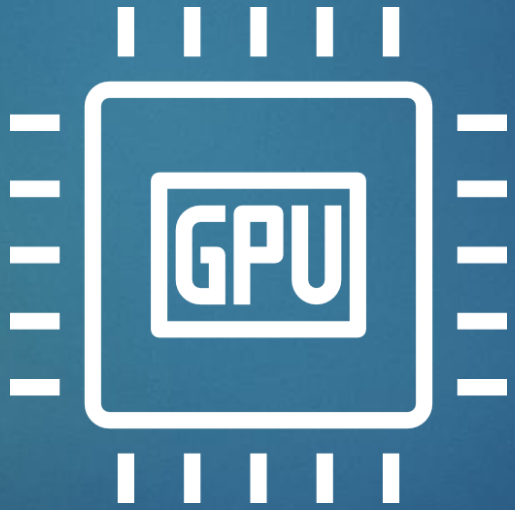
Deep Learning from Scratch

Session #4: Hardware and Platforms



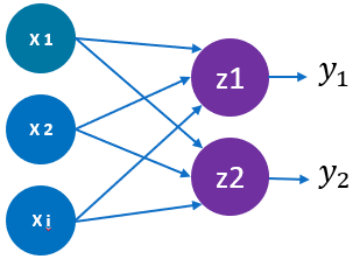
by: Ali Tourani – Summer 2021

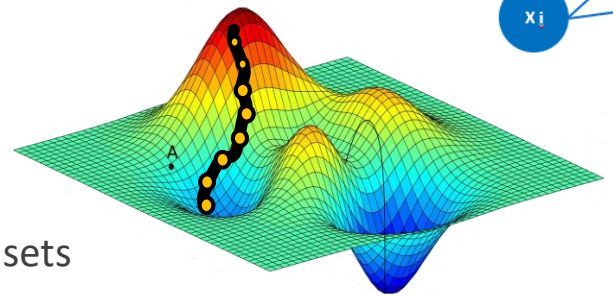
Agenda

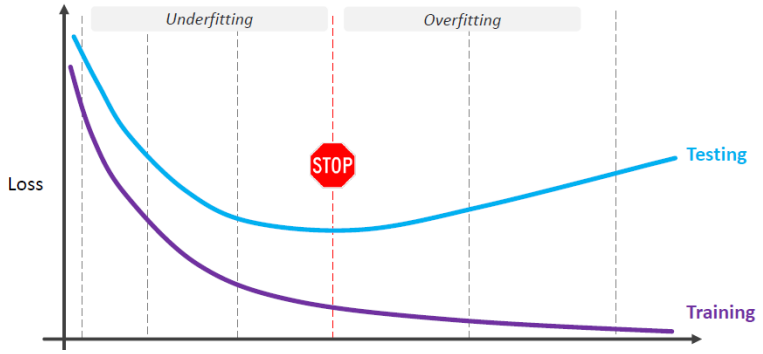
- Warm-up and Review
- Importance of Hardware
- Google Colab

Warm-up and Review

- Artificial Neural Networks (ANNs)
  - Bias, perceptron, Activation Functions
- Training the Network
  - GDA, loss functions and optimization
- Data
  - Data types, datasets, training and test sets
- Feeding DNNs
  - Batch, epoch, iteration
  - Hyperparameters, overfitting/underfitting







Importance of Hardware

- Main requirements of Deep Learning
  - Big Data
  - **Powerful Hardware**
  - Efficient Software

We are here!

Why is hardware so important?

