

Project 2 Setup Guide

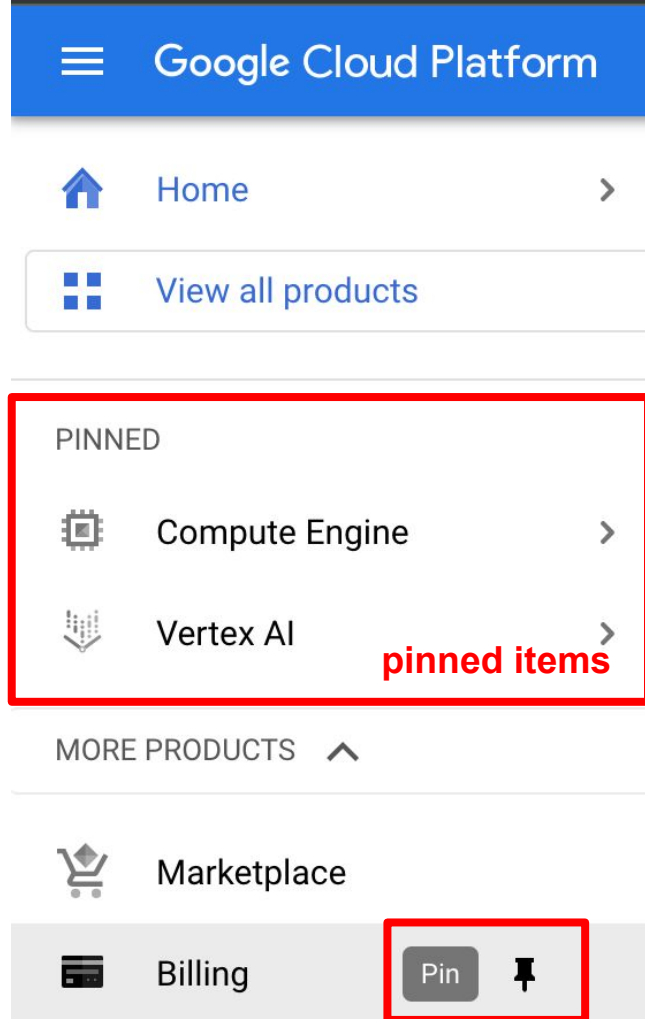
Before you start

<https://console.cloud.google.com/>

Login using your **LionMail** account

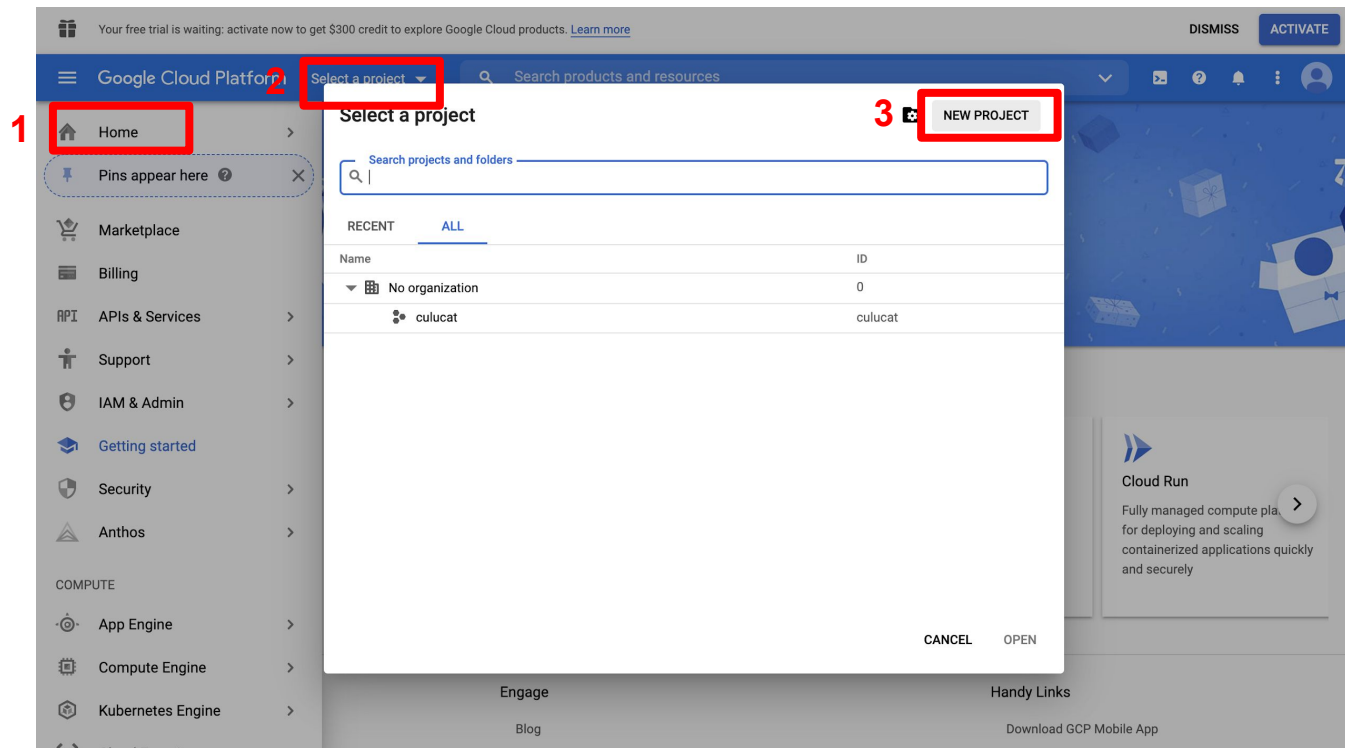
Pin these items on your navigation menu:

- ARTIFICIAL INTELLIGENCE -> Vertex AI
- Billing
- COMPUTE -> Compute Engine



Create a project for this class

Home -> Select a Project -> New Project



Create a project for this class

Project name and ID:
uni-4733

Organization and location:
columbia.edu

The screenshot shows the 'New Project' page on the Google Cloud Platform. At the top, there is a blue header with the Google Cloud Platform logo and a search bar. Below the header, the title 'New Project' is displayed. A warning message states: 'You have 22 projects remaining in your quota. Request an increase or delete projects. [Learn more](#)'. Below this, there is a link to 'MANAGE QUOTAS'. The form consists of several fields: 1. 'Project name *' with the value 'rs3989-4733'. 2. 'Project ID *' with the value 'rs3989-4733'. A red error message below this field states: 'Project ID is not available.' 3. 'Organization *' with the value 'columbia.edu'. 4. 'Location *' with the value 'columbia.edu'. A 'BROWSE' button is next to the location field. 5. At the bottom, there are two buttons: 'CREATE' and 'CANCEL'. Red boxes and numbers 1, 2, and 3 highlight the 'Project name *' and 'Project ID *' fields, the 'Organization *' and 'Location *' fields, and the 'CREATE' button, respectively.

Google Cloud Platform Search products and resources

New Project

You have 22 projects remaining in your quota. Request an increase or delete projects. [Learn more](#)

[MANAGE QUOTAS](#)

1 Project name *
rs3989-4733

Project ID *
rs3989-4733

Project ID is not available.

2 Organization *
columbia.edu

Select an organization to attach it to a project. This selection can't be changed later.

Location *
columbia.edu

BROWSE

Parent organization or folder

3 CREATE CANCEL

Redeem your coupon

<https://console.cloud.google.com/education>

Make sure you are logged in with your LionMail account

Enter the code sent to your LionMail from cc4617@columbia.edu

(Please contact cc4617@columbia.edu if you haven't received it)

GCP credit application

Fill in the following information below to apply GCP credits to your account listed below.

First name *
Zeyi

Last name *
Liu

Account email
zl2753@columbia.edu

Credits will be applied to this account. If you'd like to apply credits to a different account, specify your preference [here](#).

Coupon code *
|

Terms and conditions

The following [Terms of Service](#) apply to the credit you received for Google Cloud products.

