Homework 2

Start Assignment

Due Monday by 11:59pm **Points** 100 **Submitting** a file upload **Available** Feb 8 at 12am - Feb 21 at 11:59pm

Homework 2 (100 Points)

Homework instructions:

- You will submit: (1) a report (pdf file) that explains your answers for each problem. The report MUST contain the link to your Github repository to access the source code you have developed for this homework. Your report should contain your name, student ID, and homework number. (2) a second pdf file that contains both source codes, results, and plots you have developed and plotted for this homework. You can easily generate this pdf in Jupyter Lab or Jupyter Notebook (sample pdf provided on Canvas.). The pdf file name should contain your name, student ID, and homework number.
- In your report, provide separate and clear responses for each problem. Make reasonable assumptions where necessary and clearly state them! Be sure to show all the work involved in deriving your answers! If you just give a final answer without explanation, you may not receive credit for that question.
- You may discuss concepts with your classmates. This fosters group learning and improves the class' progress. However, make sure to submit your own independent and individual solutions.
- **Make sure to use Google Collab (with GPU addon option), or your personal GPU card for the training.**

Problem 1 (20pts)

Let's modernize LeNet as we did in the lectures. Implement and test the following changes over FashionMNIST

1. Replace the average pooling with max-pooling.
2. Replace the softmax layer with ReLU.

Start training from scratch based on FashinMNIST. Compare the training loss, training accuracy, and validation accuracy against the baseline we did in the lectures.

Problem 2 (40pts)

Try to change the size of the LeNet style network to improve its accuracy in addition to max-pooling and ReLU.

1. Adjust the convolution window size.
2. Adjust the number of output channels (width of each layer).
3. Adjust the number of convolution layers.
4. Adjust the number of fully connected layers.
5. Explore the learning rates.

For all training adjustments, restart training from scratch based on FashinMNIST. Compare the training loss, training accuracy, and validation accuracy against each other and the baseline in problem 1. Argue which adjustment presents the better benefit and generalization. Measure and compare theoretical computation complexity (number of operations and parameters size) using ptflops https://pypi.org/project/ptflops/

Problem 3 (10pts)

Pick the best model from problem 2. Apply dropout to LeNet-5 across all experiments in problem 2. Does it improve the training? For all training adjustments, restart training from scratch based on FashinMNIST. Compare the training loss, training accuracy, and validation accuracy against the best model in problem 2.

Problem 4 (30 pts)

AlexNet may be too complex for the Fashion-MNIST dataset, in particular, due to the low resolution of the initial images; try simplifying the model to make the training faster while ensuring that the accuracy stays relatively high. Compare your training loss, training, and validation accuracy against the best model in Problem 3 and Problem 2. Also, measure your computational saving in the number of operations as well as the number of parameters in your network using ptflops https://pypi.org/project/ptflops/

Problem 5 (Extra 20 Bonus points)

Design a better model that works directly on 28 * 28 images with better accuracy than AlexNet, but with lower theoretical computational complexity (operation and parameter size).