- ✓ Deep learning models require datasets with hundreds/thousands of instances
- ✓ Processing the huge amount of data is impossible with weak resources
- ✓ Parallelization is a fundamental demand in deep learning

Image source: https://www.hp.com

Importance of Hardware

General Guides

- Laptops? Maybe not!
  - Even the most powerful gaming ones
- Desktop computers?
  - Equipped with **GPU**

Only CPU

One GPU

Two GPUs

Four GPUs

Eight GPUs (rack-mount)

Image source: https://www.gamespot.com and https://Sweden.desertcart.com

Importance of Hardware

CPUs vs. GPUs

- *Use-case:* throughput evaluation for object detection by DECI

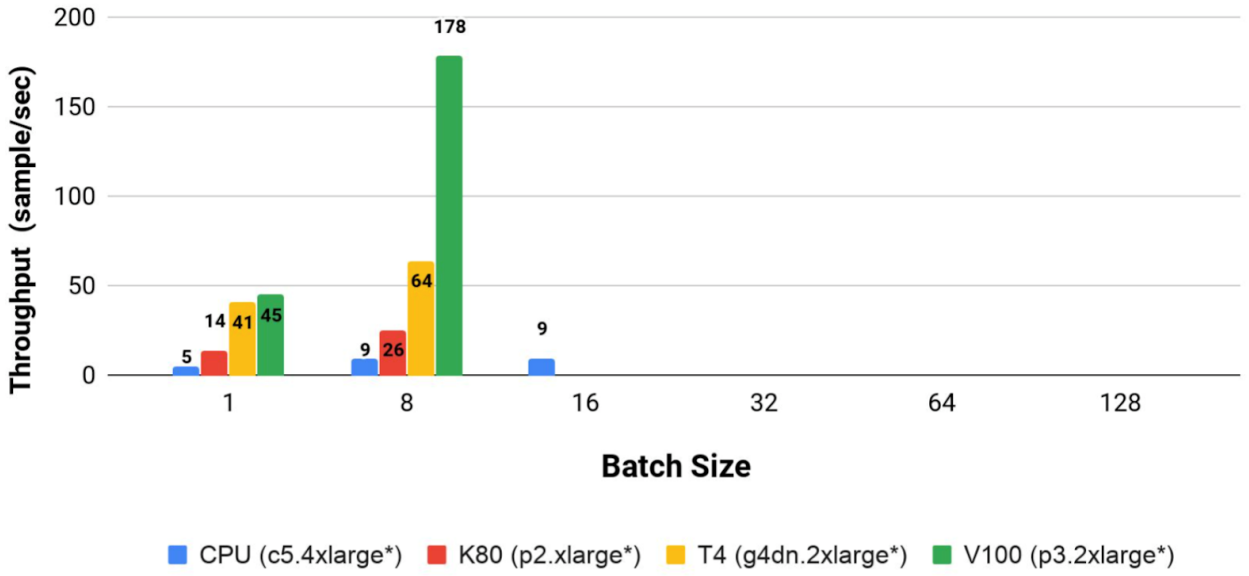


Image source: https://www.pngkit.com

Importance of Hardware

Why GPUs?

- Parallelism with many-core processors
- Efficient for Single Program Multiple Data (SPMD)

You can check my presentation, "an Introduction to CUDA"