ACCEPT AND CONTINUE

* Indicates required

Change billing account

<https://console.cloud.google.com/billing>

Billing -> Select an organization: COLUMBIA.EDU ->

MY PROJECTS ->

uni-4733 ->

Actions -> Change billing

The screenshot shows the Google Cloud Platform Billing console interface. At the top, the header bar says "Google Cloud Platform" with a search icon, a notification badge with the number "1", and a user profile icon. Below the header, the "Billing" section is active. A red box highlights the "Select an organization:" dropdown menu, which currently shows "COLUMBIA.EDU". Below this, the "MY BILLING ACCOUNTS" section is visible. A red box highlights the "MY PROJECTS" button. Below that, a table lists billing accounts. A red box highlights the "Name" column header and the first row, which shows "rs3989-4733". Another red box highlights the "Actions" column header and the first row, which shows a menu with "Disable billing" and "Change billing" options.

Google Cloud Platform

Billing

Select an organization: COLUMBIA.EDU

MY BILLING ACCOUNTS MY PROJECTS

Name	ID	Billing account	Billing account ID	Actions
rs3989-4733	rs3989-coms4733	My Billing Account		<ul style="list-style-type: none">Disable billingChange billing

Change billing account

Set the billing account for project “uni-4733”

Billing account *

Billing Account for Education



Any charges for this project will be billed to the account you select here.

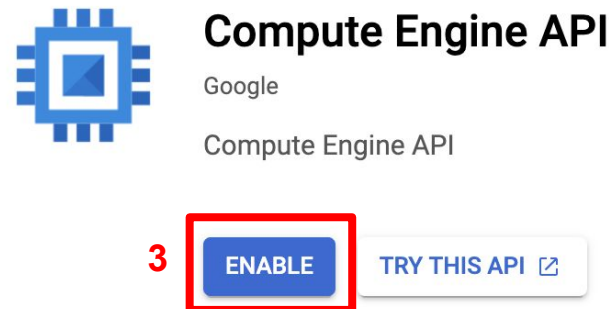
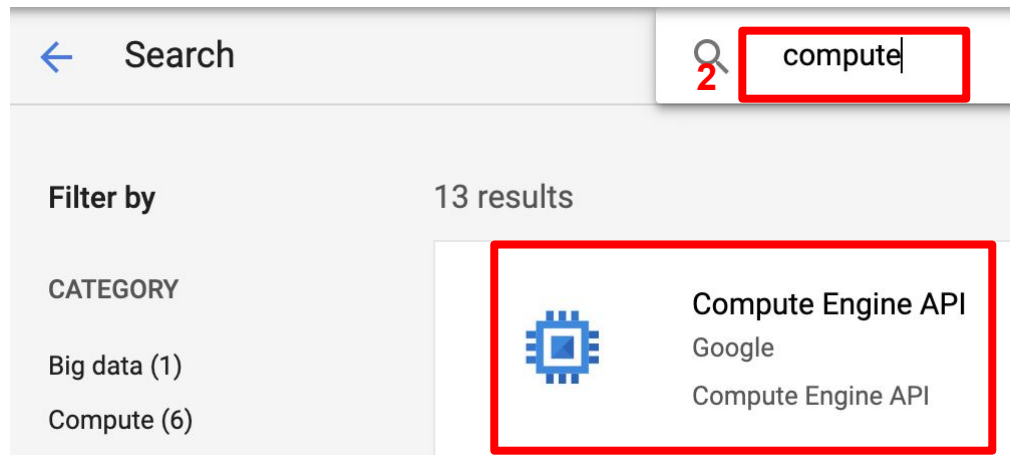
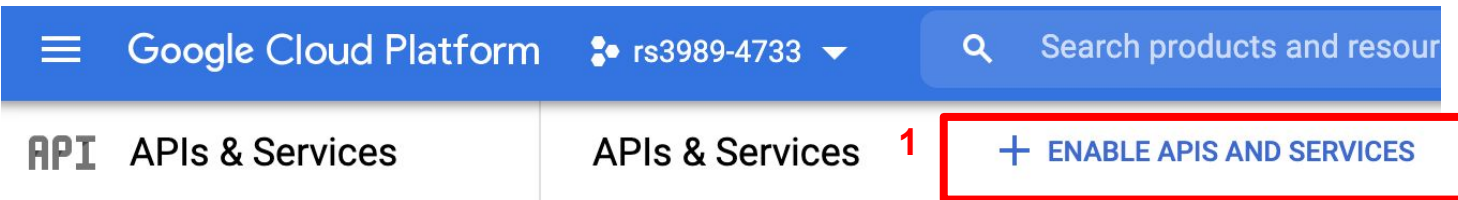
CANCEL

SET ACCOUNT

Enable Compute Engine API

<https://console.cloud.google.com/apis/dashboard>

ENABLE APIS AND SERVICES->search "compute"->Compute Engine API->enable



Edit Quota for GPU

<https://console.cloud.google.com/iam-admin/quotas>

IAM & Admin -> Quotas -> **Filter -> type in "Quota:all"** -> GPUs (all regions)

The screenshot shows the Google Cloud Platform console interface. The left sidebar contains the navigation menu with 'IAM & Admin' highlighted. The main content area displays 'Quotas for project "uni-4733"'. At the top, there are three summary cards: 'Near the limit' (0), 'Low usage' (5,382), and 'All quotas' (5,569). Below these is a 'Filter' dropdown menu that has been opened, showing a list of services. The 'Quota:all' filter is applied, resulting in a list of quotas. The 'GPUs (all regions)' quota is highlighted, showing a limit of 5. Other visible quotas include 'CPUs (all regions)' with a limit of 100, 'Network Firewall Policies' with a limit of 100, and 'Routes' with a limit of 200.

Service	Limit
CPUs (all regions)	100
GPUs (all regions)	5
Network Firewall Policies	100
Regional Network Firewall Policies	100
Regional Network Firewall Policies (default)	100
Routes	200

Edit Quota for GPU

Google Cloud Platform

uni-4733

Search Products, resources, docs (/)

IAM & Admin

IAM

Identity & Organization

Policy Troubleshooter

Policy Analyzer

Organization Policies

Service Accounts

Workload Identity Federat...

Quotas for project "uni-4733"

EDIT QUOTAS

Near the limit

0

View quotas

Low usage

5,378

View quotas

All quotas

5,569

Filter

Quota : GPUs (all regions)

Enter property name or value

Service	Quota	Dimensions (e.g. location)	Limit	Current usage
Compute Engine API	GPUs (all regions)		0	

Edit Quota for GPU

Click on EDIT QUOTAS -> New limit = 1

The screenshot shows the Google Cloud Platform console for project 'uni-4733'. The left sidebar contains navigation links for IAM & Admin, IAM, Identity & Organization, Policy Troubleshooter, Policy Analyzer, Organization Policies, Service Accounts, Workload Identity Federat..., Labels, Tags, Settings, Privacy & Security, Manage Resources, and Release Notes. The main content area is titled 'Quotas for project "uni-4733"' and features a red box around the 'EDIT QUOTAS' link. Below this, there are summary cards for 'Near the limit' (0), 'Low usage' (5,378), and 'All quotas' (5,569). A table lists quotas with columns for Service, Quota, Dimensions (e.g. location), and Limit. The 'Compute Engine API' quota for 'GPUs (all regions)' is selected. A modal window titled '1 quota selected' is open, showing 'Quota changes' and 'Compute Engine API' details. The 'New limit' is set to 1, and the 'Request description' is 'For COMS 4733 robotics course projects at Columbia University'. A red box highlights the 'New limit' and 'Request description' fields. The modal also includes a 'DONE' button and a 'NEXT' button at the bottom.

Google Cloud Platform uni-4733 Search Products, resources, docs (/)

IAM & Admin Quotas for project "uni-4733" **EDIT QUOTAS**

Near the limit 0 View quotas Low usage 5,378 View quotas All quotas 5,569

Filter Quota : GPUs (all regions) Enter property name or value

Service	Quota	Dimensions (e.g. location)	Limit
<input checked="" type="checkbox"/>	Compute Engine API	GPUs (all regions)	0

1 quota selected

Quota changes
Expand each service card to change individual quotas.

