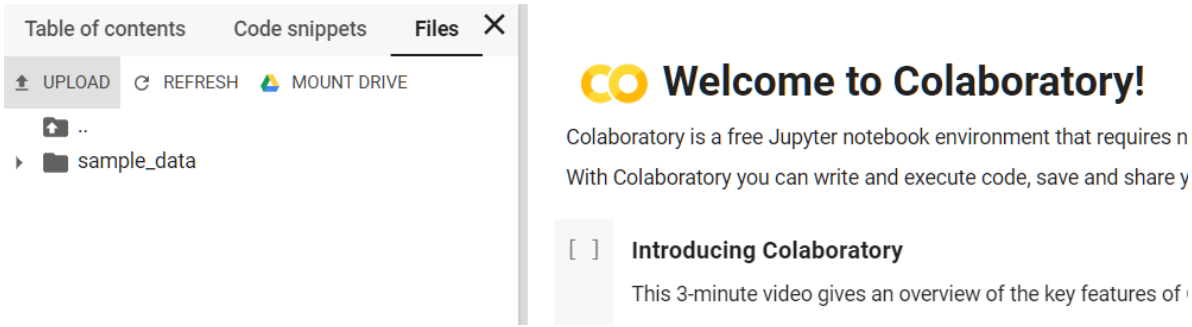


STEP 3: Create a new folder in Google Drive by clicking the '*New*' menu on the left side and then selecting '*Folder*'. You can assign any name to the folder and then click on Create. You will use this folder to store all your projects which will include Colab notebooks and any other data files.



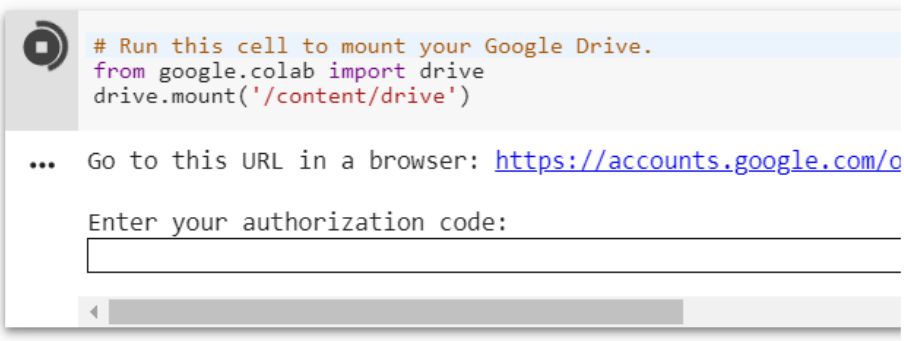
STEP 4: Navigate to **Google Colab** by typing the following link in the address bar of the browser: https://colab.research.google.com/notebooks/welcome.ipynb **Note:** When using different Web Browsers, make sure they are logged into the same Google Account when using Google Collab. This ensures that you are working with the most recent revision of your Python Notebook.

STEP 5: Click on *'Files'* present on the top-left side of the window.

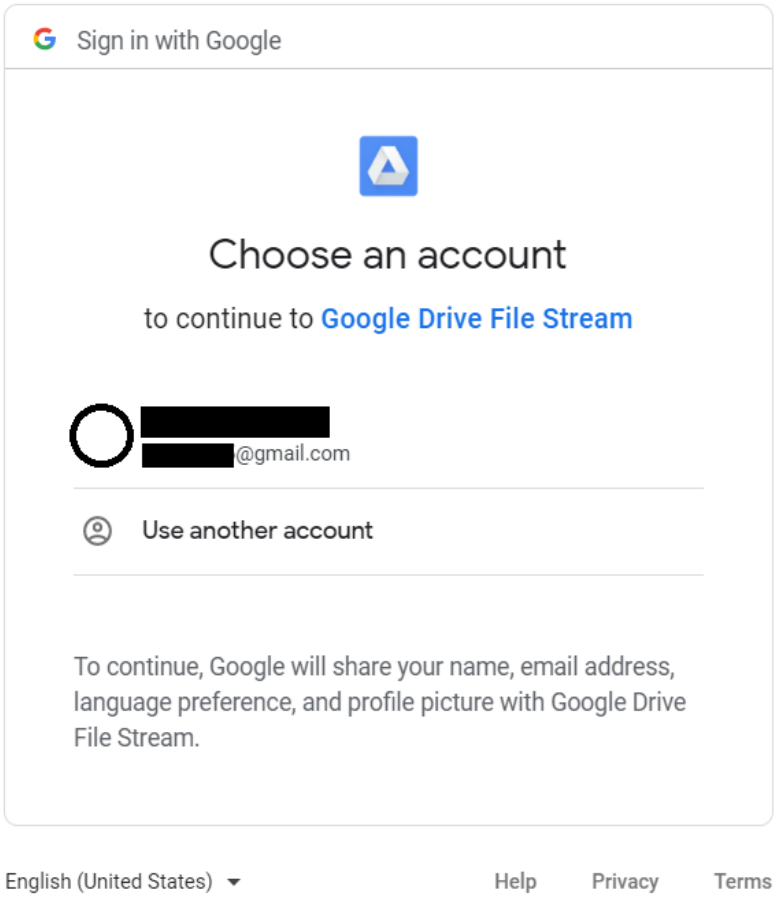


Next, click on **Mount Drive.** This will insert a new cell in the existing default notebook which will have code to mount the drive. Execute this cell by clicking on the **Play** ▶ button next to the cell.

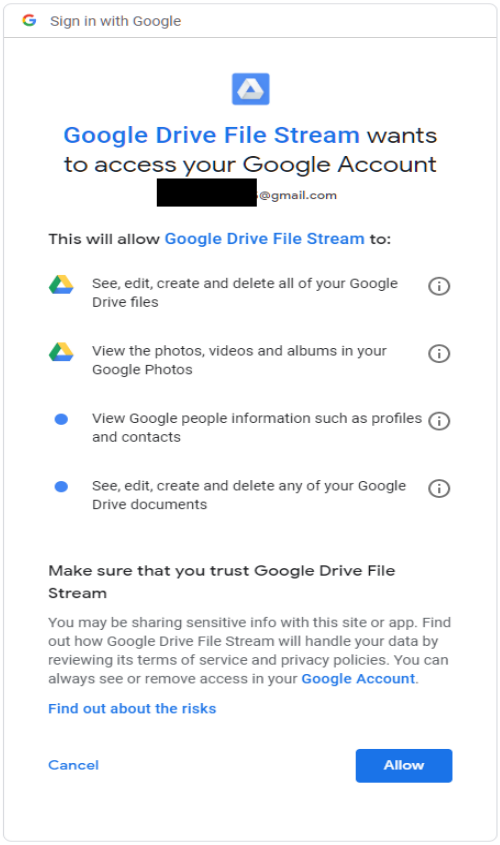
STEP 6: Click on the Link obtained in the output window as shown below:

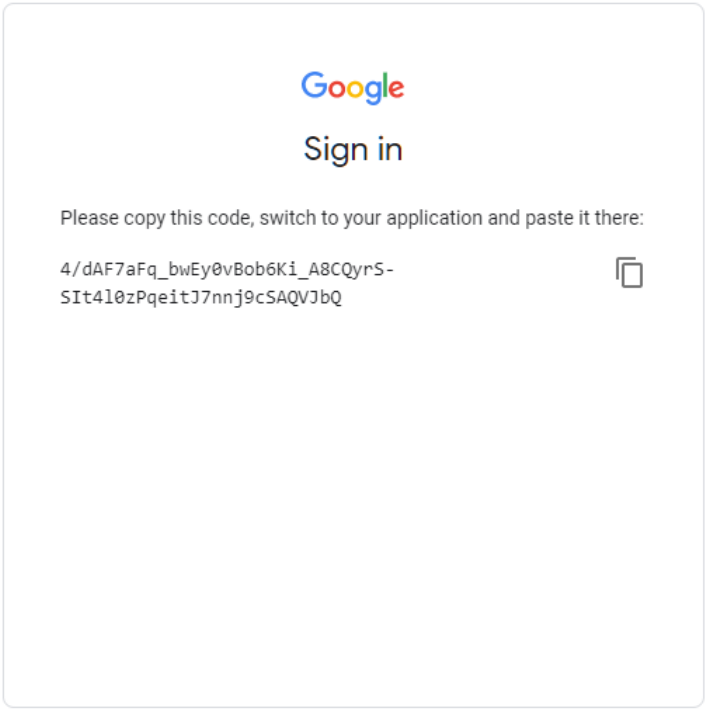


Choose your **Google** account



Click on *Allow*.

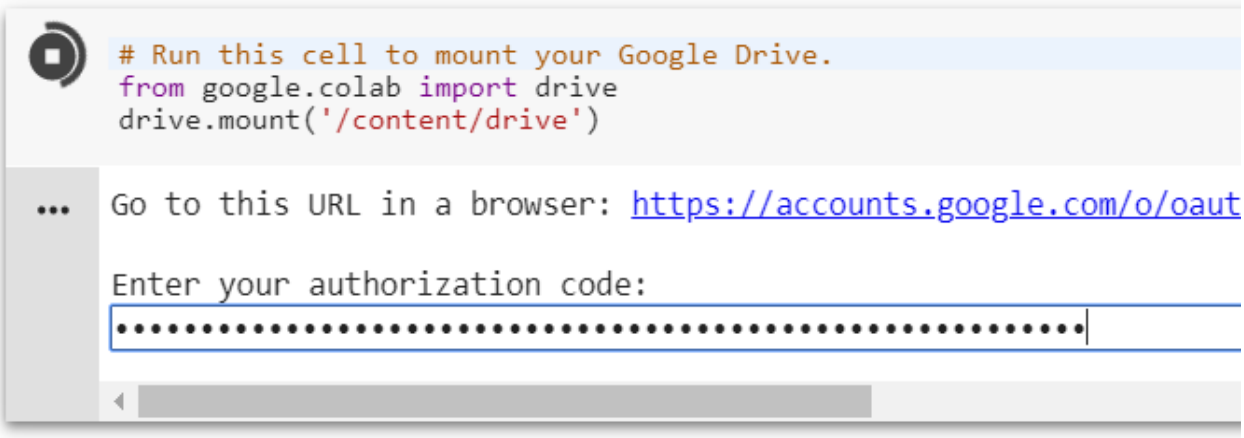




Copy and paste the above code in the box given in the output cell in our notebook and press Enter.

After some time, you will get a message stating that the drive is '*Mounted at /content/drive*'. Now, click on refresh in the explorer pane on the left. And, you should now be able to see and view your Google Drive folder.

You can access any data files by navigating to '*/content/drive*'.

