



STAT 453: Introduction to Deep Learning and Generative Models

Ben Lengerich

Lecture 07: Cloud computing resources

September 24, 2025



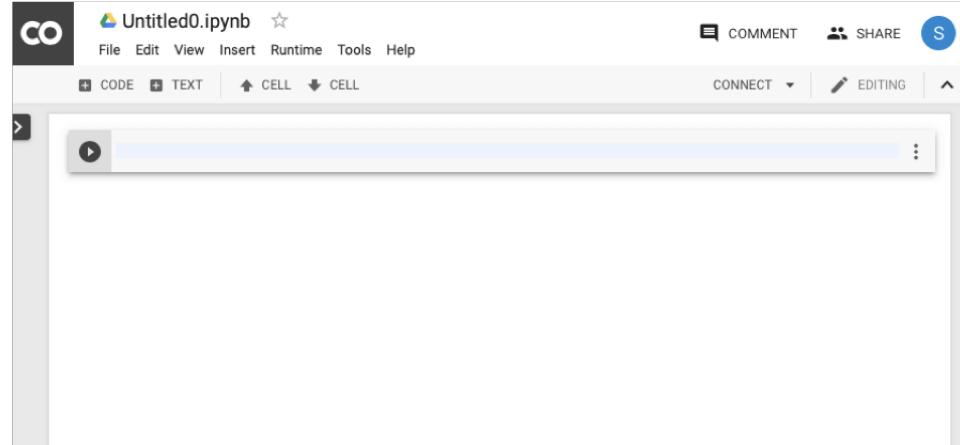
Today: Computing partial derivatives with PyTorch

1. Google Colab
2. Center for High-Throughput Computing



Google Colab

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



- Free Google-flavored Jupyter Notebooks in the Cloud
- For each notebook, they spin up a custom (Linux-based) computing instance
- Computations limited to ~12 h though; you won't lose your notebook, but computations will be interrupted
- Maybe useful for quick testing/experimenting/sharing (but maybe tedious as you need to reinstall packages each time)



Google Colab

Welcome to Colaboratory!