Compute Engine API

Quota: GPUs (all regions)
Current limit: 0
Enter a new quota limit. A limit above 0 will require approval from your service provider.

New limit *
1

Request description *
For COMS 4733 robotics course projects at Columbia University

Your description will be sent to your service provider and is used to evaluate your request. It's useful to include the intent of the quota usage, future growth plans, region or zone spread, and any additional requirements or dependencies.

DONE

NEXT

Edit Quota for GPU

Usually available within 15 min (confirmation will be sent to your LionMail)

That being said, better to APPLY EARLY!!!



Google Compute Engine Quota Support <esupport@google.com>

to me ▾

Hello,

Your quota request for rs3989-coms4733 has been approved and your project quota has been adjusted according to the following requested limits:

+-----+-----+-----+			
	Name	Region	Requested Limit
+-----+-----+-----+			
	GPUS_ALL_REGIONS	GLOBAL	1
+-----+-----+-----+			

After approved, Quotas can take up to 15 min to be fully visible in the Cloud

Console and available to you.

Google Cloud Platform

uni-4733

Search Products, resources, docs (/)

IAM & Admin

Labels

Tags

Settings

Privacy & Security

Identity-Aware Proxy

Roles

Audit Logs

Asset Inventory

Quotas for project "uni-4733"

EDIT QUOTAS

Near the limit
0
[View quotas](#)

Low usage
5,390
[View quotas](#)

All quotas
5,602

Filter

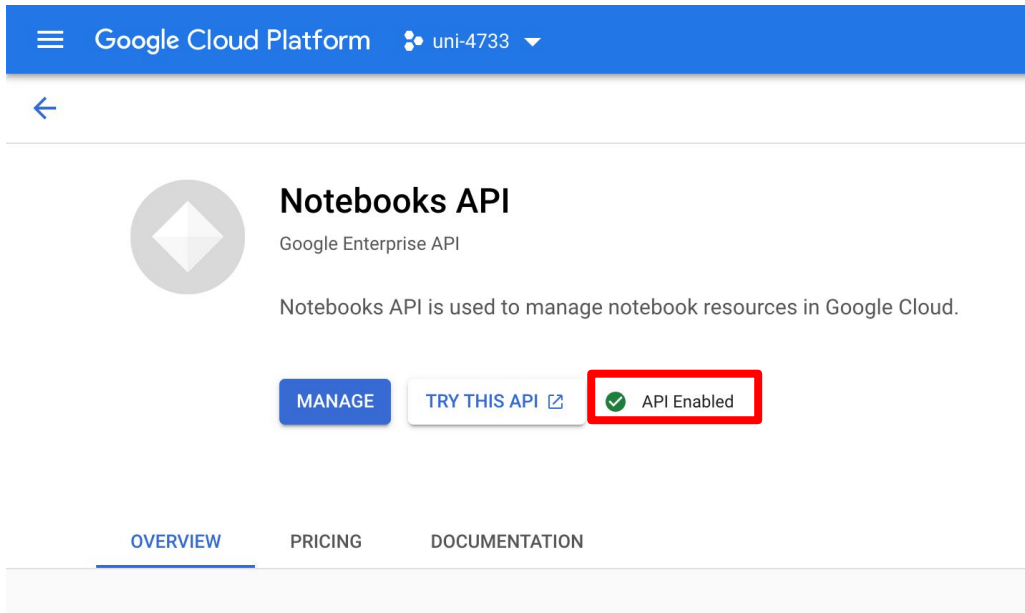
Quota : GPUs (all regions)

Enter property name or value

	Service	Quota	Dimensions (e.g. location)	Limit	Current usage percentage
<input type="checkbox"/>	Compute Engine API	GPUs (all regions)		1	

You should see the limit is now 1

Create a Virtual Machine



Google Cloud Platform uni-4733

Notebooks API

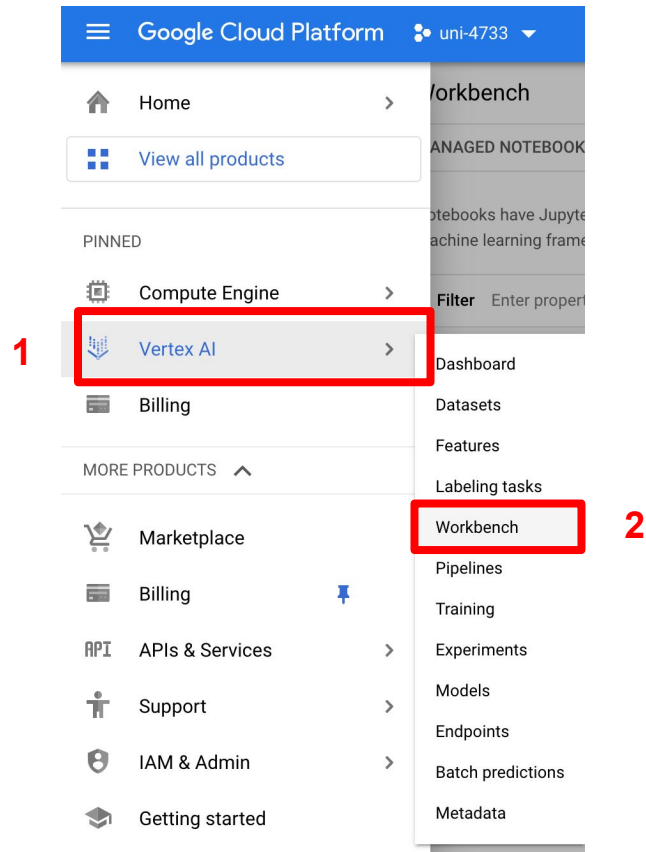
Google Enterprise API

Notebooks API is used to manage notebook resources in Google Cloud.

[MANAGE](#) [TRY THIS API](#) ✓ API Enabled

[OVERVIEW](#) [PRICING](#) [DOCUMENTATION](#)

Enable the Notebooks API first



Google Cloud Platform uni-4733

- Home
- View all products
- PINNED
 - Compute Engine
 - Vertex AI**
 - Billing
- MORE PRODUCTS
 - Marketplace
 - Billing
 - APIs & Services
 - Support
 - IAM & Admin
 - Getting started

- Workbench
- MANAGED NOTEBOOK
- Notebooks have Jupyter machine learning frame
- Filter Enter proper
- Dashboard
- Datasets
- Features
- Labeling tasks
- Workbench**
- Pipelines
- Training
- Experiments
- Models
- Endpoints
- Batch predictions
- Metadata

Create a Virtual Machine

Vertex AI -> Workbench -> NEW INSTANCE -> PyTorch 1.10 -> With 1 NVIDIA Tesla T4

The screenshot displays the Google Cloud Platform (GCP) Vertex AI Workbench interface. The top navigation bar includes the Google Cloud Platform logo, the user's account (uni-4733), a search bar, and a dropdown menu. The left sidebar shows the navigation menu with options like Dashboard, Datasets, Features, Labeling tasks, Workbench (selected), Pipelines, Training, and Experiments. The main content area is titled 'Workbench' and shows a list of managed notebooks. A red box labeled '1' highlights the '+ NEW NOTEBOOK' button. A dropdown menu is open, showing various environments: Python 3, Python 3 (CUDA Toolkit 11.0), TensorFlow Enterprise, PyTorch 1.10 (highlighted with a red box labeled '2'), and R 4.1. To the right, a table shows the available machine types and GPUs. A red box labeled '3' highlights the 'With 1 NVIDIA Tesla T4' option in the table.

Environment	Machine type	GP
Without GPUs	5 GB	No
With 1 NVIDIA Tesla T4		

Create a VM

DO
LOOK AT
THE NEXT PAGE!!!

Use us-central1

IMPORTANT: check this box

New notebook

Notebook name *
hw2

Make it easy and recognizable

63-char limit with lowercase letters, digits, or '-' only. Must start with a letter. Cannot end with a '-'.
63-char limit with lowercase letters, digits, or '-' only. Must start with a letter. Cannot end with a '-'.