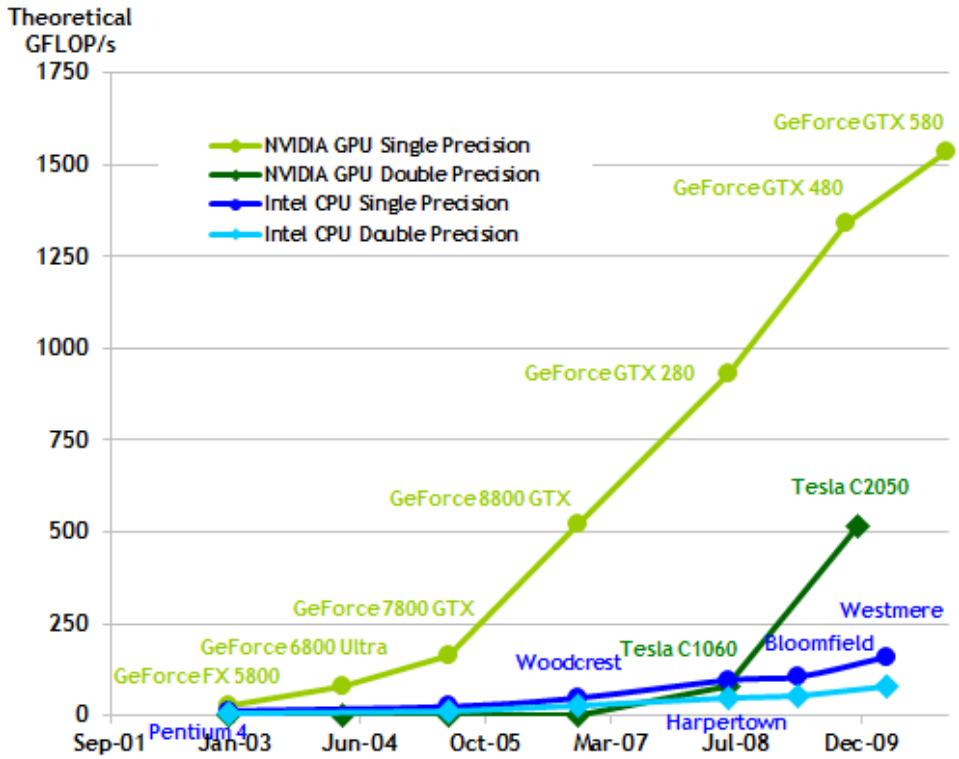


Image source: https://www.researchgate.net

Google Colab

Why is Google Colab?

- A free online cloud-based Jupyter Notebook
- Looking for some **free GPUs** for DL practices?
- Simply start developing using Python libraries
- **Benefits:**
  - A great tool for AI researchers, data scientists, and students
  - Free access to CPUs, GPUs, and TPUs
  - Easy code sharing and zero configuration required