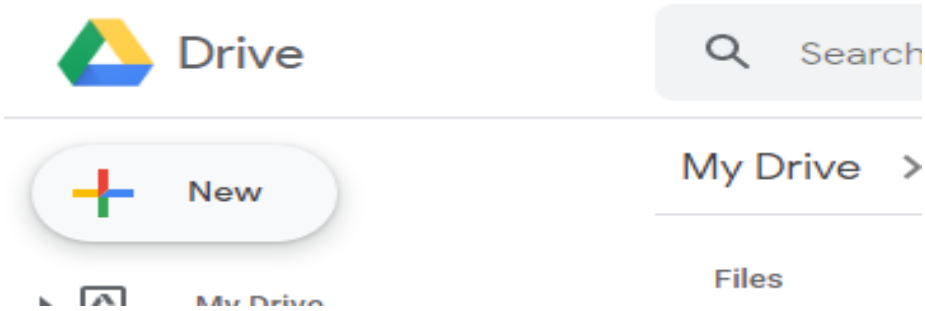


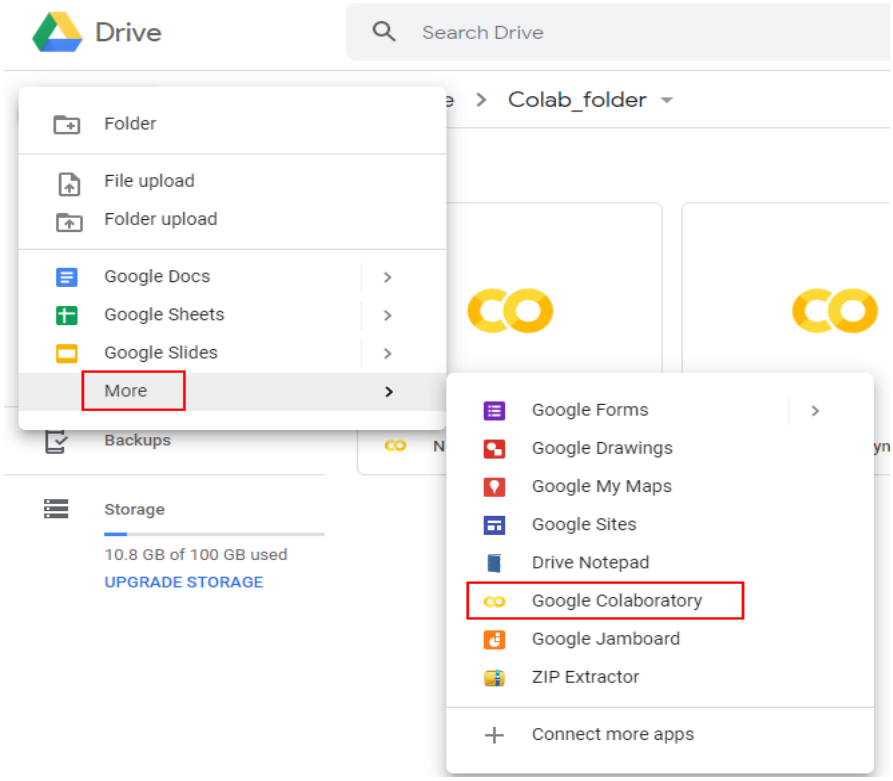
STEP 7: The setup is now complete. Now, you can create your new notebook by clicking on the *File* menu and select '*New Python 3 Notebook*' or '*New Python 2 Notebook*'.

NOTE: **Create a notebook in a Google Drive folder of your choice**

Steps for creating a notebook in a Google Drive folder of your choice is as follows:

- Go to Google Drive
- Open the folder where you want to create the notebook. (Steps for creating a folder are given in Step 3)
- Click on '*New*' → '*More*' → *'Google Colaboratory'*



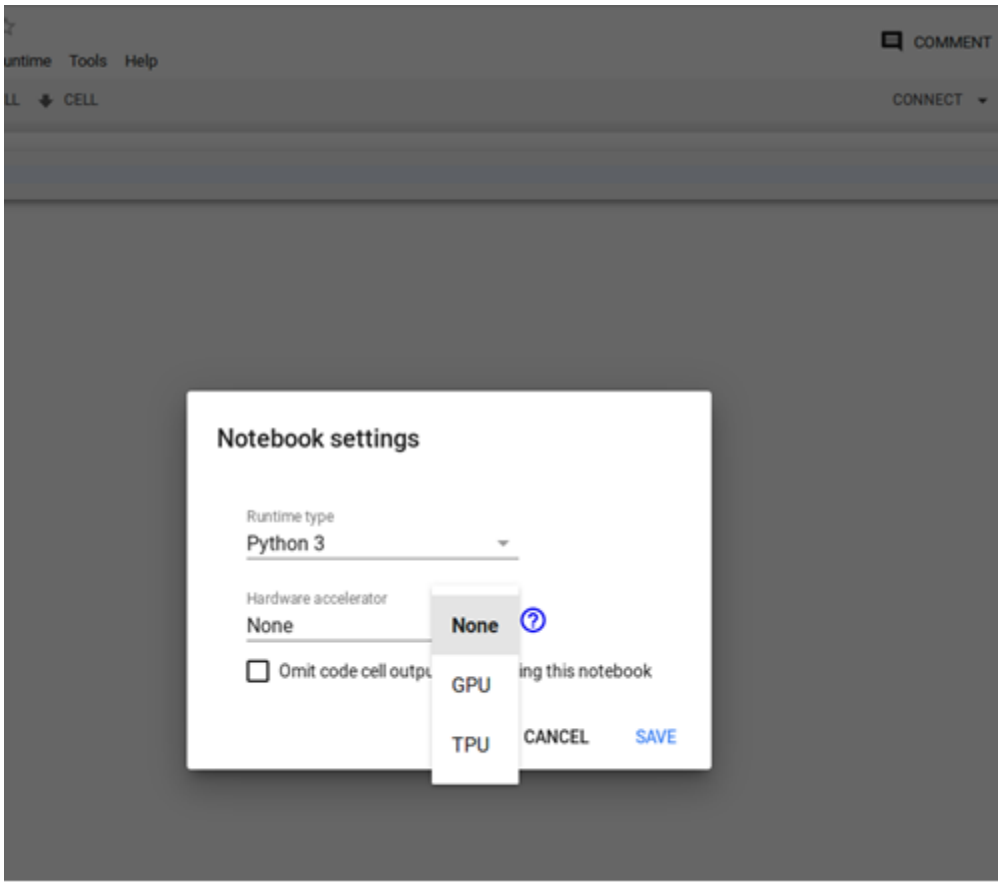


- Notebook will open in a new tab

STEP 8: After you open your new notebook, if you want to use GPU for processing your code, follow the steps below:

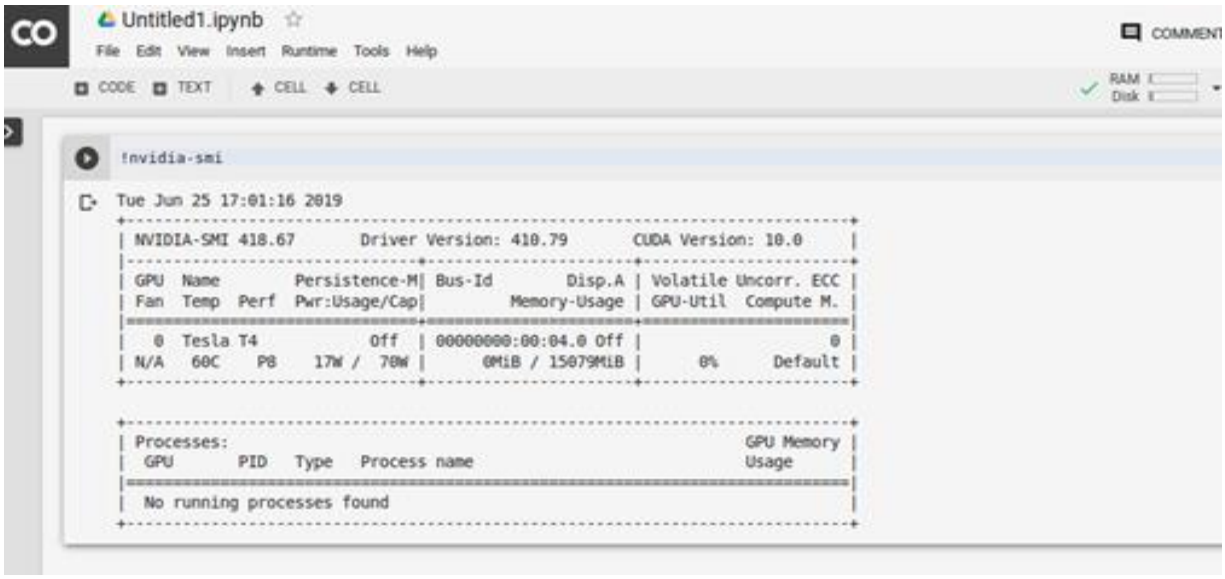
- Go to '*Runtime*' menu
- Click on '*Change Runtime Type*'
- Click on '*Hardware Accelerator*'
- Select '*GPU*' and click '*Save*'

You should now be able to access the GPU in your notebook.



Create a new cell by clicking on **CODE**

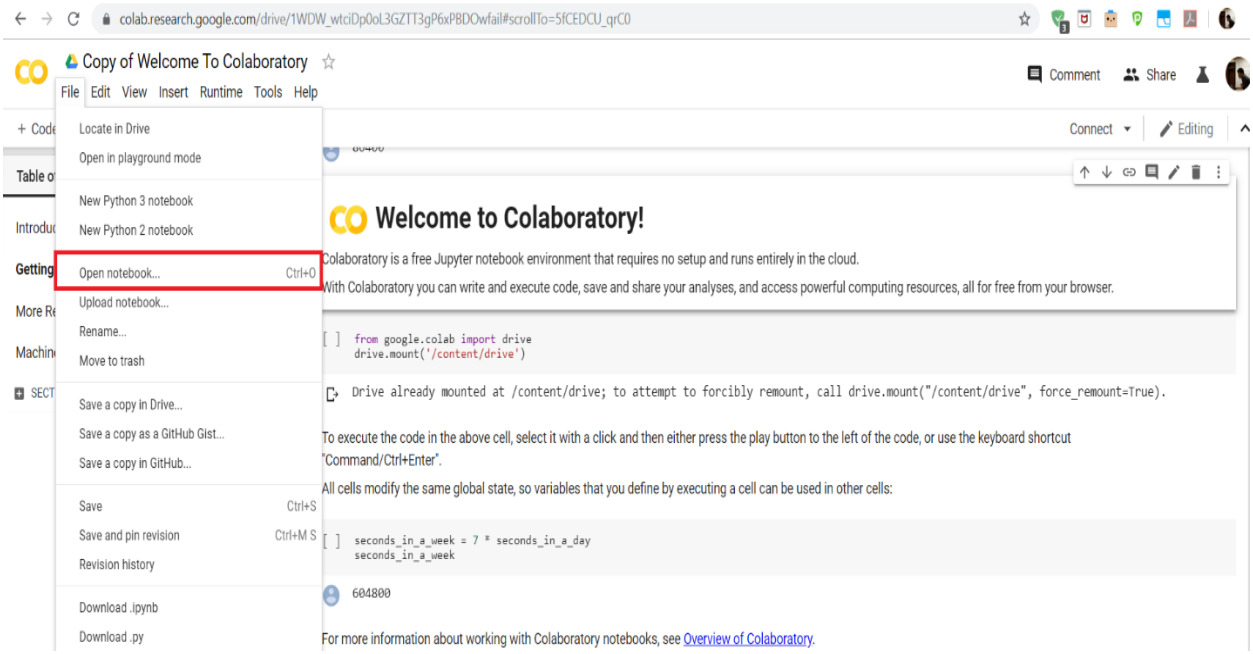
Type '*!nvidia-smi*' in the cell and execute it. If the notebook is using GPU you should be able to see the output as shown in the screenshot below.



