CSE 575 - PROJECT 3 - Deep Neural Networks - Report

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INTRODUCTION - The project implements a simple Convolution Neural Network to classify 4 digits (subset of samples from MNIST dataset). Following sections provide results and analysis.

RESULTS (Given MNIST subset data for My ID: 1216126522)

Table 1 provides 4 train/test accuracy/loss values after running 10 epochs on the Neural Net:-

Training Accuracy	0.774
Training Loss	0.545
Testing Accuracy	0.670
Testing Loss	0.739

Table.1. Train/test Accuracy/Loss values for Neural Net

PLOTS (Given MNIST subset data for My ID: 1216126522)

Over 10 epochs/runs, the aim is to learn the dataset enough to be able to optimize the weights. Therefore, the accuracy and loss values would accordingly change for both train and test datasets. It is best understood through the following plots (Figures 1 & 2 below):

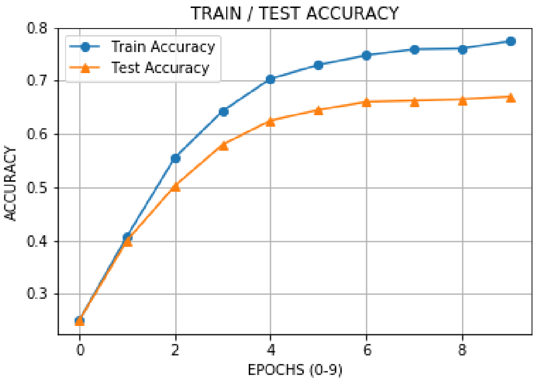

Fig.1. Accuracy for Train/Test dataset

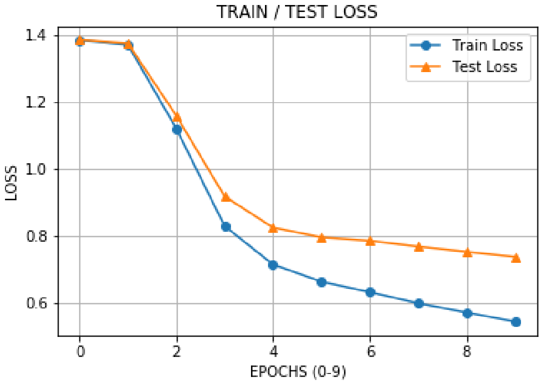

Fig.2. Loss for Train/Test dataset

OBSERVATION & ANALYSIS

The Neural Network built in this project has layers as follows:
Convolution2D → ReLu → Maxpooling2D → Flatten → FullyConnected → ReLu → FullyConnected → Softmax

We start with 28x28 image input, process it through these layers to extract the possible features. In this process, the filters are used to get edges of images and different patterns are learned through network weights. A vector of length 4 is output at the end. For this output vector, the argument of its maximum value gives the predicted class assignment.

This class assignment is compared to the actual class labels in training and an effort is made to reduce train error/loss as much as possible. In this way, we expect the test loss to also decrease and be able to make future predictions as perfectly as possible.

To visualize the accuracy and loss values over 10 epochs of the Neural Net, we have figures 1 and 2. In case of accuracy (Fig.1), the curve starts around 0 and gradually increases towards 1. The initial increase is faster. However, as the network tries to minimize errors for different data points, accuracy saturates over time. Another obvious observation is that the test accuracy is lower and slower than train accuracy.

For training/test losses (Fig.2), the curves decrease gradually. One interesting region is between epoch=0 and epoch=1. The decrease is small in this part, which could be explained by the fact that we use random weights initialization in the beginning. For the first few epochs, it is still trying to come to reasonable weight values. After that, it starts having a smoother decrease.

Additionally, we can observe a clear inverse relationship between loss and accuracy. As one increases the other decreases. The goal of the Neural Net is to be more accurate and have the least amount of errors/loss.

In conclusion, Convolution Neural Networks (CNN) also work towards the same goal and are often used on image inputs / for visual classification tasks. They are capable of finding smaller patterns in images with the use of masks(filters). Using fully connected networks for images with multiple dimensions would definitely be computationally expensive. Extracting patterns does not require fully connected networks; rather, a CNN is more efficient.