CS 410/510: Deep Learning: Computational Structures and Programming
Winter 2021
Assignment 2
Due 11:59pm, Feb 3 (Wednesday)

The goal of this assignment is to gain some experience with CNNs. You will use the CIFAR-10 dataset for all the experiments.

1. Construct a simple CNN that follows the architecture of LeNet. However, the images have 3 channels. The first kernel will be 6 5x5x3 kernels that takes us to 28x28x6. The remainder of the network is the same. Stride is 1 for convolution and 2 for pooling layers. You need to train the network for different choices of parameters: learning rate 0.1, 0.01, 0.001, activation function = sigmoid, Tanh, loss function = MSE, cross-entropy.
    a. *Submit plots of training error vs epoch and test error vs epoch for each combination of parameters. Describe the reasons for what you observe*
    b. *For one trained network and parameter choice, display feature maps of 10 images at the last convolution layer. What has your network learned?*
2. Select Relu, learning rate of 0.001, cross-entropy loss. Change the network to use 3x3 kernels for both convolutions rather than 5x5. Same pooling.
    a. *Plot the error (test, train) vs epoch and discuss how your results differ from the previous network*
3. Build a CNN with 5 convolution layers with 3x3 kernels and corresponding 2x2 average pooling with stride 1. Use *padding* at each convolution layer so that the size of the output matches the input after each convolution layer. Train the network for any choice of model parameters.
    a. *How long did it take to train? Why?*
    b. *How does the accuracy of this network compare against the previous two? Explain*

Submit a pdf of your discussion and also include links to the colab code (if using) or include a gzipped directory of code.