Region *
us-central1 (Iowa)

Zone *
us-central1-a

Restricted by GPU selection.

Notebook properties

Keep default settings

Environment ? PyTorch 1.10 (with Intel® MKL-DNN/MKL)

Machine type 4 vCPUs, 15 GB RAM

GPUs ? 1 NVIDIA Tesla T4

Boot disk 100 GB Standard persistent disk

Data disk 100 GB Standard persistent disk

Subnetwork
default(10.128.0.0/20)

External IP Ephemeral(Automatic)

Permission Compute Engine default service account

Estimated cost ? \$281.58 monthly, \$0.386 hourly

Pricing shown here

☒ Install NVIDIA GPU driver automatically for me ?

ADVANCED OPTIONS

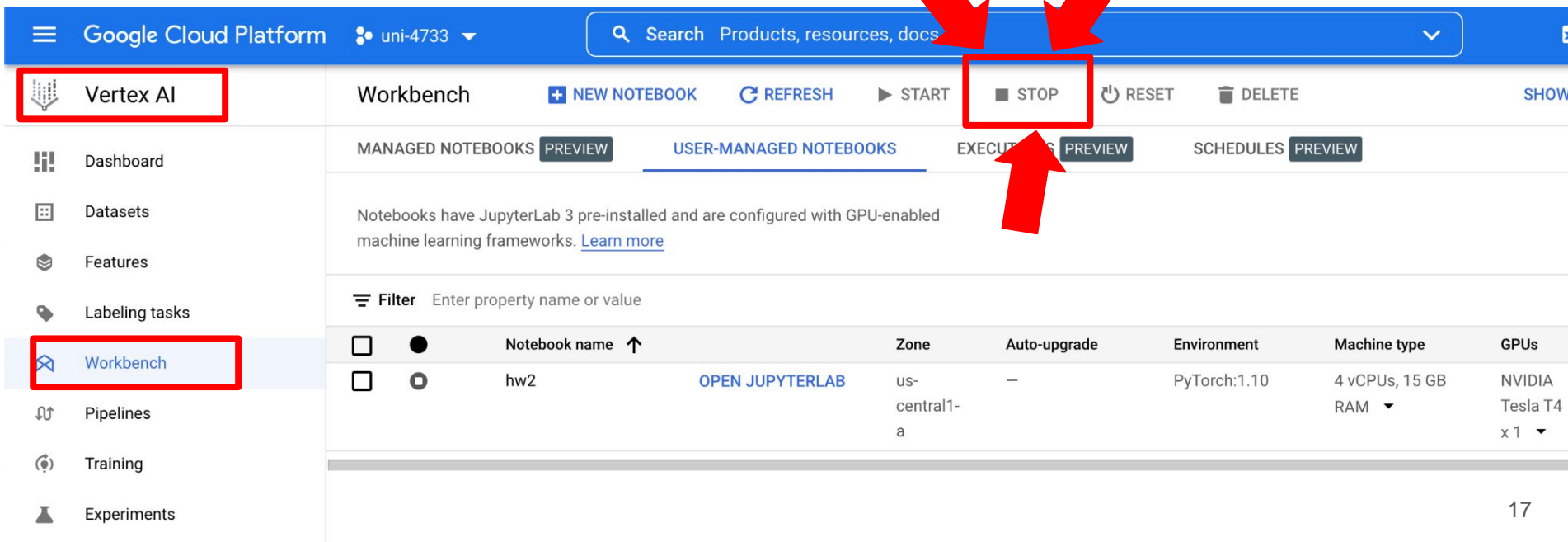
CANCEL

CREATE

IMPORTANT: STOP the VM!!!

After you successfully create the VM, it will automatically START.

STOP the VM when you are not using it!!!



The screenshot shows the Google Cloud Platform interface for Vertex AI Workbench. The left sidebar contains a menu with items: Vertex AI, Dashboard, Datasets, Features, Labeling tasks, Workbench (highlighted with a red box), Pipelines, Training, and Experiments. The main content area is titled 'Workbench' and includes buttons for '+ NEW NOTEBOOK', 'REFRESH', 'START', 'STOP' (highlighted with a red box), 'RESET', and 'DELETE'. Below these buttons are tabs for 'MANAGED NOTEBOOKS', 'USER-MANAGED NOTEBOOKS', 'EXECUTING' (highlighted with a red box), and 'SCHEDULES'. A table lists notebooks, with one named 'hw2' in the 'EXECUTING' state. The table columns are: Notebook name, Zone, Auto-upgrade, Environment, Machine type, and GPUs.

		Notebook name ↑	Zone	Auto-upgrade	Environment	Machine type	GPUs
<input type="checkbox"/>	●	hw2	us-central1-a	—	PyTorch:1.10	4 vCPUs, 15 GB RAM	NVIDIA Tesla T4 x 1

Start the VM - jupyter notebook

<https://console.cloud.google.com/vertex-ai/workbench/list/instances>

Google Cloud Platform uni-4733

Search Products, resources, docs (/)

Vertex AI

Workbench

+ NEW NOTEBOOK REFRESH START STOP RESET DELETE

MANAGED NOTEBOOKS PREVIEW USER-MANAGED NOTEBOOKS EXECUTIONS PREVIEW SCHEDULES PREVIEW

Notebooks have JupyterLab 3 pre-installed and are configured with GPU-enabled machine learning frameworks. [Learn more](#)

Filter Enter property name or value

<input type="checkbox"/>	<input checked="" type="radio"/>	Notebook name ↑	Zone	Auto-upgrade	Environment	Machine type	GPUs
<input type="checkbox"/>	<input checked="" type="radio"/>	hw2	us-central1-a	—	PyTorch:1.10	4 vCPUs, 15 GB RAM	NVIDIA Tesla V100 x1

OPEN JUPYTERLAB

Be careful not to click this :(

IMPORTANT: environment for hw2

We **DON'T** need a virtual environment
on VM

Do not install the virtual environment on VM.

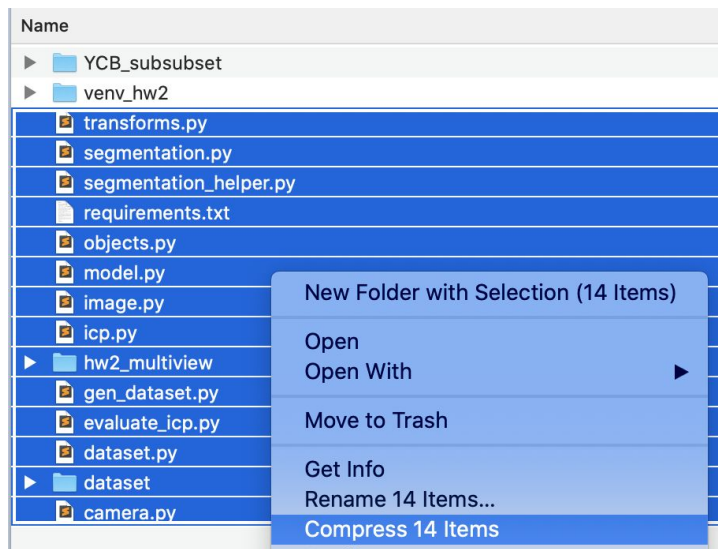
- run `pip install opencv-python==4.4.0.42` in the terminal
- All other packages are pre-installed on the VM.

STOP the VM when you are not using it!!!