EXAMPLES RECENT GOOGLE DRIVE GITHUB UPLOAD FAQ for

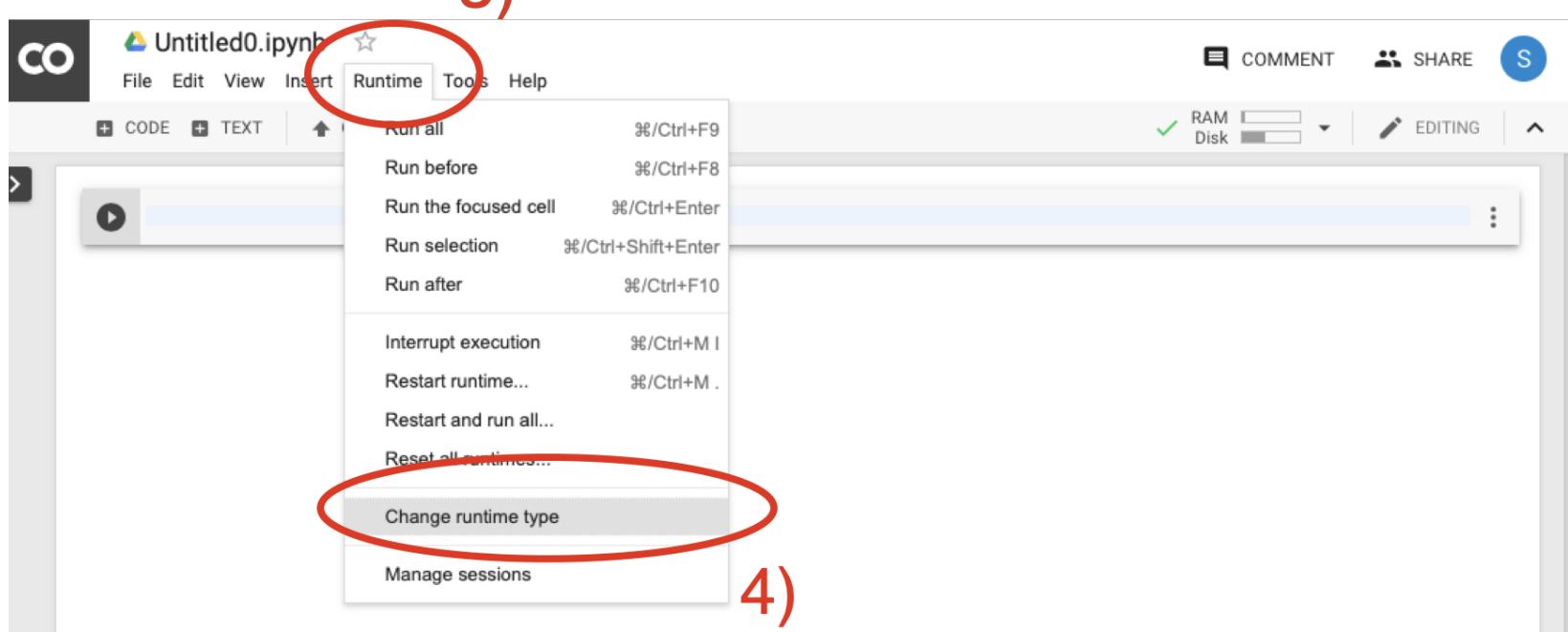
Filter notebooks

Title	Owner	Last modified	Last opened	Actions
Untitled	Sebastian Raschka	3 days ago	3 days ago	
Untitled7.ipynb	Sebastian Raschka	11 days ago	11 days ago	
Untitled6.ipynb	Sebastian Raschka	Jan 12, 2019	Jan 12, 2019	
Untitled5.ipynb	Sebastian Raschka	Dec 17, 2018	Dec 17, 2018	
Untitled4.ipynb	Sebastian Raschka	Oct 12, 2018	Oct 12, 2018	