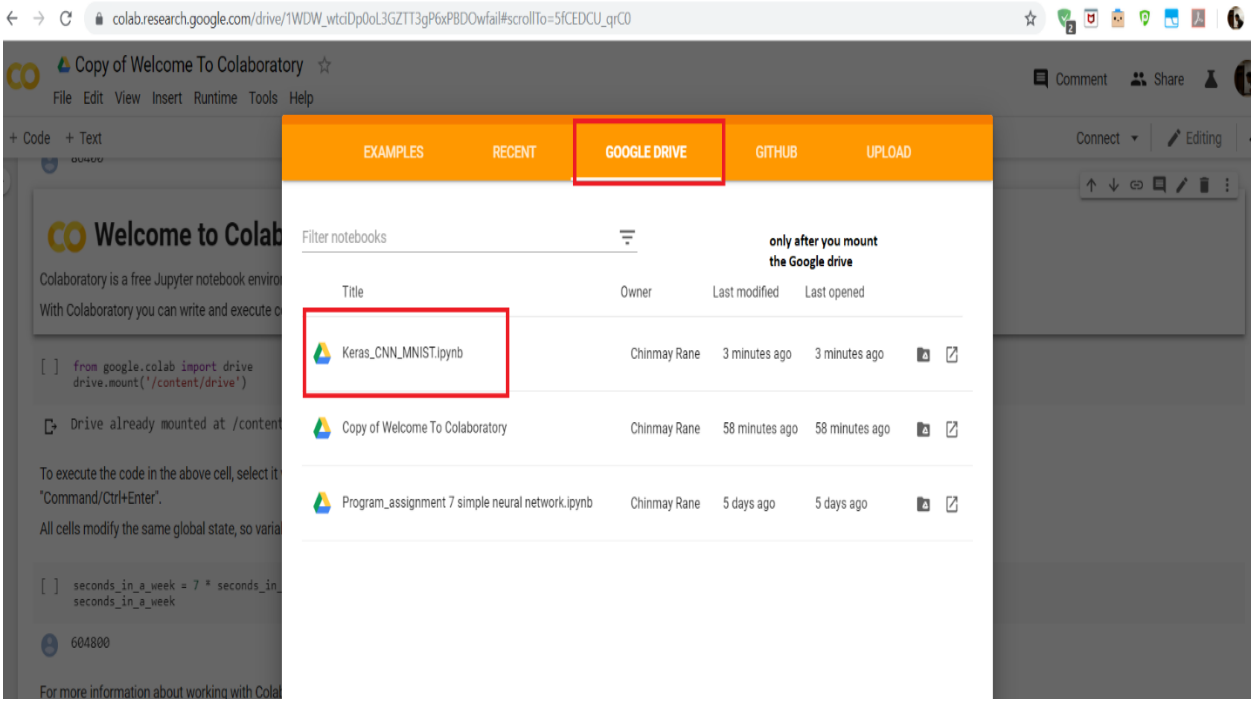
STEP 9: RUNNING KERAS IN GOOGLE COLAB NOTEBOOK

Keras

Please transfer the file Keras_CNN_MNIST.ipynb attached in the mail into the folder in your google drive you created. Select File -> Open Notebook



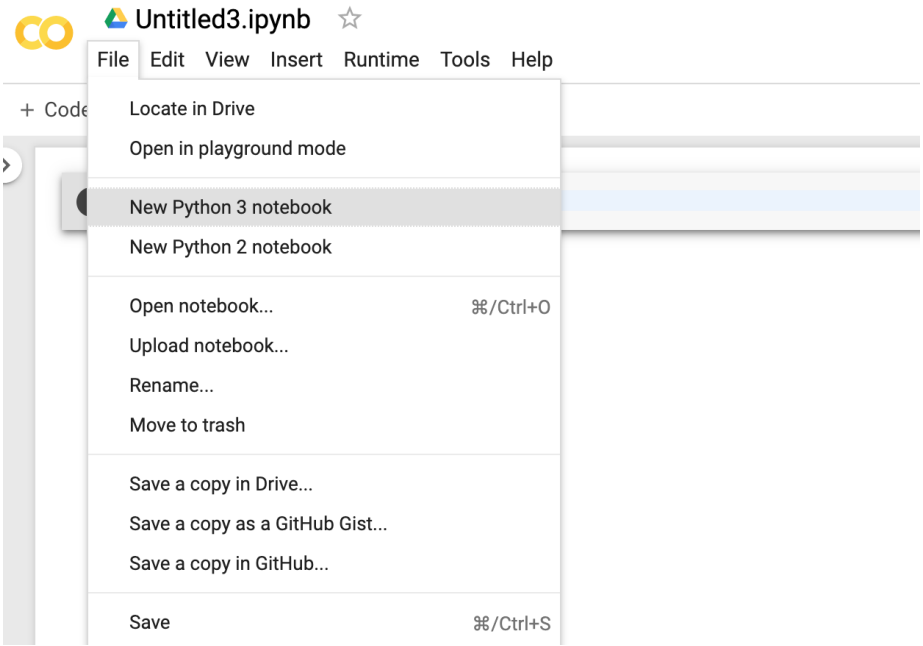
In google Drive option select the name of the python notebook



Run using the run button

If you need to run your own code Do the following. THE FOLLWING IS NOT ASKED IN CURRENT OR ANY PROGRAM ASSIGNMENTS IN EE5353. Code will always be provided

Go to **File** and then click on **New Python 3 notebook**



A new Python3 notebook opens up.

Copy the **Keras** sample code from https://github.com/keras-team/keras/blob/master/examples/mnist_cnn.py and paste it in the new Google Collab notebook

Untitled4.ipynb ☆

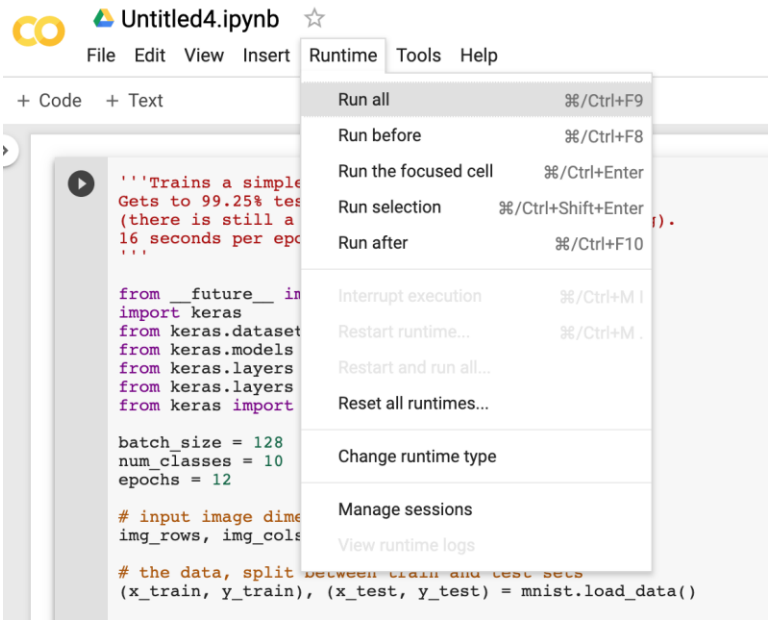
File Edit View Insert Runtime Tools Help

+ Code + Text

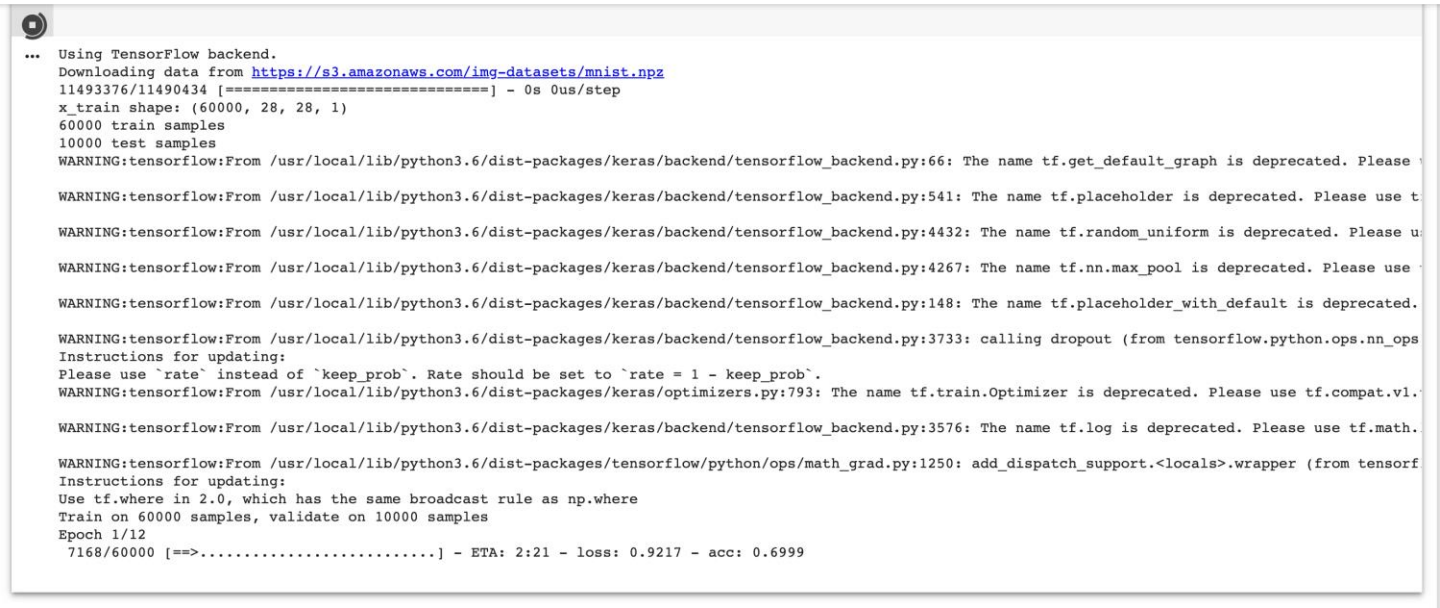
```
'''Trains a simple convnet on the MNIST dataset.
Gets to 99.25% test accuracy after 12 epochs
(there is still a lot of margin for parameter tuning).
16 seconds per epoch on a GRID K520 GPU.
'''

from __future__ import print_function
import keras
from keras.datasets import mnist
from keras.models import Sequential
from keras.layers import Dense, Dropout, Flatten
from keras.layers import Conv2D, MaxPooling2D
from keras import backend as K

batch_size = 128
num_classes = 10
epochs = 12

# input image dimensions
img_rows, img_cols = 28, 28

# the data, split between train and test sets
(x_train, y_train), (x_test, y_test) = mnist.load_data()

if K.image_data_format() == 'channels_first':
    x_train = x_train.reshape(x_train.shape[0], 1, img_rows, img_cols)
    x_test = x_test.reshape(x_test.shape[0], 1, img_rows, img_cols)
    input_shape = (1, img_rows, img_cols)
else:
    x_train = x_train.reshape(x_train.shape[0], img_rows, img_cols, 1)
    x_test = x_test.reshape(x_test.shape[0], img_rows, img_cols, 1)
    input_shape = (img_rows, img_cols, 1)

x_train = x_train.astype('float32')
x_test = x_test.astype('float32')
x_train /= 255
x_test /= 255
print('x_train shape:', x_train.shape)
print(x_train.shape[0], 'train samples')
print(x_test.shape[0], 'test samples')
```

```
# convert class vectors to binary class matrices
y_train = keras.utils.to_categorical(y_train, num_classes)
y_test = keras.utils.to_categorical(y_test, num_classes)

model = Sequential()
model.add(Conv2D(32, kernel_size=(3, 3),
                 activation='relu',
                 input_shape=input_shape))
model.add(Conv2D(64, (3, 3), activation='relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Flatten())
model.add(Dense(128, activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(num_classes, activation='softmax'))

model.compile(loss=keras.losses.categorical_crossentropy,
              optimizer=keras.optimizers.Adadelta(),
              metrics=['accuracy'])

model.fit(x_train, y_train,
          batch_size=batch_size,
          epochs=epochs,
          verbose=1,
          validation_data=(x_test, y_test))
score = model.evaluate(x_test, y_test, verbose=0)
print('Test loss:', score[0])
print('Test accuracy:', score[1])
```