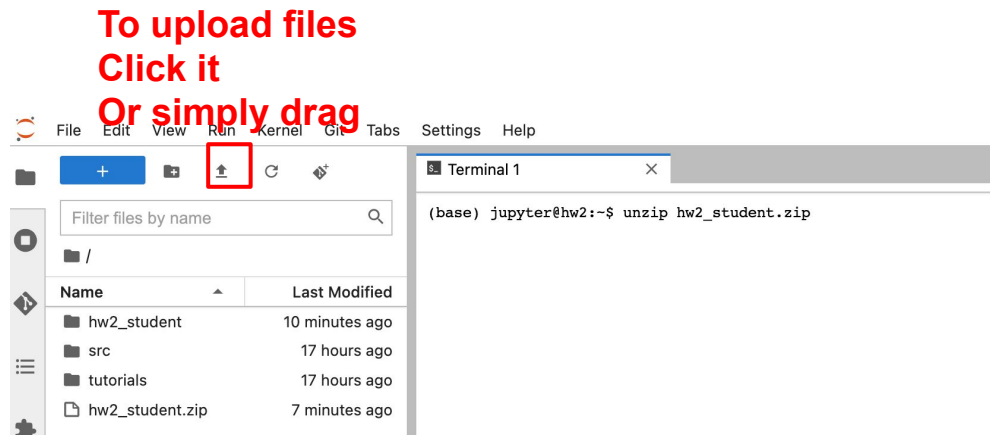
Transfer files between PC and VM

When you upload your homework2 from PC to VM:

- **DON'T include /venv_hw2 and /YCB_subsubset**
- Compress all files you want to upload in a zip file and upload to VM



PC



VM

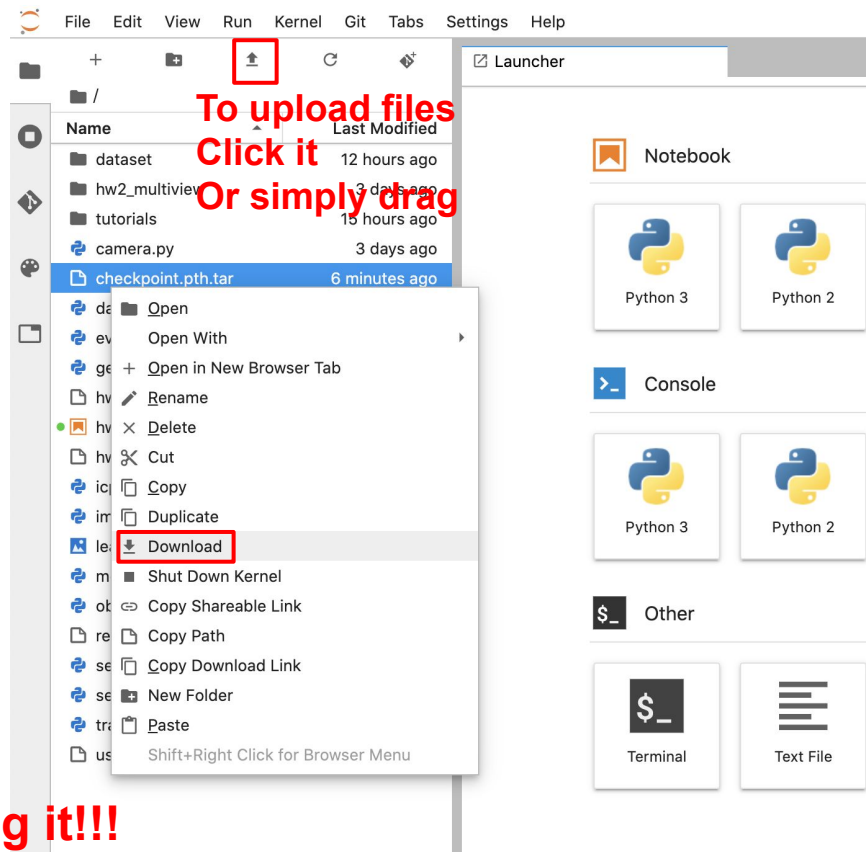
Transfer files between PC and VM

Start your VM to do this.

OPEN JUPYTERLAB

you will be able to

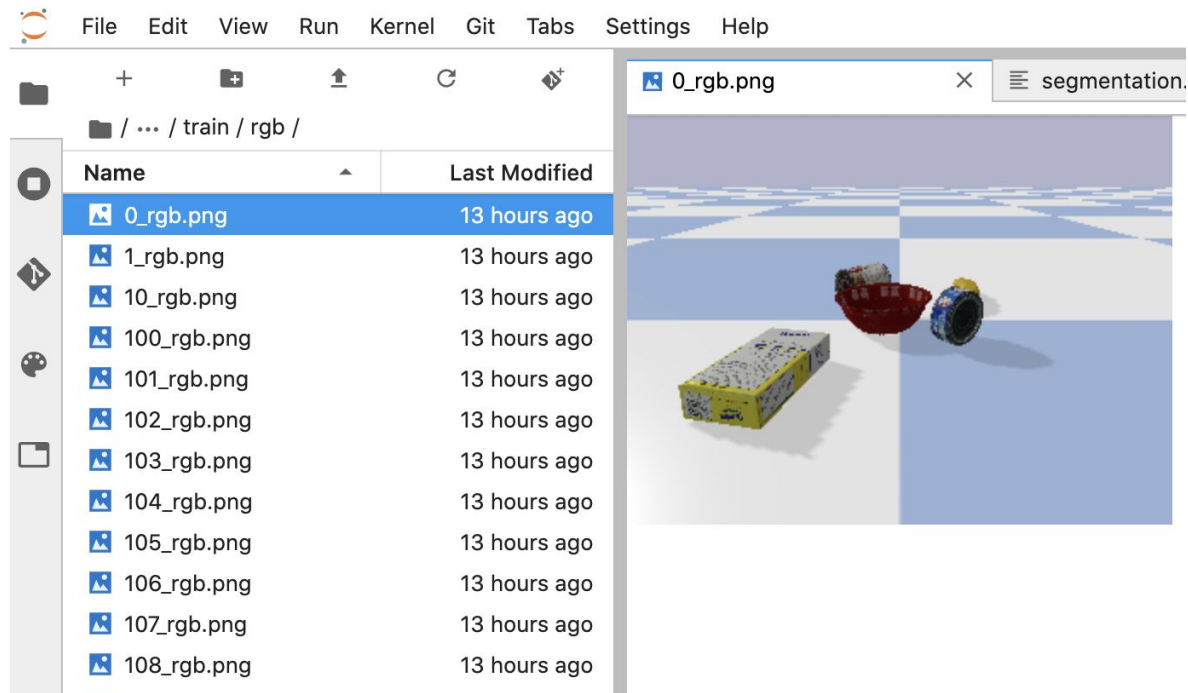
- Drag files to upload
- Right click on files to download



STOP the VM when you are not using it!!!

Use JupyterLab in GCP

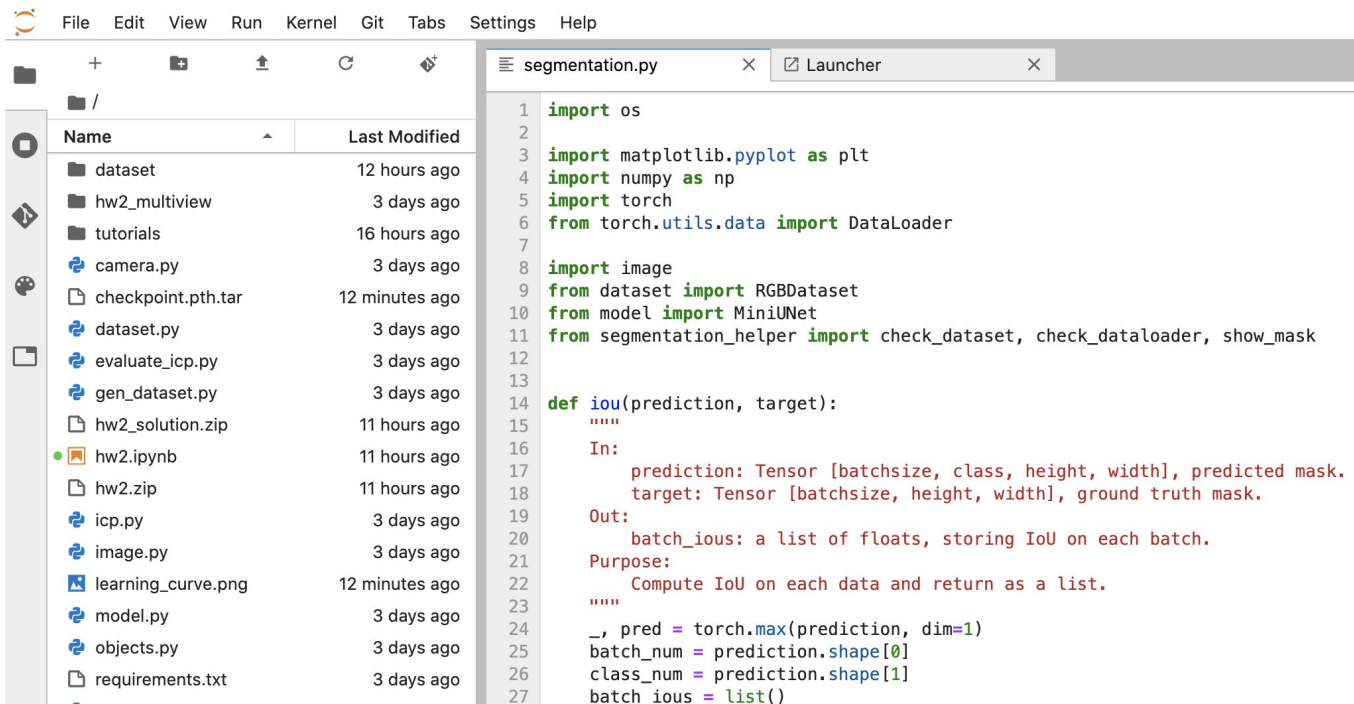
Double click to open files. For example, an image.