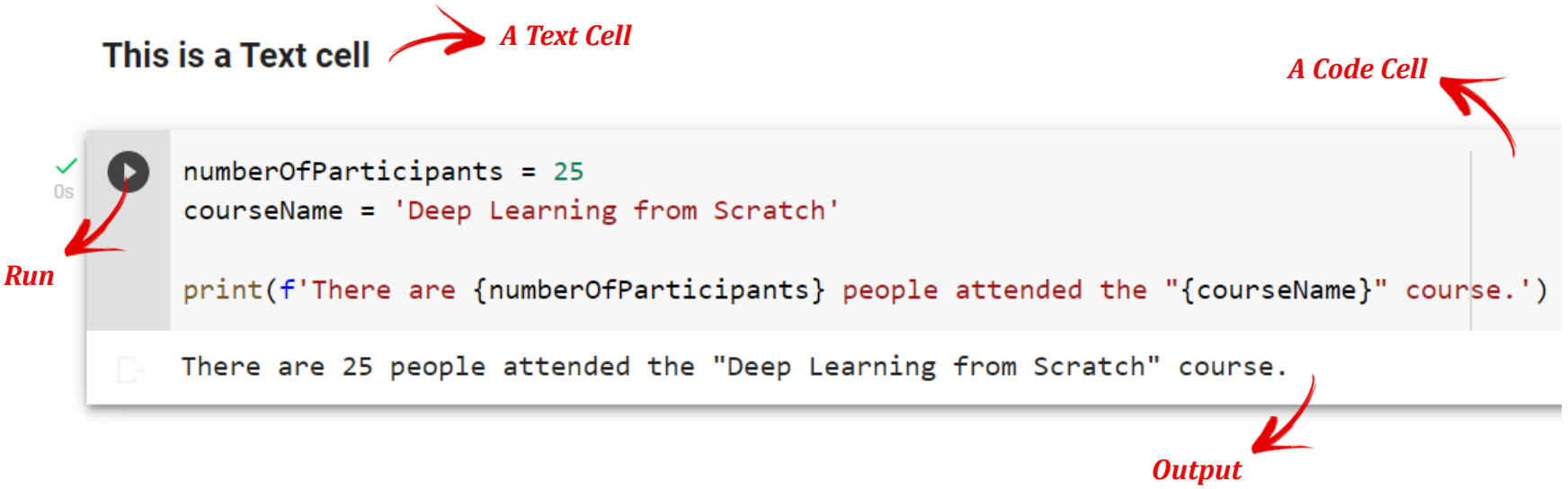
https://colab.research.google.com/

Image source: https://www.colab.research.google.com

Google Colab

Getting Started

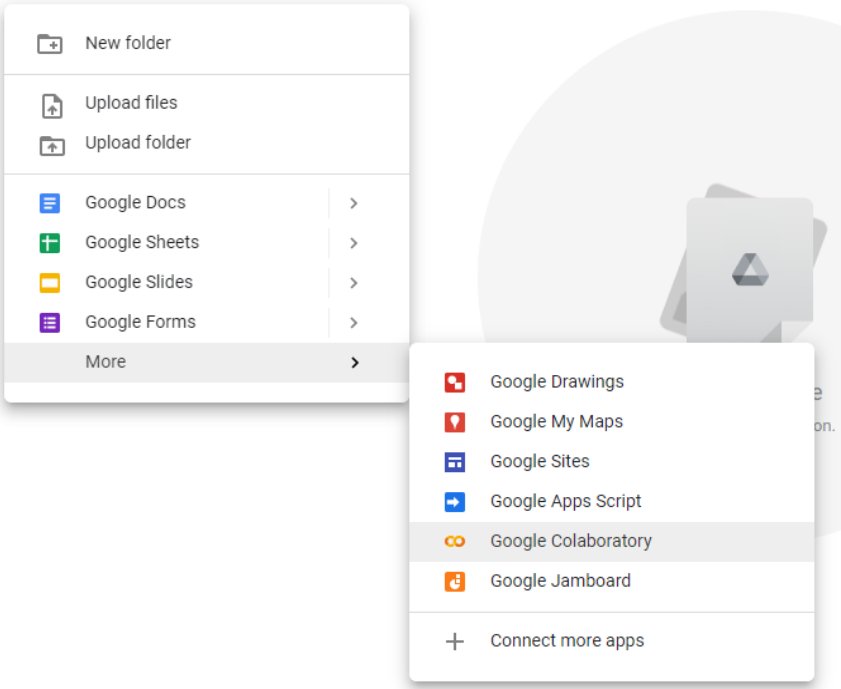
- See https://colab.research.google.com/notebooks/intro.ipynb
- What to expect in a **Colab Notebook**?



Google Colab

A great tool for you!

- You can have both executable code and rich text documents
- You can easily share your work with others
- You can load data from Google Drive, Google Sheets, etc.
- You can use popular Python libraries like **NumPy**, **matplotlib**, **TensorFlow**, **Panda**, etc.
- You can choose GPUs or TPUs as your hardware accelerator

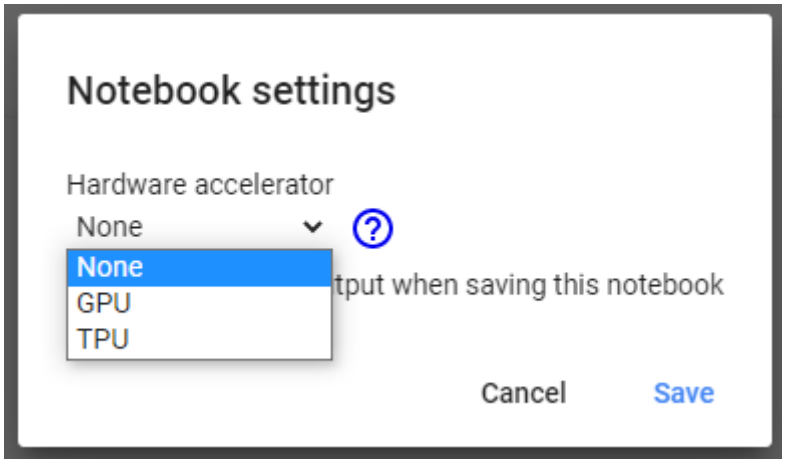


Google Colab

Hardware Accelerators

- Switch between TPUs (Tensor Processing Units), GPUs, and CPUs
  - How to get them? Runtime → Change runtime type

Hardware	*When to use it?*
TPU	- You have Large batches and need the highest possible training throughput
GPU	- You need flexibility and programmability for processing
CPU	- You have large models and need a large memory capacity