Now Click on **Runtime** from the top menu and click on **Run all**



Keras will now execute on your Google Colab notebook! You can see the output similar to the screencaps below.



```
Train on 60000 samples, validate on 10000 samples
Epoch 1/12
60000/60000 [==============================] - 157s 3ms/step - loss: 0.2655 - acc: 0.9173 - val_loss: 0.0579 - val_acc: 0.9817
Epoch 2/12
60000/60000 [==============================] - 155s 3ms/step - loss: 0.0879 - acc: 0.9740 - val_loss: 0.0428 - val_acc: 0.9865
Epoch 3/12
60000/60000 [==============================] - 155s 3ms/step - loss: 0.0667 - acc: 0.9806 - val_loss: 0.0333 - val_acc: 0.9881
Epoch 4/12
60000/60000 [==============================] - 155s 3ms/step - loss: 0.0545 - acc: 0.9832 - val_loss: 0.0324 - val_acc: 0.9894
Epoch 5/12
60000/60000 [==============================] - 156s 3ms/step - loss: 0.0473 - acc: 0.9857 - val_loss: 0.0346 - val_acc: 0.9878
Epoch 6/12
60000/60000 [==============================] - 155s 3ms/step - loss: 0.0406 - acc: 0.9874 - val_loss: 0.0302 - val_acc: 0.9903
Epoch 7/12
60000/60000 [==============================] - 155s 3ms/step - loss: 0.0367 - acc: 0.9885 - val_loss: 0.0289 - val_acc: 0.9904
Epoch 8/12
60000/60000 [==============================] - 154s 3ms/step - loss: 0.0329 - acc: 0.9900 - val_loss: 0.0305 - val_acc: 0.9900
Epoch 9/12
60000/60000 [==============================] - 153s 3ms/step - loss: 0.0317 - acc: 0.9899 - val_loss: 0.0295 - val_acc: 0.9903
Epoch 10/12
60000/60000 [==============================] - 152s 3ms/step - loss: 0.0290 - acc: 0.9910 - val_loss: 0.0277 - val_acc: 0.9914
Epoch 11/12
60000/60000 [==============================] - 151s 3ms/step - loss: 0.0277 - acc: 0.9911 - val_loss: 0.0286 - val_acc: 0.9909
Epoch 12/12
60000/60000 [==============================] - 156s 3ms/step - loss: 0.0254 - acc: 0.9924 - val_loss: 0.0299 - val_acc: 0.9902
Test loss: 0.029910168372955 83
Test accuracy: 0.9902
```

ADDITIONAL INFORMATION FOR RESEARCH AND STUDY PURPOSE

LINKS TO HELP YOU WITH ADDITIONAL TESTING:

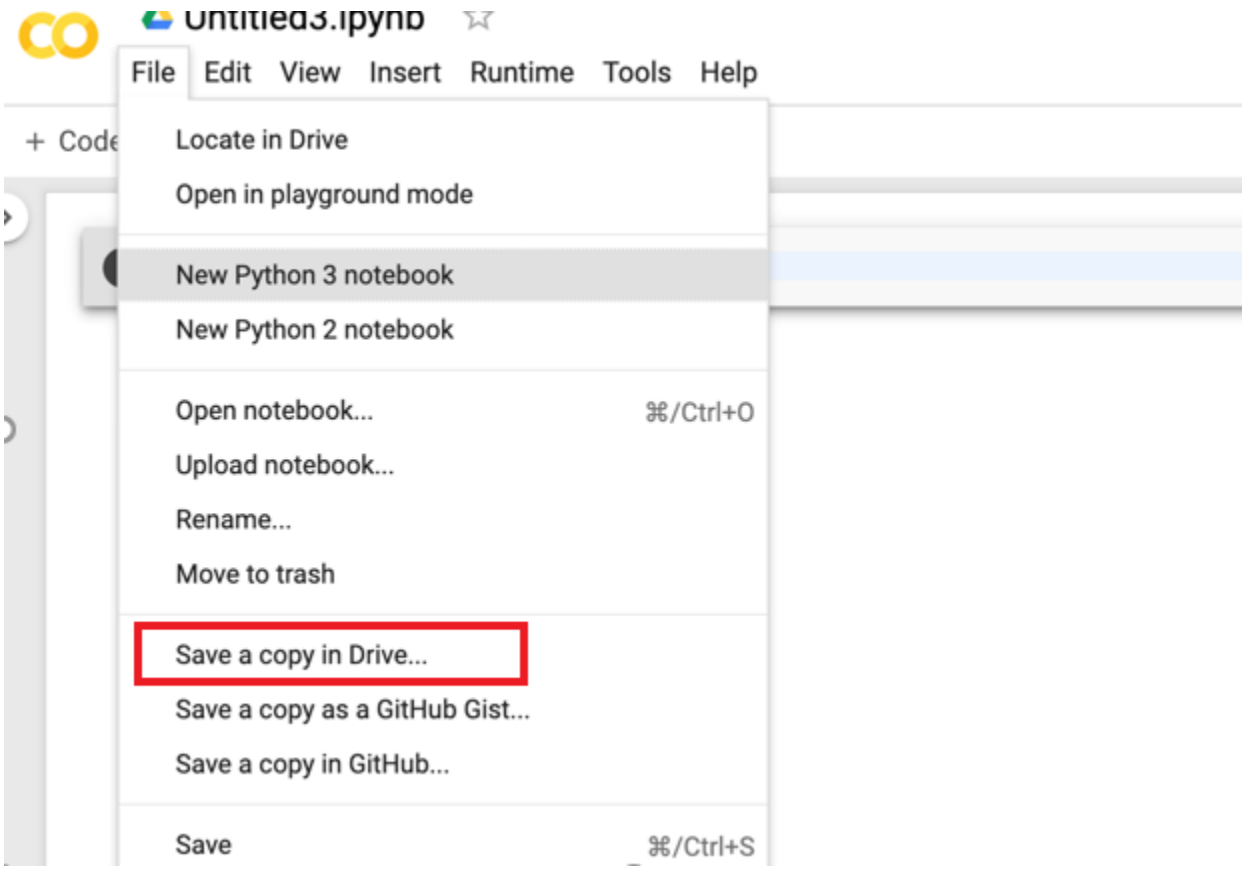
1. https://github.com/hvplus/Google_Colab/blob/master/Test_Colab.ipynb
2. https://github.com/yunjey/pytorch-tutorial/blob/master/tutorials/01-basics/feedforward_neural_network/main.py#L37-L49

STEP 10: SAVING AND PRINTING

A) SAVING A COPY OF THE CODE ON GOOGLE DRIVE

To save a copy of your code on Google Drive, while the notebook is open, click on **'File'** and click on **'Save a copy in Drive'.**

A copy of the notebook will be saved in 'Colab Notebooks' folder in your Google Drive. If 'Colab Notebooks' folder did not exist already, Google Colab creates one.

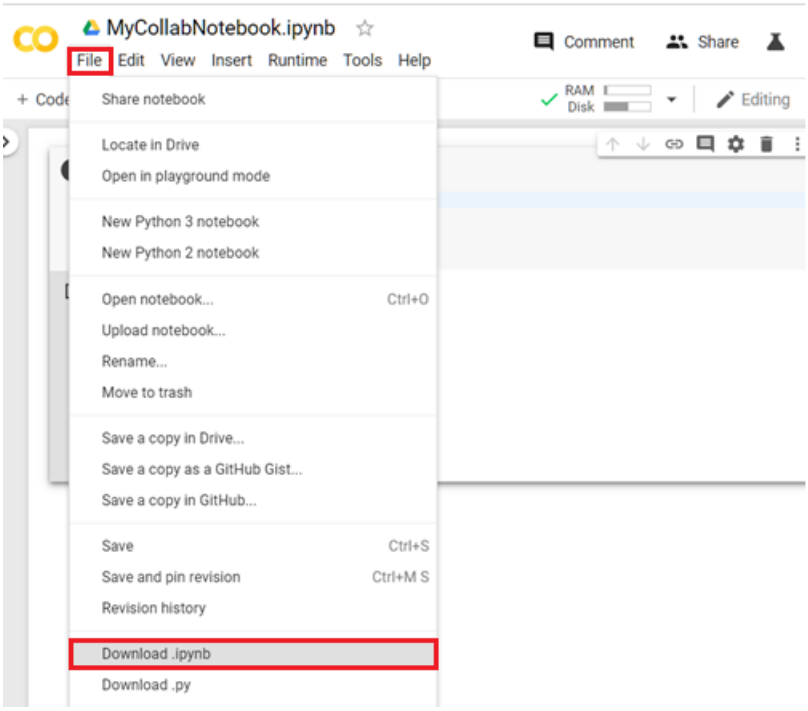


If you want the notebook to be saved in the folder (say, 'MyProjects' is the folder name) that you created in Step 3, use the following steps:

- Open the folder
- Click **'New'-> 'More' -> 'Google Colaboratory'**
- This will create a notebook in the 'MyProjects' folder and will open in a new tab.