STOP the VM when you are not using it!!!

Use JupyterLab in GCP

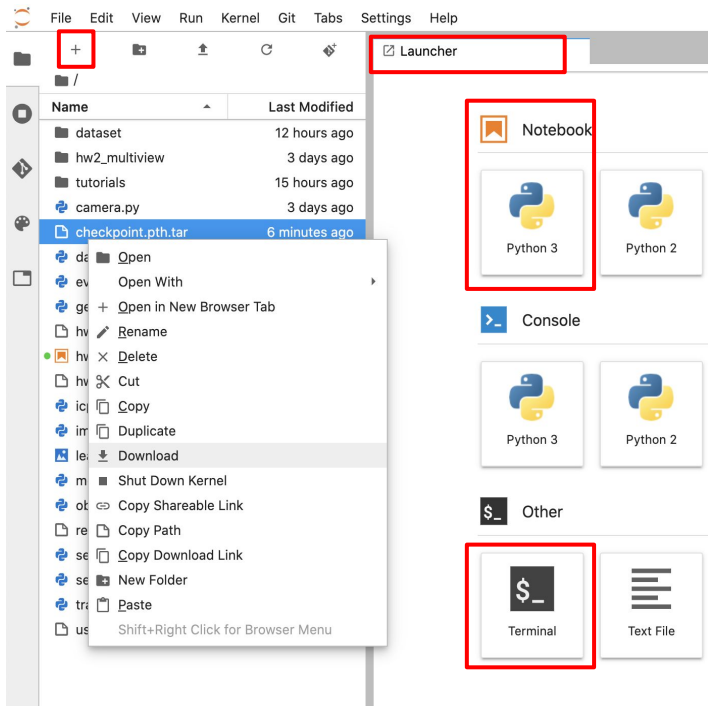
JupyterLab interface provides in-built code editor. Double click a code file to open.



STOP the VM when you are not using it!!!

Use JupyterLab in GCP

In the Launcher, you are able to open Notebook and Terminal



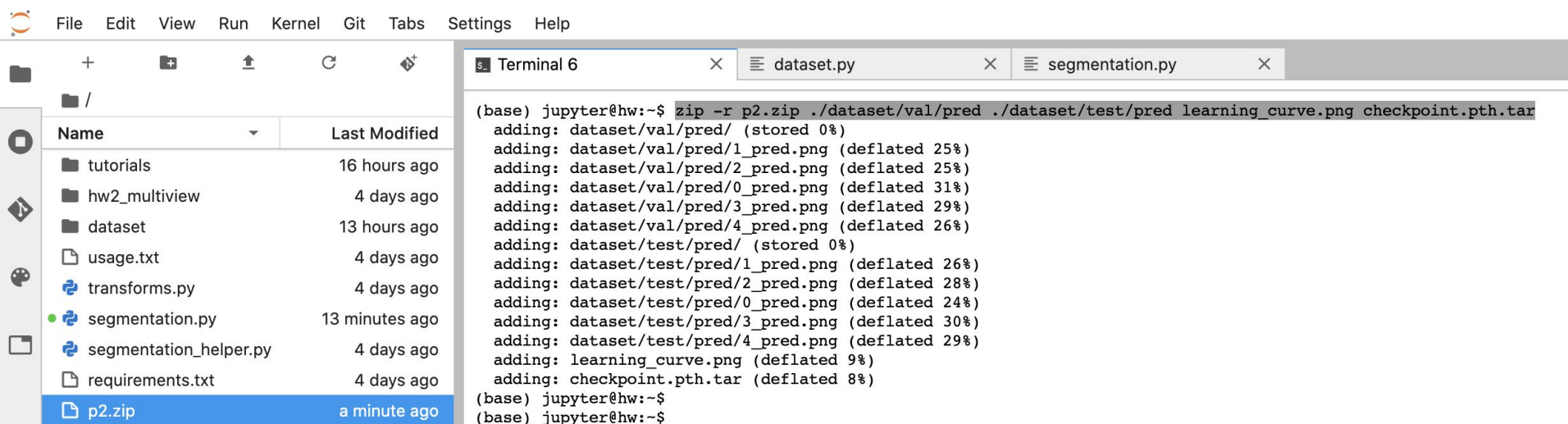
STOP the VM when you are not using it!!!

Use JupyterLab in GCP

Use **Terminal** to run commands. (unzip uploaded file, run scripts, zip when you finish...)

You can zip your output files to download (**also don't forget to download your code**)

```
zip -r p2.zip ./dataset/val/pred ./dataset/test/pred learning_curve.png checkpoint.pth.tar
```



The screenshot displays the JupyterLab web interface. On the left is a file browser pane showing a directory structure with folders like 'tutorials', 'hw2_multiview', and 'dataset', and files like 'usage.txt', 'transforms.py', 'segmentation.py', 'segmentation_helper.py', 'requirements.txt', and 'p2.zip'. The 'p2.zip' file is selected. On the right is a terminal window titled 'Terminal 6' with tabs for 'dataset.py' and 'segmentation.py'. The terminal shows the execution of the command to create a zip file, with progress output for each file added.