NEW PYTHON 3 NOTEBOOK ▾ CANCEL

Menu appears if you visit <https://colab.research.google.com>

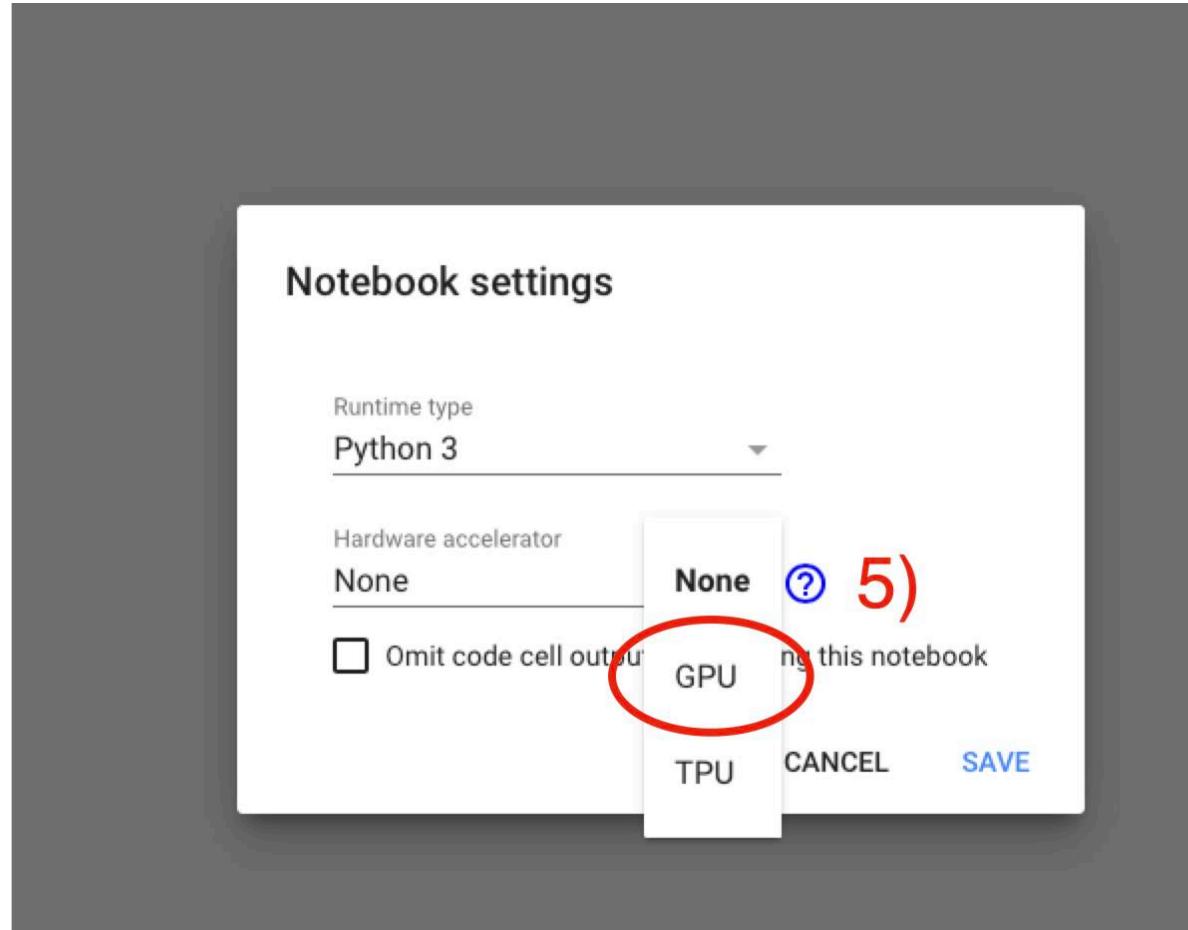
Google Colab



Follow these steps for running code on GPU later (default is CPU)

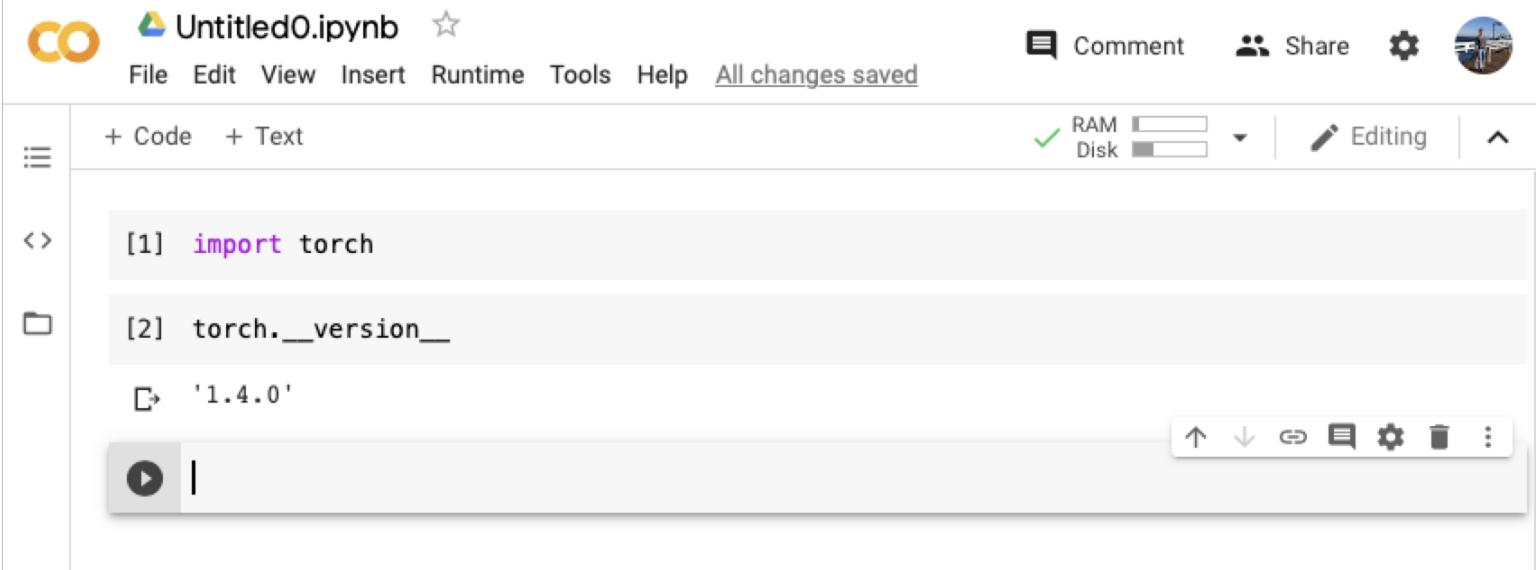


Google Colab



Follow these steps for running code on GPU later (default is CPU)