B) SAVING A COPY OF THE CODE ON YOUR SYSTEM

You can save a copy of your Notebook on your system as a .ipynb or .py file. To do so, click on **File** from the menu (Highlighted in red) and click on **"Download.ipynb"** or **"Download.py".**

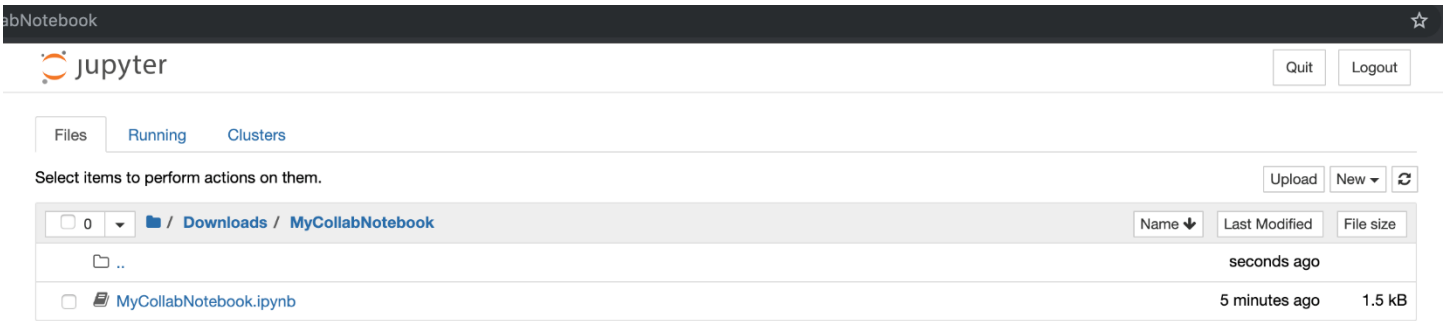


The file should be downloaded to your Downloads folder. You can now interact with the '**.ipynb**' file using **Jupyter Notebook** and '**.py**' file with any **python IDE**.

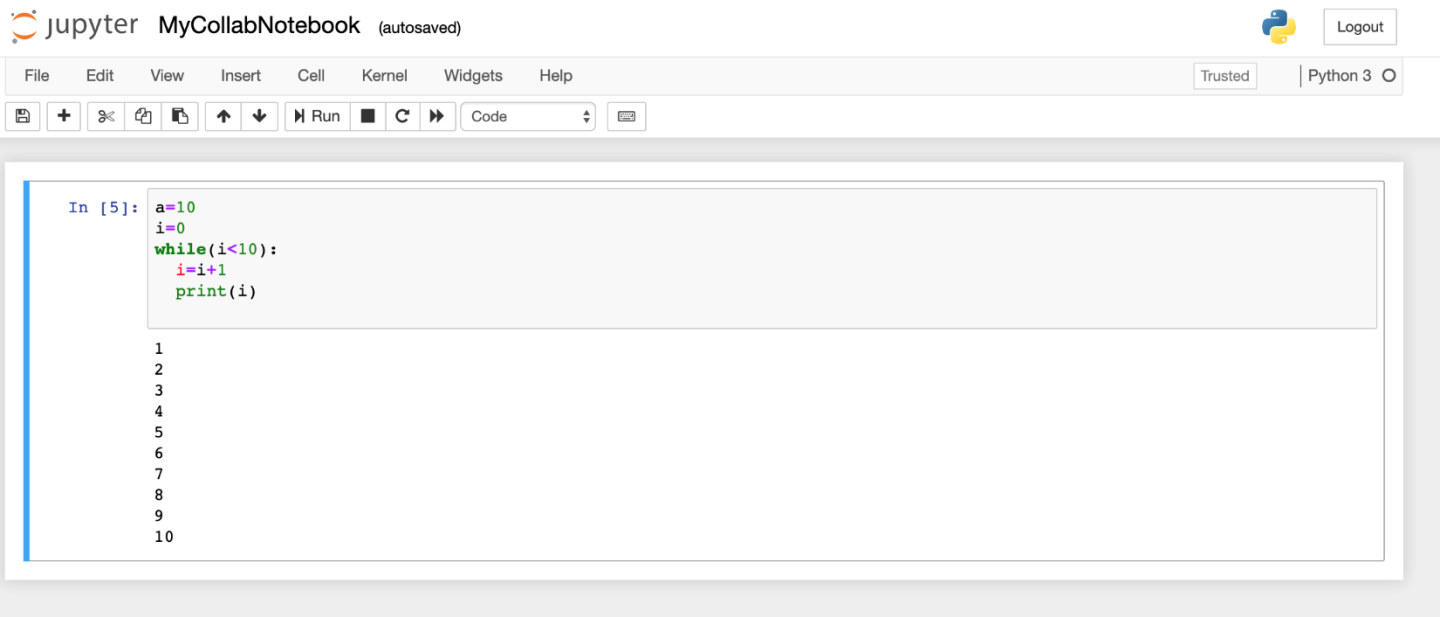
C) PRINTING YOUR GOOGLE COLLAB NOTEBOOK

You can print your Google Collab notebook by downloading the .ipynb file (As shown in **(b)**)

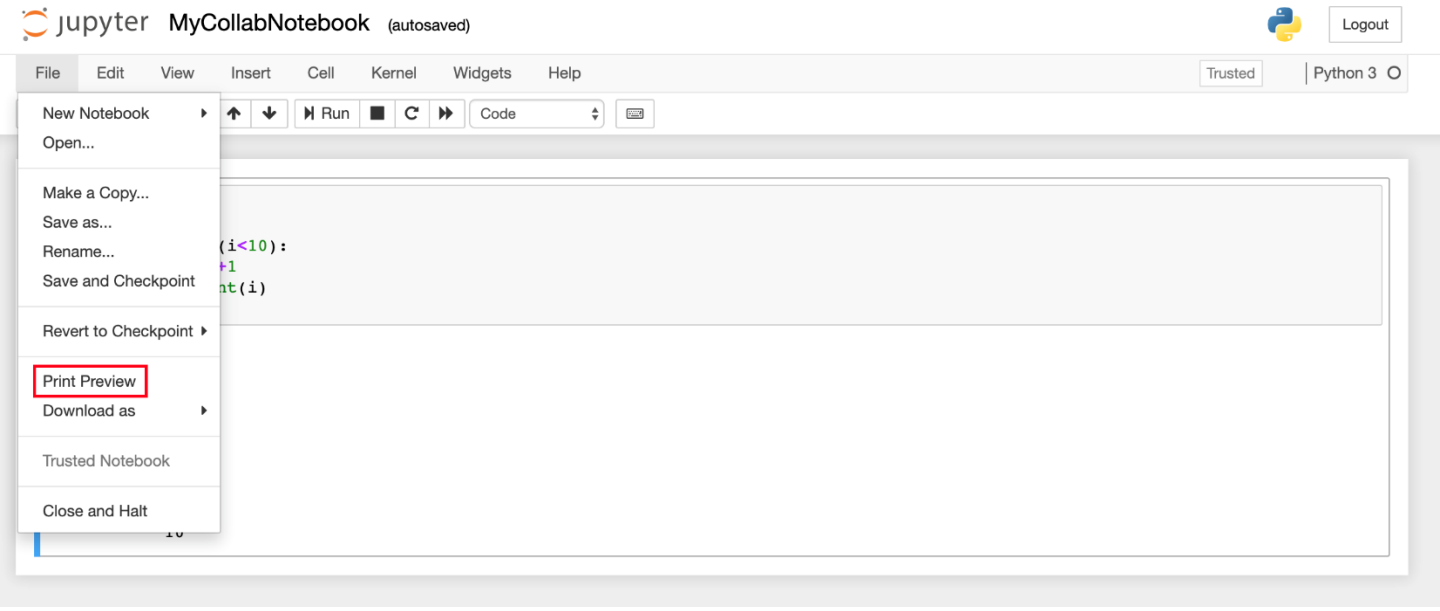
Open the .ipynb file in **Jupyter Notebook**



Your Python Notebook will be displayed.



After opening the file, click on the **File** and then select **Print Preview** (Highlighted in red)



Clicking on **Print Preview** will now display the print-ready format of your Python Notebook as shown below:

```
In [5]: a=10
        i=0
        while(i<10):
          i=i+1
          print(i)

1
2
3
4
5
6
7
8
9
10
```

Press **Ctrl+P (Windows & Linux)** or **Command+P (MacOS)** to print your Python Notebook.

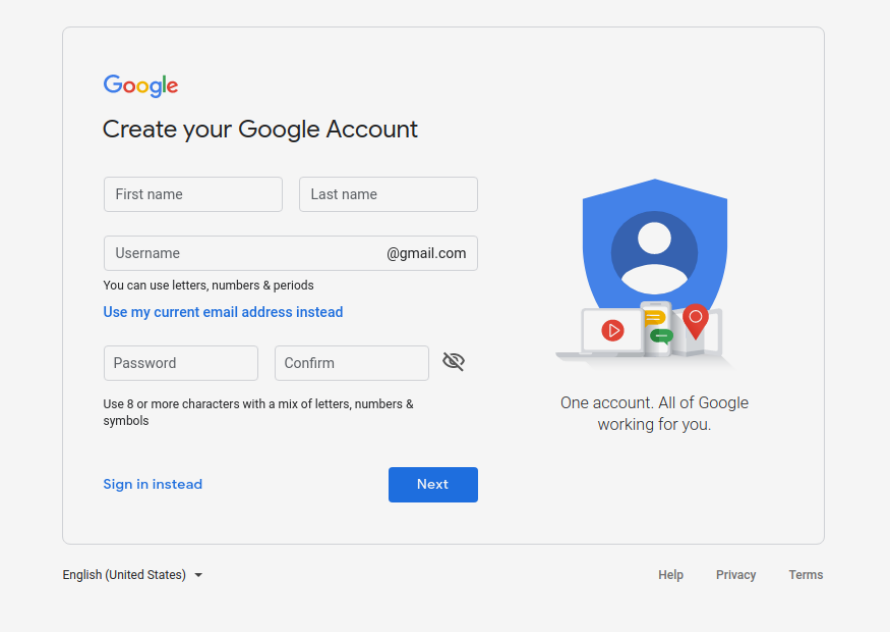
NOTE:

1. The Google Drive setup is a one-time process. (Next time, when you log in, Google Drive will automatically be mounted for you).
2. You can install additional packages by creating a new cell and executing the below commands (according to the Python version)
    a. For Python 2, execute '!pip install <package-name>'
    b. For Python 3, execute '!pip3 install <package-name>'