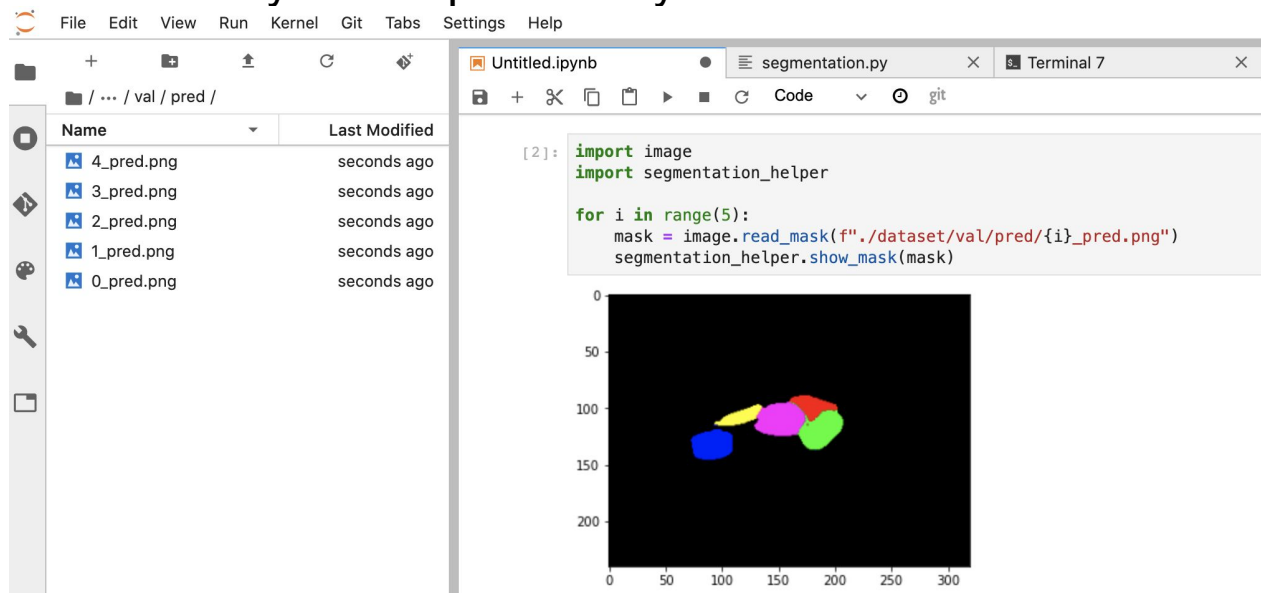
Name	Last Modified
tutorials	16 hours ago
hw2_multiview	4 days ago
dataset	13 hours ago
usage.txt	4 days ago
transforms.py	4 days ago
segmentation.py	13 minutes ago
segmentation_helper.py	4 days ago
requirements.txt	4 days ago
p2.zip	a minute ago

```
(base) jupyter@hw:~$ zip -r p2.zip ./dataset/val/pred ./dataset/test/pred learning_curve.png checkpoint.pth.tar
adding: dataset/val/pred/ (stored 0%)
adding: dataset/val/pred/1_pred.png (deflated 25%)
adding: dataset/val/pred/2_pred.png (deflated 25%)
adding: dataset/val/pred/0_pred.png (deflated 31%)
adding: dataset/val/pred/3_pred.png (deflated 29%)
adding: dataset/val/pred/4_pred.png (deflated 26%)
adding: dataset/test/pred/ (stored 0%)
adding: dataset/test/pred/1_pred.png (deflated 26%)
adding: dataset/test/pred/2_pred.png (deflated 28%)
adding: dataset/test/pred/0_pred.png (deflated 24%)
adding: dataset/test/pred/3_pred.png (deflated 30%)
adding: dataset/test/pred/4_pred.png (deflated 29%)
adding: learning_curve.png (deflated 9%)
adding: checkpoint.pth.tar (deflated 8%)
(base) jupyter@hw:~$
(base) jupyter@hw:~$
```

STOP the VM when you are not using it!!!

Use JupyterLab in GCP

You can use Jupyter Notebook for visualization/debugging
e.g. `show_mask()`, `check_dataset()`, `check_dataloader()` from `segmentation_helper.py`
BUT, use **Terminal** to run your scripts when you finalize!



The screenshot displays the JupyterLab environment. On the left is a file browser showing the directory `/.../val/pred/` with files `0_pred.png` through `4_pred.png`. The central pane shows a code editor with the following Python code:

```
[2]: import image
import segmentation_helper

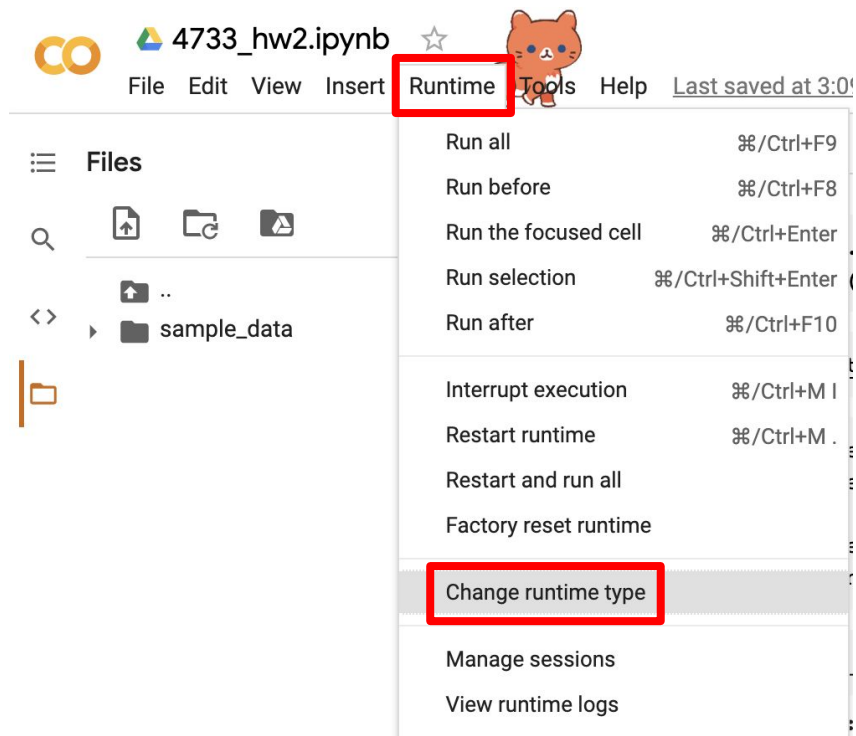
for i in range(5):
    mask = image.read_mask(f"./dataset/val/pred/{i}_pred.png")
    segmentation_helper.show_mask(mask)
```

Below the code, a visualization of the segmentation mask is shown. It is a 300x200 pixel image with a black background. The mask contains several colored regions: a blue region on the left, a yellow region at the top, a red region on the right, a green region at the bottom right, and a magenta region in the center. The axes are labeled from 0 to 200 on the y-axis and 0 to 300 on the x-axis.

STOP the VM when you are not using it!!!

Alternative: Google Colab

<https://colab.research.google.com/>



The screenshot shows the Google Colab interface. At the top, the file name is "4733_hw2.ipynb". Below it is a menu bar with "File", "Edit", "View", "Insert", "Runtime", "Tools", and "Help". The "Runtime" menu is open, and the option "Change runtime type" is highlighted with a red box. Other options in the menu include "Run all", "Run before", "Run the focused cell", "Run selection", "Run after", "Interrupt execution", "Restart runtime", "Restart and run all", "Factory reset runtime", "Manage sessions", and "View runtime logs". On the left side, there is a "Files" panel showing a folder named "sample_data".

Notebook settings

Hardware accelerator
GPU



To get the most out of Colab, avoid using a GPU unless you need one. [Learn more](#)

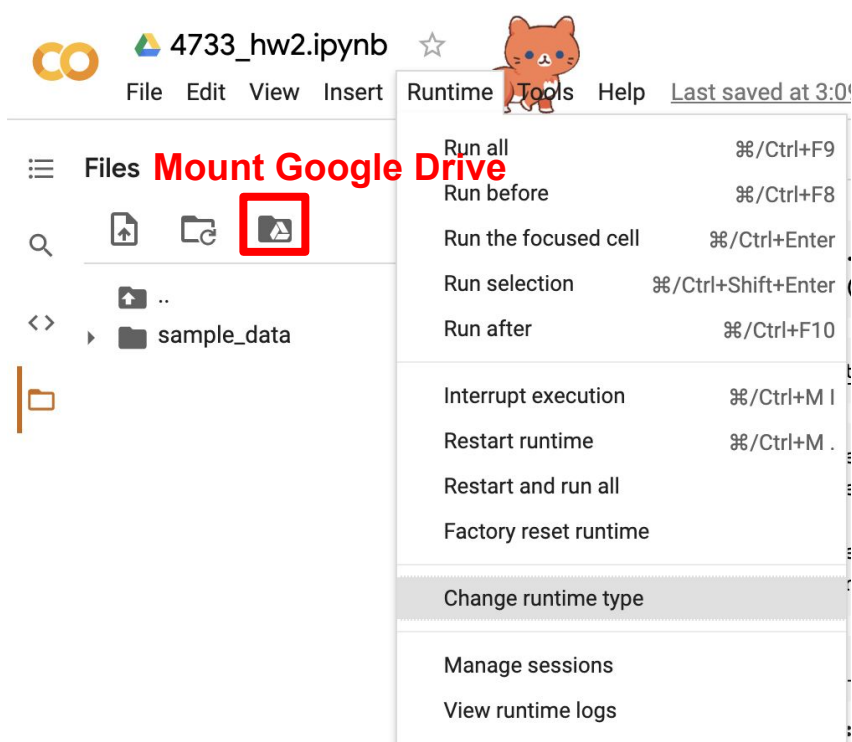
☐ Omit code cell output when saving this notebook