Google Colab



The screenshot shows a Google Colab notebook titled "Untitled0.ipynb". The interface includes a toolbar with File, Edit, View, Insert, Runtime, Tools, Help, and a status bar indicating "All changes saved". The main area displays two code cells:

```
[1] import torch
[2] torch.__version__
'D 1.4.0'
```

A play button icon is visible at the bottom left of the code area.

- This is nice! It appears that PyTorch is already pre-installed now (it wasn't always the case)



Google Colab

A screenshot of a Google Colab notebook titled "Untitled0.ipynb". The interface includes a top navigation bar with File, Edit, View, Insert, Runtime, Tools, Help, and a status message "All changes saved". Below the bar are buttons for Comment, Share, and settings. A sidebar on the left has buttons for Code and Text. The main area contains four code cells:

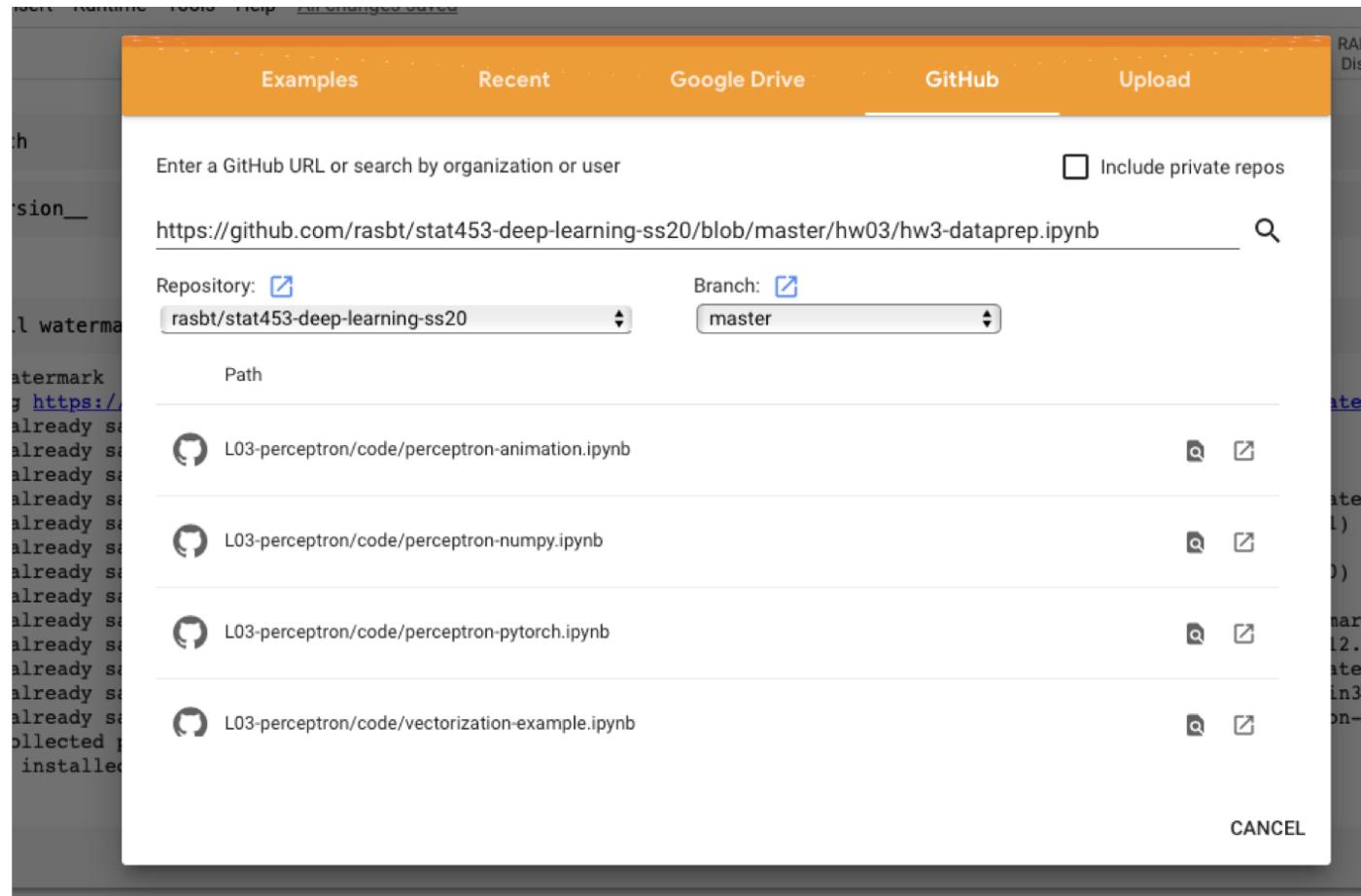
```
[1] import torch
[2] torch.__version__
[3] '1.4.0'
[4] !pip install watermark
```