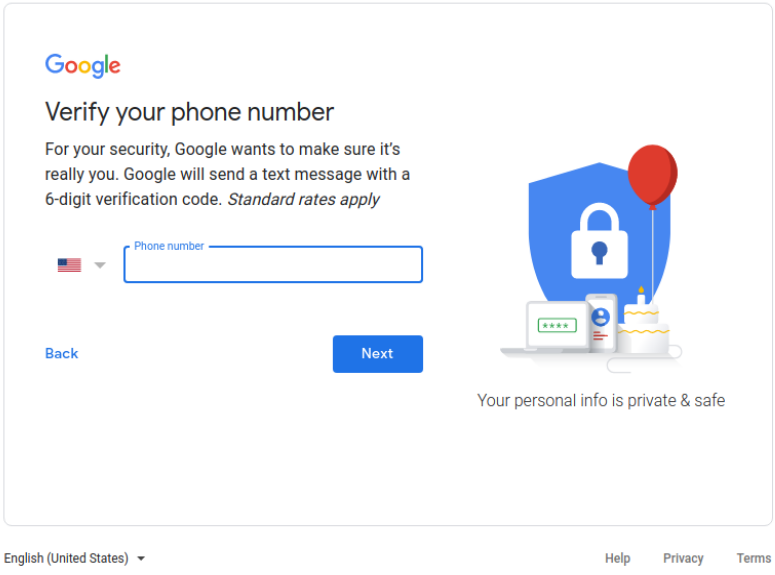
APPENDIX

SECTION 1: STEPS TO CREATE A GOOGLE ACCOUNT

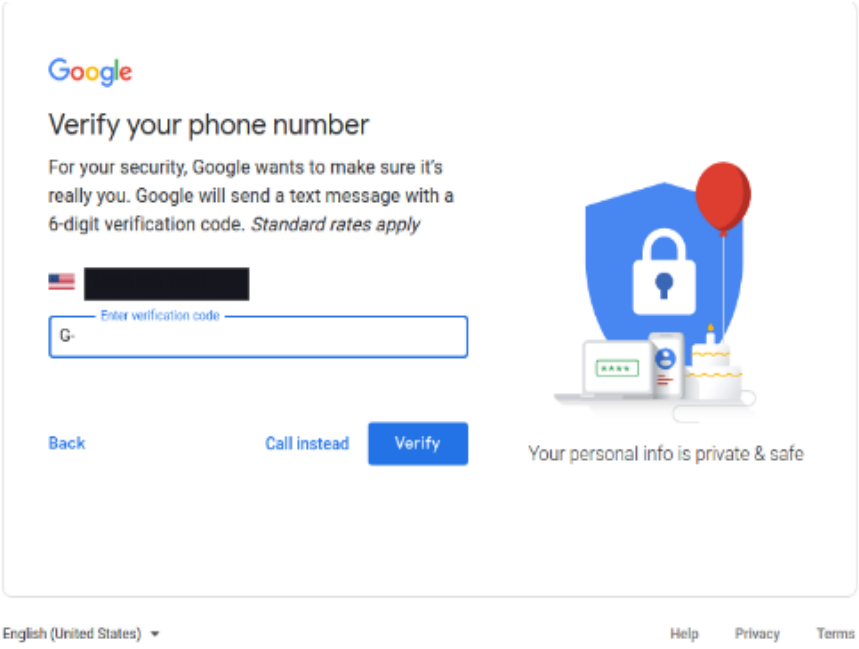
STEP 1: Navigate to the following link: https://accounts.google.com/signup/v2/webcreateaccount?flowName=GlifWebSignIn&flowEntry=SignUp. Enter your 'First name', 'Last name', 'Username', 'Password' and click on *'Next'*.



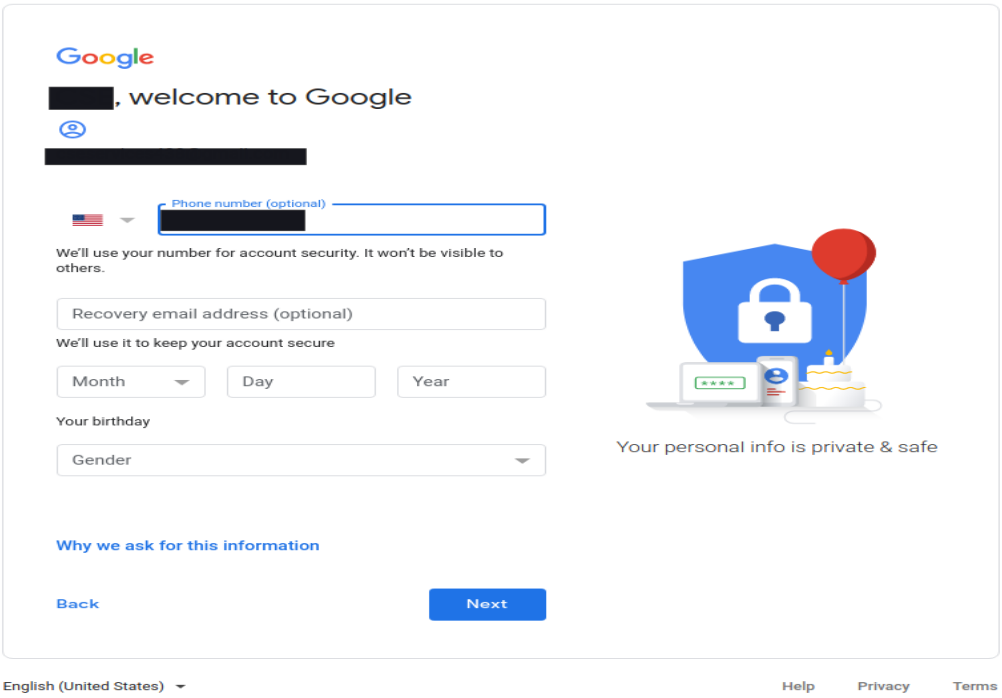
STEP 2: Enter your phone number and click on *'Next'*.



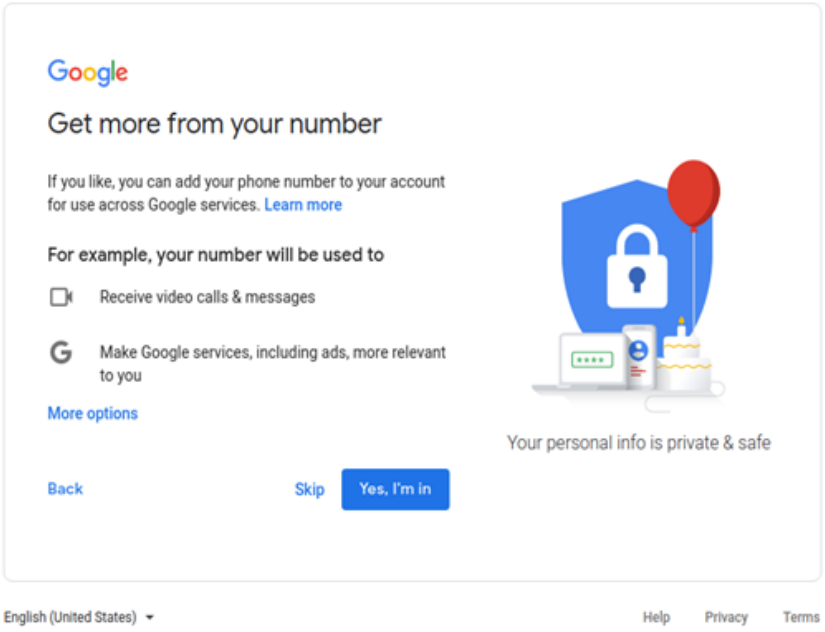
STEP 3: Enter the verification code you have received as a text message on the mobile number you just entered and click on *'Verify'*.



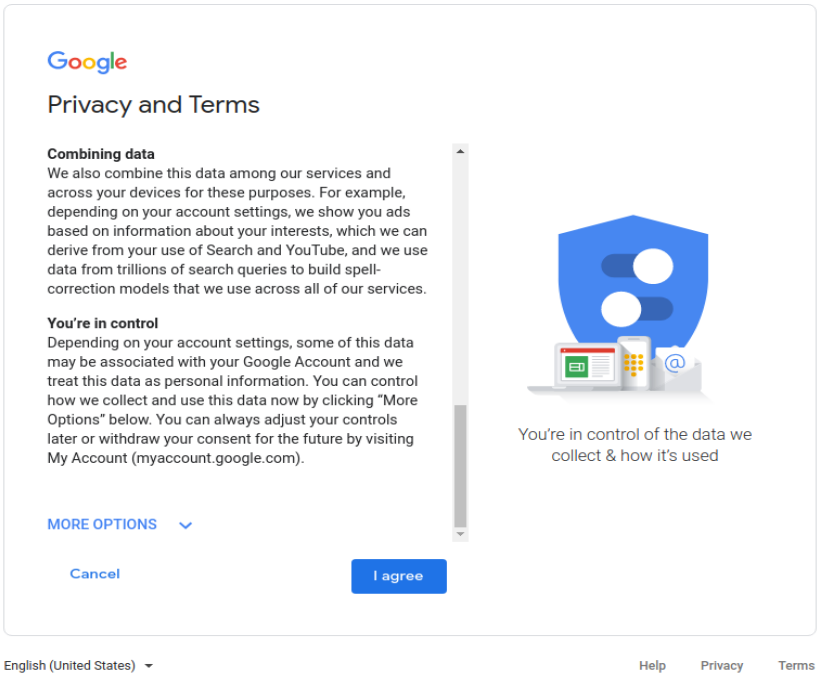
STEP 4: Enter your 'Birthday' and 'Gender' and click 'Next'.



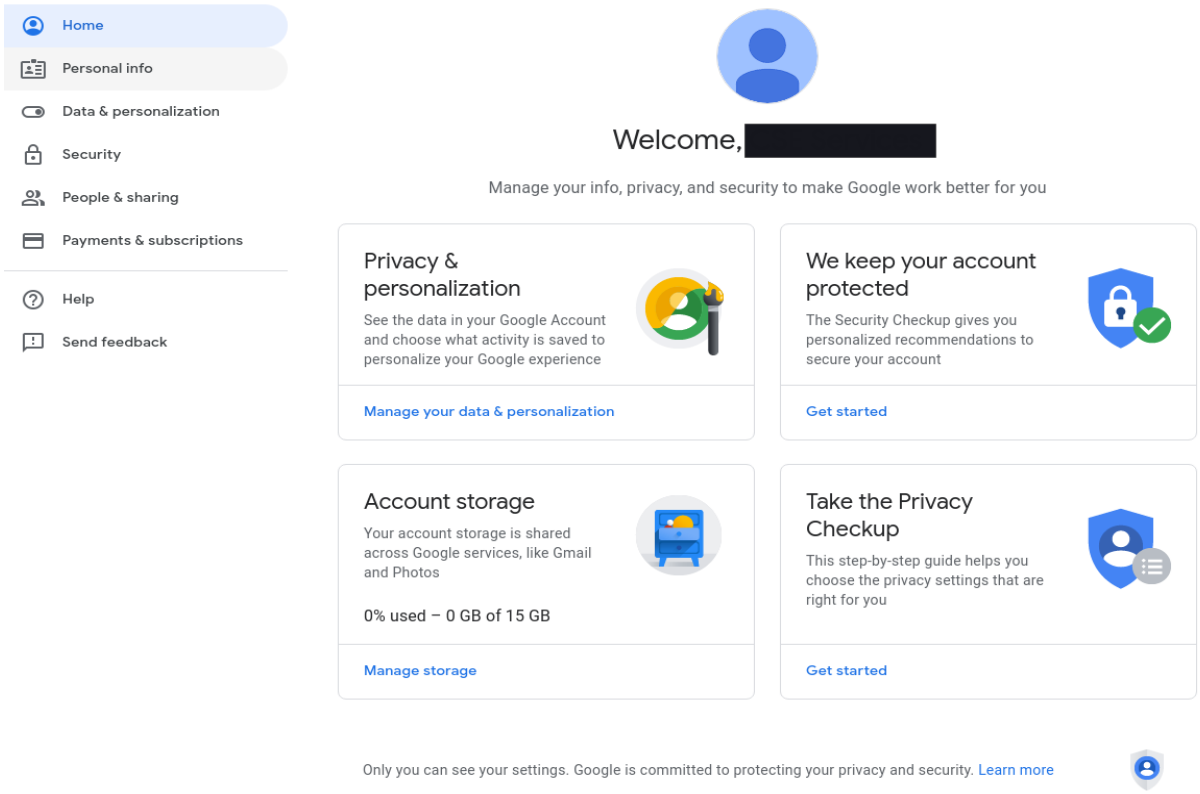
STEP 5: Click on Skip



STEP.6: Scroll through the terms and conditions and click on '*I agree*'.