CANCEL

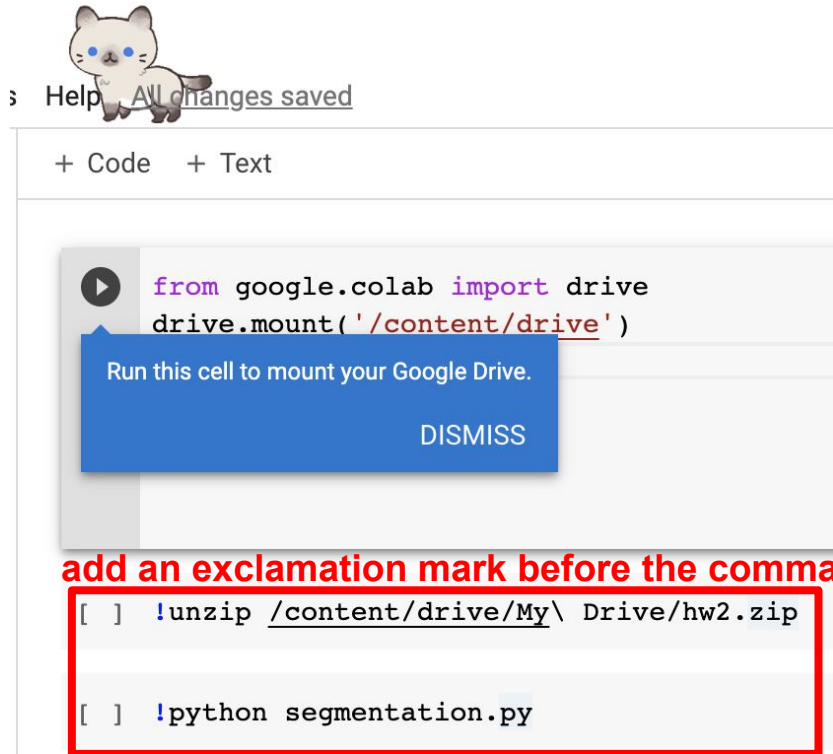
SAVE

Alternative: Google Colab

Upload and save to Google Drive. (slow and temporary in Colab)



The screenshot shows the Google Colab interface. In the top left, the Colab logo is next to the file name '4733_hw2.ipynb'. Below the menu bar (File, Edit, View, Insert, Runtime, Tools, Help), the 'Files' sidebar on the left contains a 'Mount Google Drive' button, which is highlighted with a red box. The 'Runtime' menu is open, showing various options like 'Run all', 'Run before', 'Run the focused cell', 'Run selection', 'Run after', 'Interrupt execution', 'Restart runtime', 'Restart and run all', 'Factory reset runtime', 'Change runtime type', 'Manage sessions', and 'View runtime logs'. A small orange cat sticker is placed above the Runtime menu.



The screenshot shows the Google Colab code editor. At the top, a white cat sticker is above the 'Help' link. The code editor has two tabs: '+ Code' and '+ Text'. A code cell is active, containing the following Python code:

```
from google.colab import drive
drive.mount('/content/drive')
```

A blue notification box with the text 'Run this cell to mount your Google Drive.' and a 'DISMISS' button is overlaid on the code cell. Below the code cell, a red box highlights the following commands:

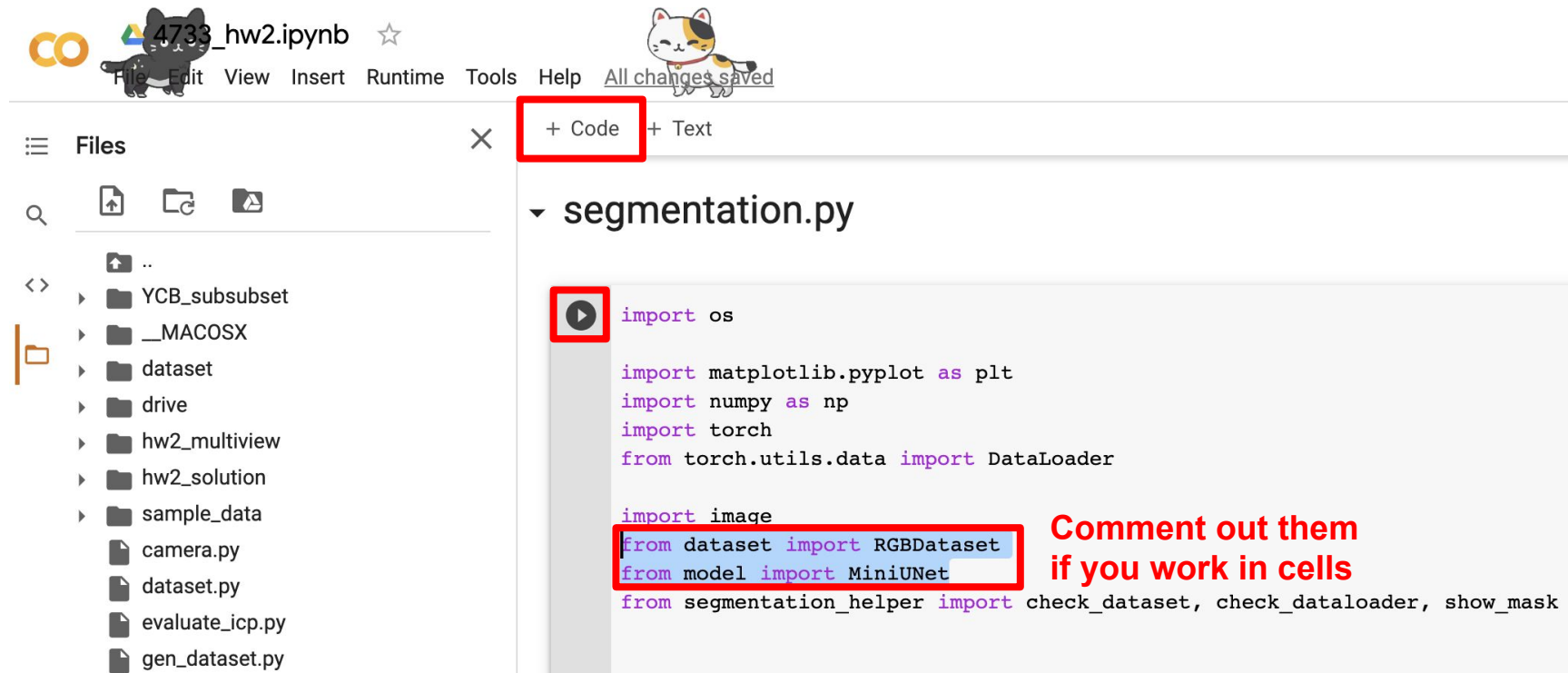
```
[ ] !unzip /content/drive/My\ Drive/hw2.zip
```

```
[ ] !python segmentation.py
```

Red text annotations are present: 'Mount Google Drive' in the first image and 'add an exclamation mark before the command' in the second image.

Alternative: Google Colab

Better to edit code in the cells in case you forget to save your code files



4733_hw2.ipynb ☆

File Edit View Insert Runtime Tools Help All changes saved

Files

Q

YCB_subsubset

__MACOSX

dataset

drive

hw2_multiview

hw2_solution

sample_data

camera.py

dataset.py

evaluate_icp.py

gen_dataset.py

+ Code + Text

segmentation.py

```
import os

import matplotlib.pyplot as plt
import numpy as np
import torch
from torch.utils.data import DataLoader

import image
from dataset import RGBDataset
from model import MiniUNet
from segmentation_helper import check_dataset, check_dataloader, show_mask
```

Comment out them if you work in cells