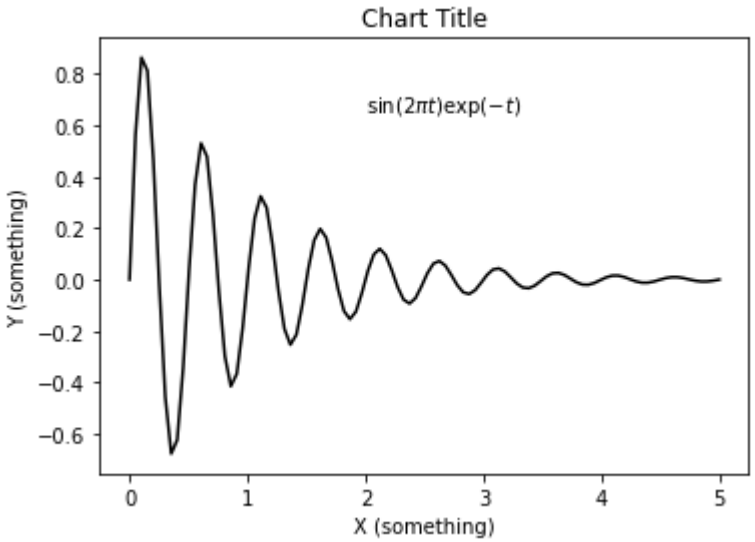
Google Colab

Popular libraries

- Simply import and use popular Python libraries

  e.g. NumPy + matplotlib for data visualization

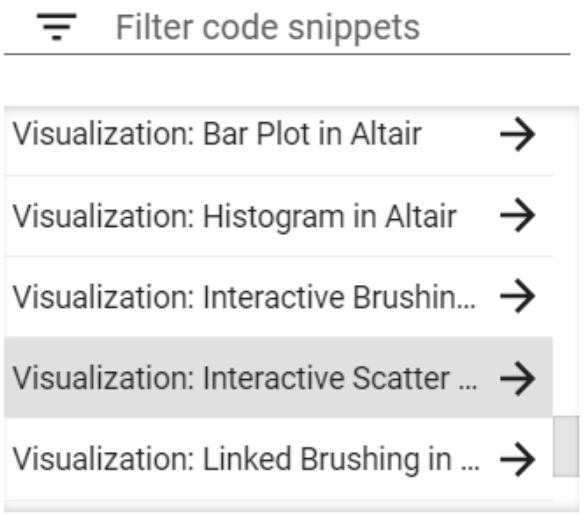
```
import numpy as np
import matplotlib.pyplot as plt

x = np.linspace(0.0, 5.0, 100) # 100 samples between 0 to 5
y = np.sin(4 * np.pi * x) * np.exp(-x)

plt.plot(x, y, 'k')
plt.title('Chart Title')
plt.text(2, 0.65, r'$\sin(2 \pi t) \exp(-t)$') # Chart's inner text
plt.xlabel('X (something)')
plt.ylabel('Y (something)')

plt.subplots_adjust(left = 0.15) # Tune the subplot layout
plt.show()
```



Google Colab

Code Snippets

- Some easy-to-use templates to enter common code patterns
  - How to get them? Insert → Code Snippets or just Ctrl + Alt + P




```
# load an example dataset
from vega_datasets import data
cars = data.cars()

# plot the dataset, referencing dataframe column names
import altair as alt
alt.Chart(cars).mark_point().encode(
  x='Horsepower',
  y='Miles_per_Gallon',
  color='Origin'
).interactive()
```

Agenda

- https://towardsdatascience.com/another-deep-learning-hardware-guide-73a4c35d3e86
- https://colab.research.google.com/github/lexfridman/mit-deep-learning/blob/master/tutorial_deep_learning_basics/deep_learning_basics.ipynb#scrollTo=mH3KKYXSowSe
- https://www.analyticsvidhya.com/blog/2020/03/google-colab-machine-learning-deep-learning/
- https://deci.ai/resources/blog/hardware-for-deep-learning/
- https://analyticsindiamag.com/tpu-vs-gpu-vs-cpu-which-hardware-should-you-choose-for-deep-learning/

Questions?