STEP 7: Your account is now created, and you would now be redirected to the Google portal.

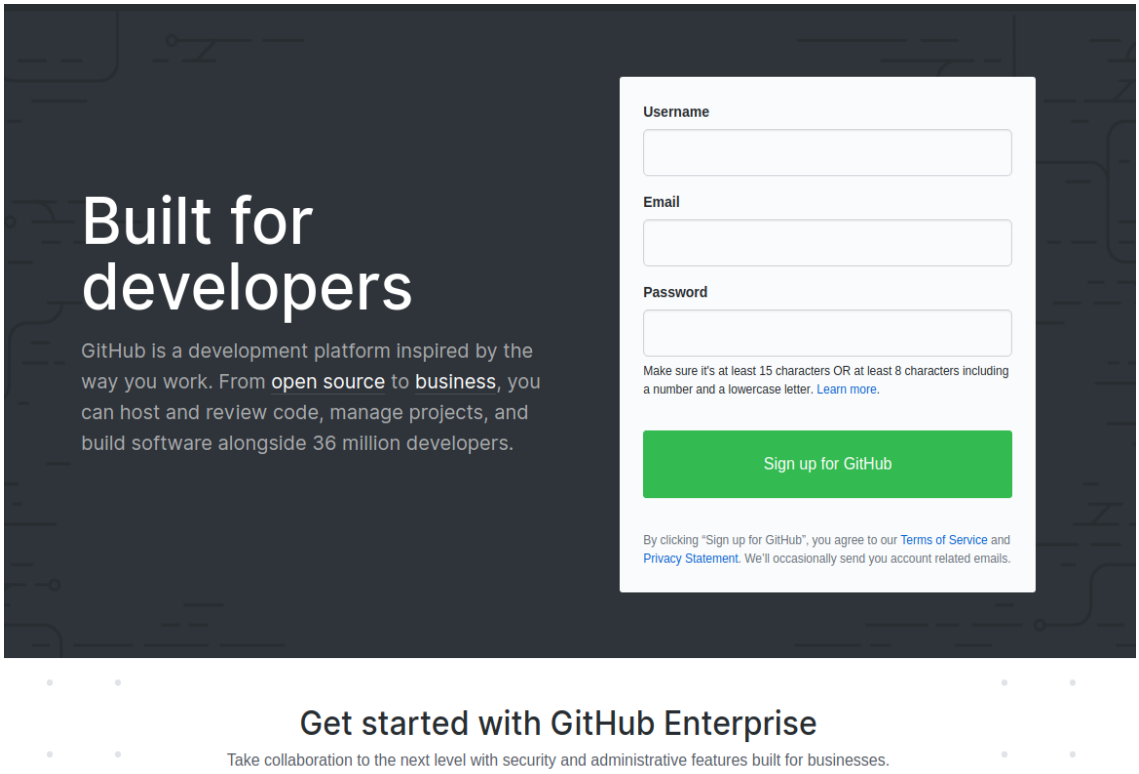


SECTION 2: SAVING YOUR GOOGLE COLAB FILE ON GITHUB

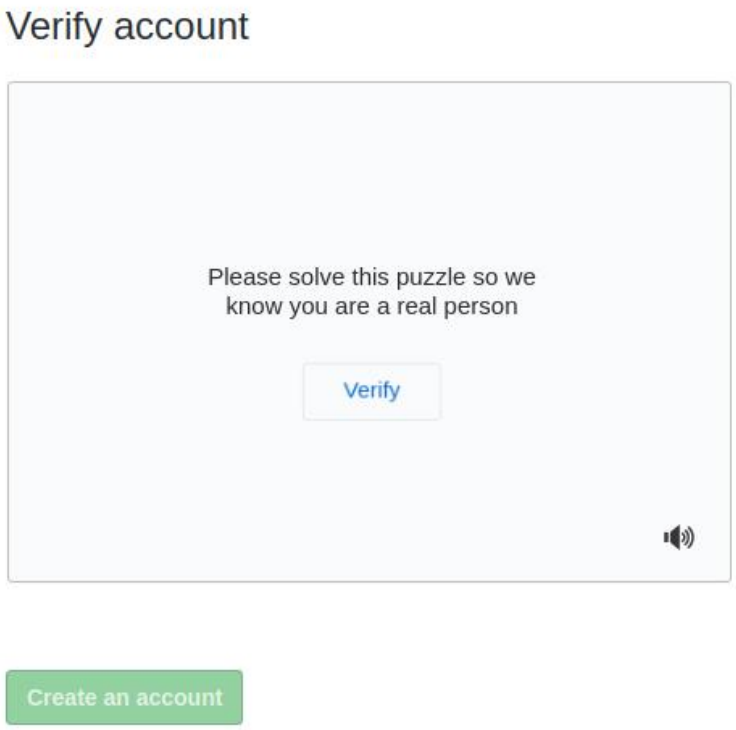
- This step is optional and is not mandatory for the setup or use of Google Colab
- GitHub is an online code repository that lets you store your code
- Creating a GitHub account would allow you to make use of additional features of Google Colab such as push or pull your code to the GitHub

STEPS TO CREATE A GITHUB ACCOUNT

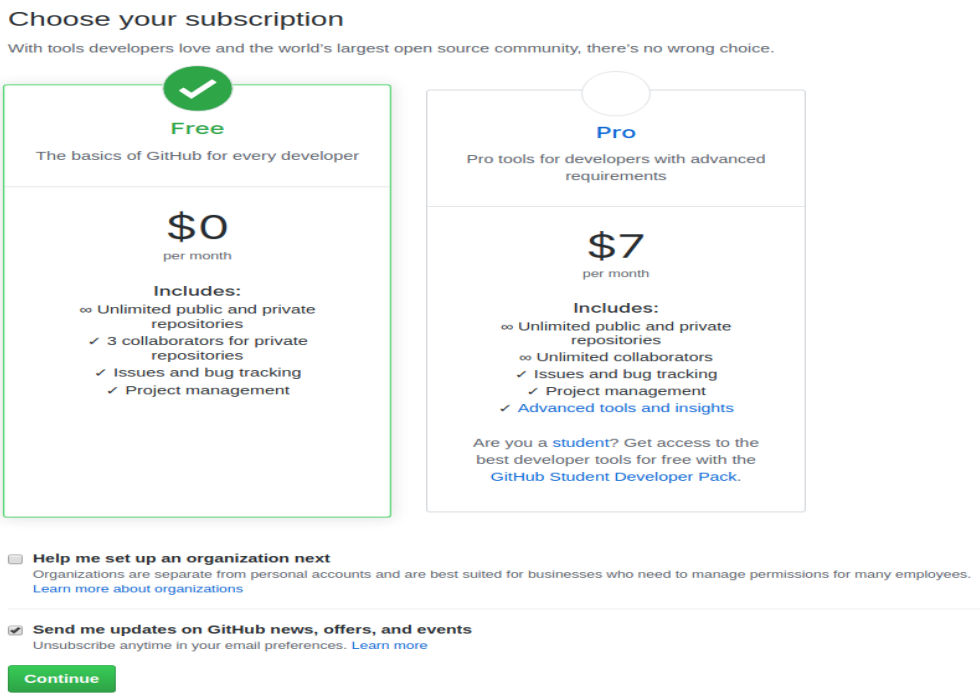
STEP 1: Navigate to https://github.com/. Enter username, your email address, password and click '*Sign Up for GitHub*'.



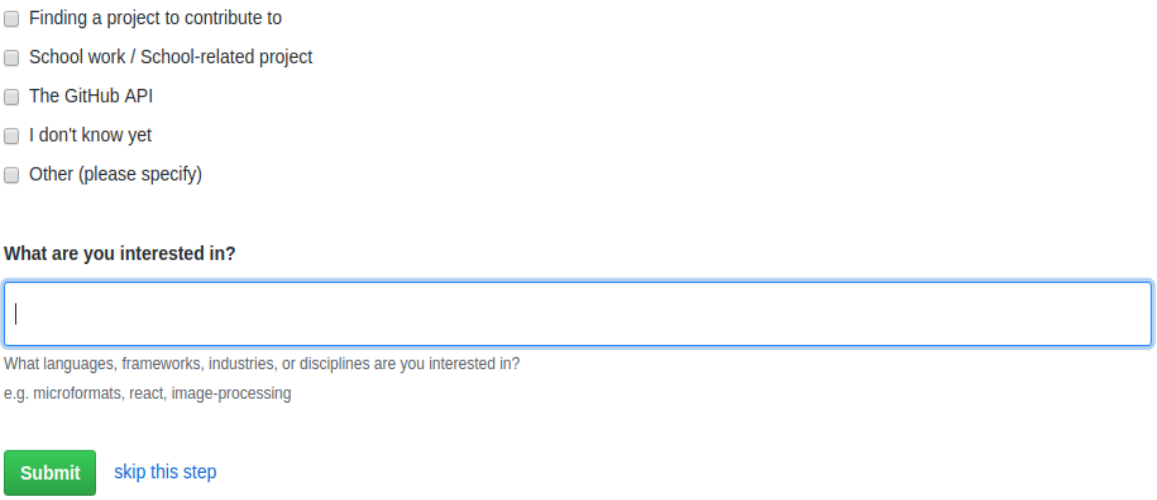
STEP 2: Click on '*Verify*' and solve the given puzzle.



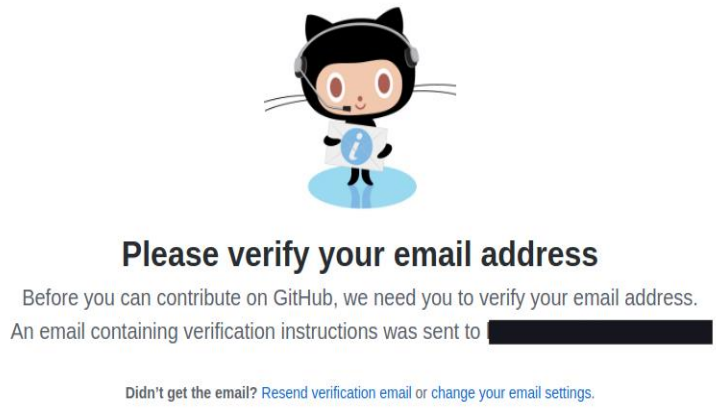
STEP 3: After you solve the puzzle you would be redirected to the below page. The default subscription is **Free**. Without making any changes, scroll down and click *'Continue'*.