The "Runtime" section shows a green checkmark next to RAM and Disk, with an "Editing" button and a dropdown menu.

- In any case, if you'd like/need to install packages, you can do it as shown in the example above
- Note that in Jupyter Notebooks, the "!" indicates that what follows on that line is a "shell command" (you can think of a "shell" as the Linux & macOS command-line terminal, e.g., a Bash Shell)



Google Colab



- You can also upload Notebooks or directly paste GitHub links to notebooks



Google Colab

A screenshot of a Google Colab notebook titled "hw3-dataprep.ipynb". The notebook contains course information: "STAT 453: Deep Learning (Spring 2020)", "Instructor: Sebastian Raschka (sraschka@wisc.edu)", "Course website: http://pages.stat.wisc.edu/~sraschka/teaching/stat453-ss2020/", and "GitHub repository: https://github.com/rasbt/stat453-deep-learning-ss20". Below the text, there are two sections: "Notebook for Preparing" and "Step 1: Downloading the es". A modal dialog box is overlaid on the page, displaying the message "Cannot save changes" and explaining that the notebook is in playground mode. It includes "CANCEL" and "SAVE A COPY IN DRIVE" buttons, with "SAVE A COPY IN DRIVE" being highlighted with a blue border. At the bottom of the page, there is a table listing three files: "train-images-idx3-ubyte.gz", "train-labels-idx1-ubyte.gz", and "t10k-images-idx3-ubyte.gz", along with their details: Name, Content, Examples, Size, and Link.

Name	Content	Examples	Size	Link
train-images-idx3-ubyte.gz	training set images	60,000	26 MBytes	Download
train-labels-idx1-ubyte.gz	training set labels	60,000	29 KBytes	Download
t10k-images-idx3-ubyte.gz	test set images	10,000	4.3 MBytes	Download

When you import a Notebook from a GitHub link, make sure to save it in your Google Drive if you plan to make edits, otherwise it will be gone later



Mounting your Google Drive to the Notebook

1)

```
from google.colab import drive  
drive.mount('/content/drive')  
  
... Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client\_id=947318  
  
Enter your authorization code:  

```

Then, click on the link and enter it in the field above

2)

```
from google.colab import drive  
drive.mount('/content/drive')  
  
... Go to this URL in a browser: https://accounts.google.co  
  
Enter your authorization code:  
.....
```

3)

```
from google.colab import drive  
drive.mount('/content/drive')  
  
Go to this URL in a browser: https://ac  
  
Enter your authorization code:  
.....  
Mounted at /content/drive
```



