

# Lecture 10:

## Deep Learning Computing

Yanbin Liu

Auckland University of Technology

May 19, 2024

- 1 Parallel Computing for Deep Learning
- 2 Cloud Computing for Deep Learning

## MATLAB: Deep Learning in Parallel and the Cloud

- Deep Learning with Big Data on GPUs and in Parallel
- Scale Up Deep Learning in Parallel and in the Cloud
- Deep Learning with MATLAB on Multiple GPUs
- Train Network Using Automatic Multi-GPU Support
- Train Deep Learning Networks in Parallel
- Use parfor to Train Multiple Deep Learning Networks
- Use parfeval to Train Multiple Deep Learning Networks
- Upload Deep Learning Data to the Cloud
- Send Deep Learning Batch Job to Cluster
- Train Network in Parallel with Custom Training Loop
- Train Network Using Federated Learning

**Web:** <https://www.mathworks.com/help/deeplearning/deep-learning-in-parallel-and-cloud.html>

## GPU: Graphics Processing Unit

- A GPU is a specialized electronic circuit to accelerate the creation of images in a frame buffer for output to a display device.
- Modern GPUs are very efficient at manipulating computer graphics and image processing.
- In a personal computer, a GPU can be presented on a video card or embedded on the motherboard.



## MATLAB Parallel Computing for Deep Learning

- Training deep networks is computationally intensive.
- Neural networks are inherently parallel algorithms.
- We usually accelerate training of convolutional neural networks by distributing training in parallel across multicore CPUs, GPUs, and clusters with multiple CPUs and GPUs.
- MATLAB uses GPU or parallel options requires Parallel Computing Toolbox.
- MATLAB supports training a single network using multiple GPUs in parallel.
- Using multiple GPUs can speed up the training significantly.

## MATLAB Parallel Computing for Deep Learning

- To speed up training by using multiple GPUs, MATLAB increases the mini-batch size and learning rate in deep learning.
- A larger batch size and learning rate can speed up training without a decrease in accuracy.
- Convolutional neural networks are typically trained iteratively using batch size.
- The optimal batch size depends on the exact network, dataset, and GPU hardware.

## Train Deep Neural Network in Parallel

- Load the dataset and create an image datastore for the dataset;
- Split the datastore into training and test datastores in a randomized way;
- Determine the classes in the training set;
- . . . . .

**Web:** <https://uk.mathworks.com/help/deeplearning/examples/train-network-in-parallel-with-custom-training-loop.html>

## Train Deep Neural Network in Parallel

- .....
- Define the network architecture and make it into a layer graph;
- Create a deep learning network for training with custom loops;
- Determine whether GPUs are available for MATLAB to use;
- Train the model and specify the training options;
- Load the test data into memory for test. To obtain the accuracy of the model, compare the predictions on the test set against the true labels.

**Web:** <https://uk.mathworks.com/help/deeplearning/examples/train-network-in-parallel-with-custom-training-loop.html>

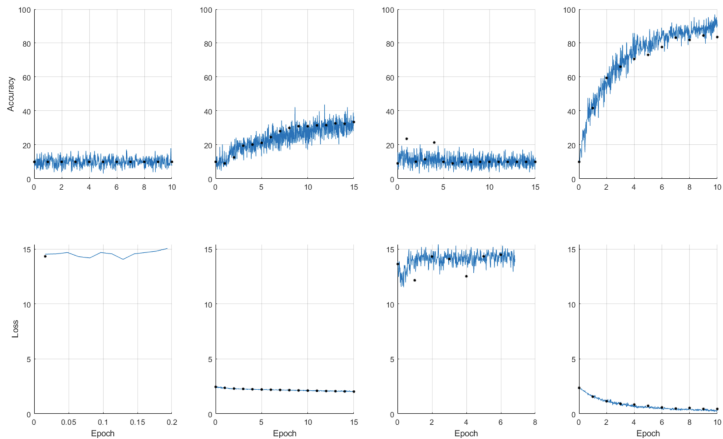


# Deep Learning Computing

## MATLAB: A Single Deep Learning Experiment



## MATLAB: Multiple Experiments in Parallel



Questions?



## MATLAB Cloud Computing for Deep Learning

- MATLAB Deep Learning Toolbox provides examples how to perform deep learning in the cloud and data stored in the cloud.
- Using the cloud, we can accelerate the training by using multiple GPUs on a single machine or in a cluster of machines with multiple GPUs.
- Using the cloud, we can train a single network using multiple GPUs, or train multiple models at once on the same data.
- For deep learning in the cloud, we can set up our accounts, copy our data into the cloud, and create a cluster.

## MATLAB Cloud Computing for Deep Learning

MathWorks® Products Solutions Academia Support Community Events

Get MATLAB WY


MATLAB Online Search MathWorks.com


Overview Specifications and Limitations System Requirements


**MATLAB Online**  
Use MATLAB through your web browser

Start using MATLAB Online

MATLAB Online is available with select licenses. [Check your eligibility](#)

 Use MATLAB with no downloads or installations. [» Learn more](#)

 Collaborate with others through online sharing and publishing [» Learn more](#)

 Store, manage, and access your files anywhere. [» Learn more](#)

# Deep Learning Computing

## Google Colab



Untitled ☆

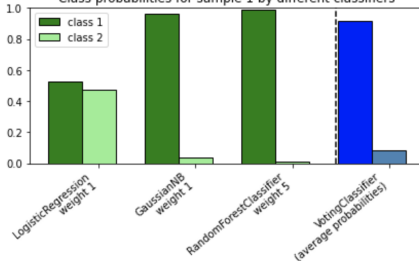
File Edit View Insert Runtime Tools Help [Last saved at 10:41 PM](#)

+ Code + Text

```
plt.show()
```

Automatically created module for IPython interactive environment

Class probabilities for sample 1 by different classifiers



## Google Colab

Google Colaboratory, or “Colab” allows us to write and execute Python codes in a browser with:

- Zero configuration required;
- Free access to GPUs;
- Easy sharing;
- With Google Colab, we harness the full power of popular Python libraries to analyze and visualize data.
- Colab notebooks execute code on Google’s cloud servers, including GPUs, TPUs, and NPUs.
- All we need is a browser.

## Google Colab

Google Colab is used extensively in the machine learning community with applications including:

- Getting started with TensorFlow
- Developing and training neural networks
- Experimenting with GPUs & TPUs
- Disseminating AI research
- Creating tutorials



Questions?



## Learning Objectives

- Demonstrate advanced understanding of the state-of-the-art in the practice of deep learning.
- Evaluate the applicability for deep learning in parallel computing and cloud computing.