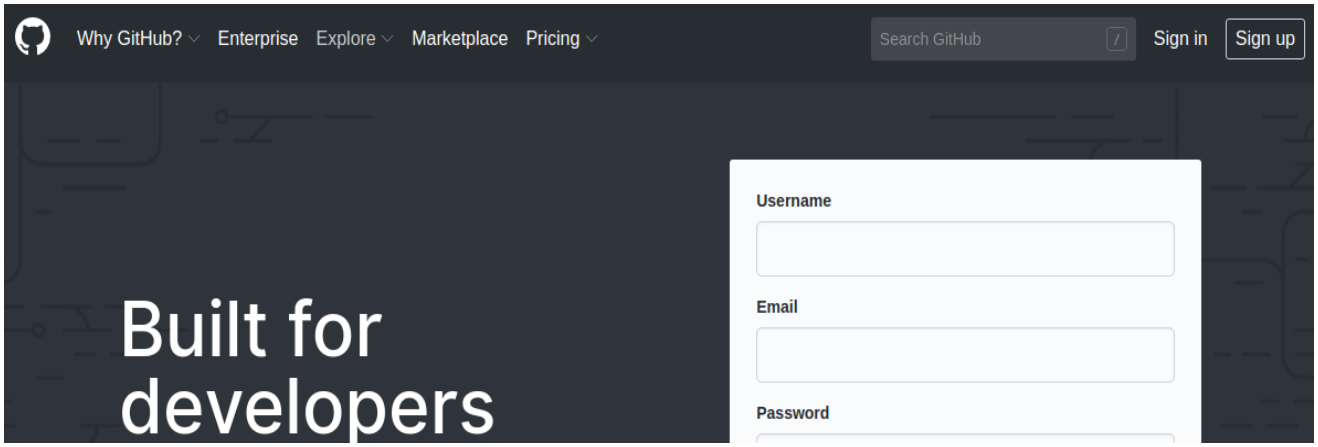
STEP 4: Click on '*skip this step*'.



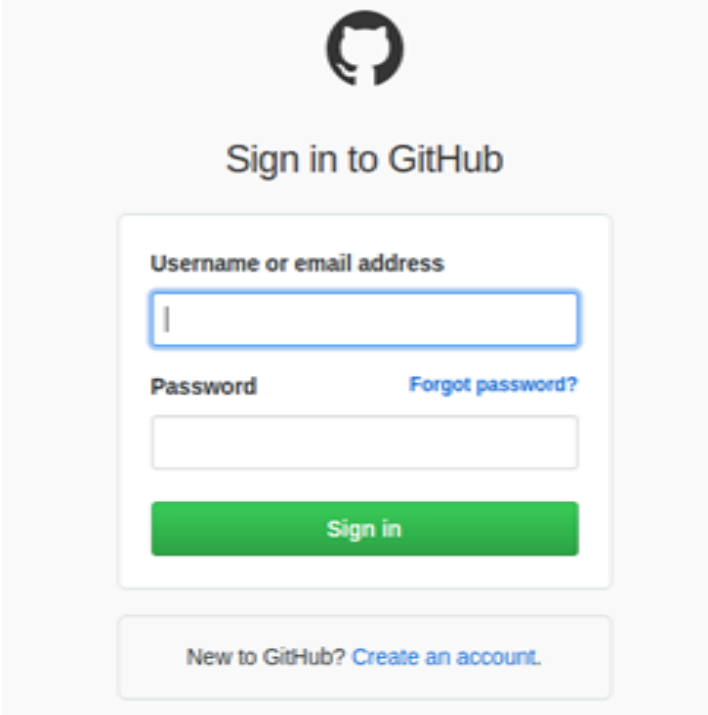
STEP 5: Log into your mailbox to check the email verification email. Follow the instructions given in the email, to verify the email address.



STEP 6: After you are done with your verification navigate to https://github.com/. And Click on '*Sign In*' button at the right-top.

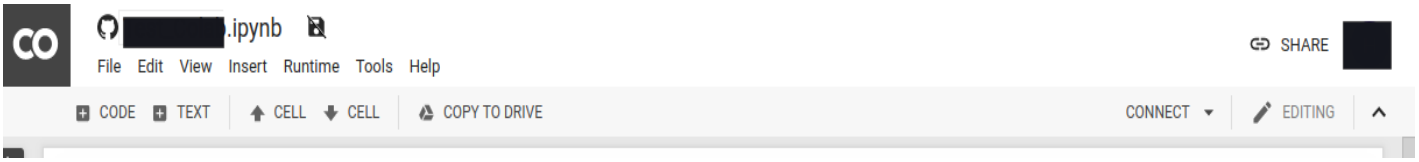


STEP 7: Enter your 'username' and 'password' and click on '*Sign In*' to log into your Github account.

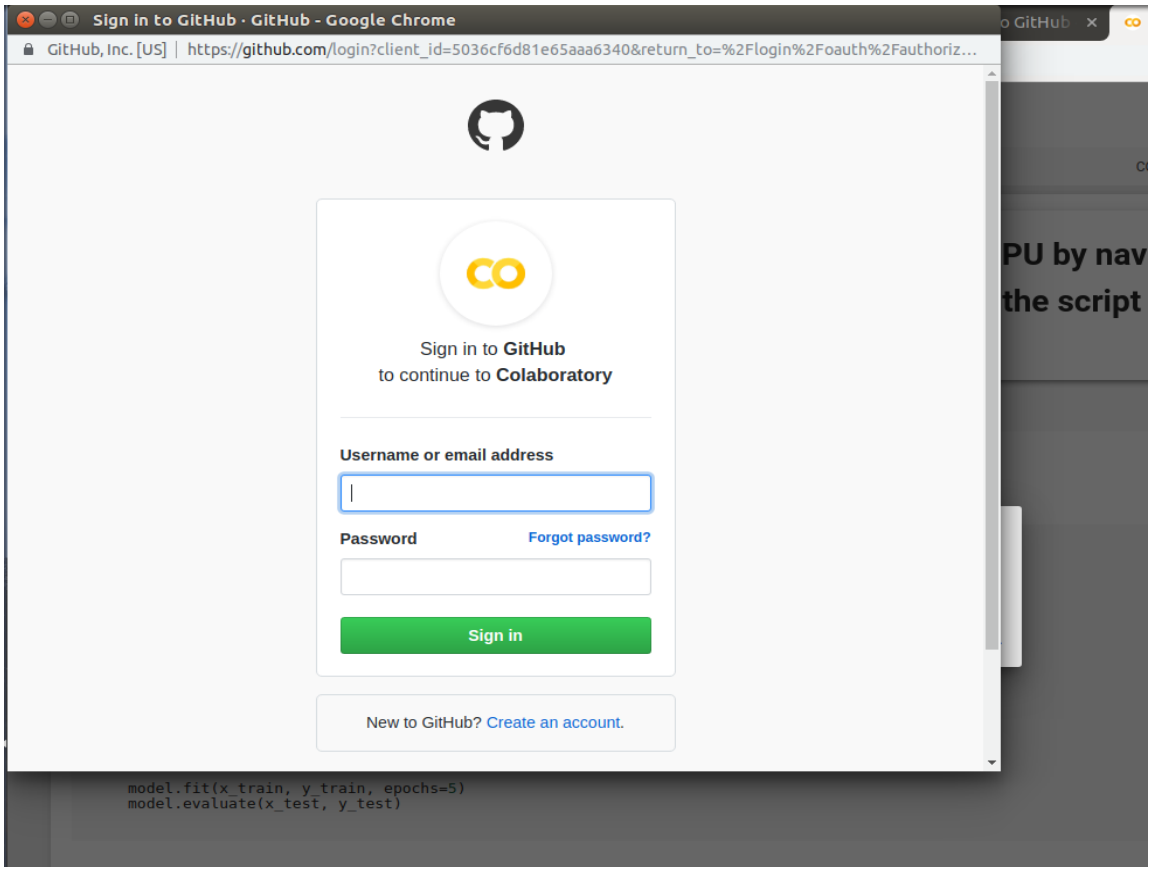


SAVING A COPY OF YOUR CODE ON GITHUB

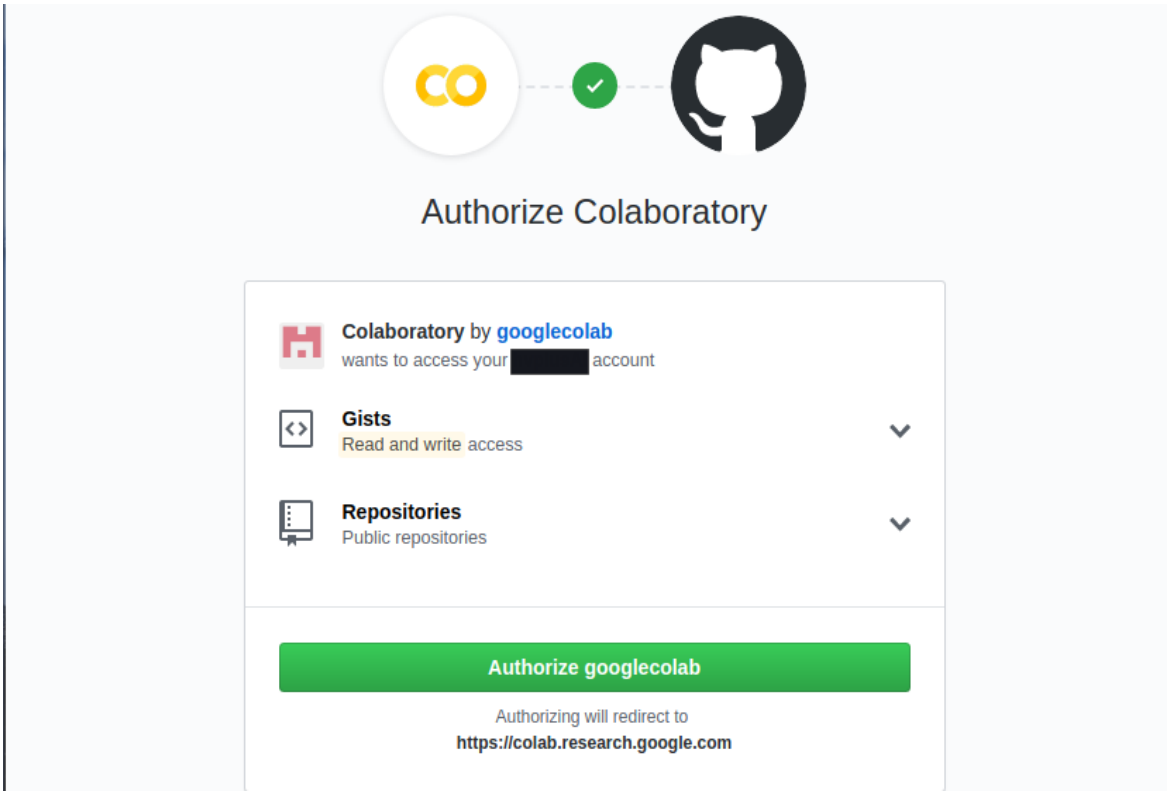
To save a copy of your code on Github, while the notebook is open, click on '*File*' and click on '*Save a copy in Github*'.



STEP 1: Enter your Github credentials and click '*Sign in*'.



STEP 2: Click on '*Authorize googlecolab*'.



STEP 3: Click on '*File*' and click on '*Save a copy in Github*'. Select the Repository from the dropdown menu and click on 'OK'.