Mounting your Google Drive to the Notebook

Once mounted, you can open dataset files

```
[16] # this code cell unzips the .gz files

import sys
import gzip
import shutil
import os

writemode = 'wb'
zipped_mnist = [f for f in os.listdir('/content/drive/My Drive/Colab Notebooks/hw03') if f.endswith('ubyte.gz')]
for z in zipped_mnist:
    path = os.path.join('/content/drive/My Drive/Colab Notebooks/hw03', z)
    with gzip.GzipFile(path, mode='rb') as decompressed, open(path[:-3], writemode) as outfile:
        outfile.write(decompressed.read())

with open(labels_path, 'rb') as lbpath:
    magic, n = struct.unpack('>II',
                            lbpath.read(8))
    labels = np.fromfile(lbpath,
                        dtype=np.uint8)

with open(images_path, 'rb') as imgpath:
    magic, num, rows, cols = struct.unpack(">IIII",
                                            imgpath.read(16))
    images = np.fromfile(imgpath,
                        dtype=np.uint8).reshape(len(labels), 784)

return images, labels

X_train, y_train = load_mnist('/content/drive/My Drive/Colab Notebooks/hw03', kind='train')
print('Rows: %d, columns: %d' % (X_train.shape[0], X_train.shape[1]))

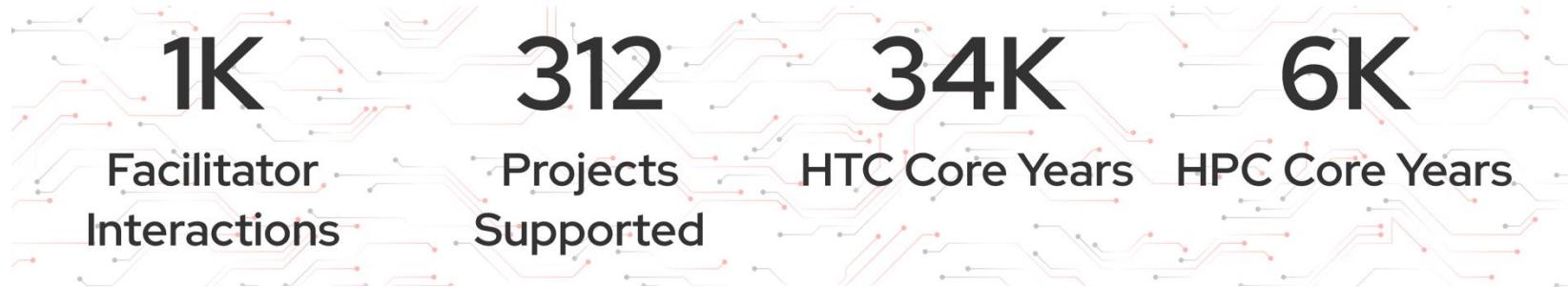
X_test, y_test = load_mnist('/content/drive/My Drive/Colab Notebooks/hw03', kind='t10k')
print('Rows: %d, columns: %d' % (X_test.shape[0], X_test.shape[1]))
```

↳ Rows: 60000, columns: 784
Rows: 10000, columns: 784



Center for High-Throughput Computing (CHTC)

Last Year Serving UW-Madison



College	Projects Supported	HTC Core Years	HPC Core Years	Facilitator Interactions
Agricultural and Life Sciences	62	8,038	54	159
Education	5	216	-	10
Engineering	66	3,342	4,221	316
Law	1	181	-	1
Letters and Sciences	112	11,645	1,244	440
Medicine and Public Health	42	7,172	54	154
Off-Campus Collaborations	14	2,852	138	-
Pharmacy	5	75	258	7
Veterinary Medicine	5	21	-	-
Total	312	33,542	5,969	1,087



Center for High-Throughput Computing (CHTC)

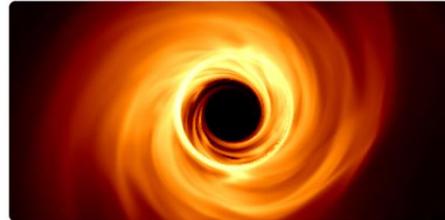
chtc.cs.wisc.edu



HTCondor Celebrates 40 Years

Powered by Community

July 25, 2025



HTC Strikes Again

June 09, 2025

The Center for High Throughput Computing (CHTC), established in 2006, aims to bring the power of High Throughput Computing to all fields of research, and to allow the future of HTC to be shaped by insight from all fields.

Are you a UW-Madison researcher looking to expand your computing beyond your local resources? Request an account now to take advantage of the open computing services offered by the CHTC!

[Request Account](#)

Upcoming Events



Questions?

