COVIS Lab 3 Report
Introduction to Deep Learning

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This report explores the effects of varying various parameters (mentioned below) on the performance of FCNN (Fully Connected Neural Network) and DCNN (Deep Convolutional Neural Network). The parameters are -Number of layers (both for FCNN and DCNN); Size of mask (for DCNN); Number of epochs (both for FCNN and DCNN).

Altering the number of layers

Result for FCNN - We observe that the highest test accuracy is observed with the usage of a single layer. As we increase the number of layers, the model accuracy decreases and model loss increases indicating that for the current case, a single layer FCNN performs relatively better. Using even more layers for prediction on this dataset may not contribute to improvement in the accuracy.

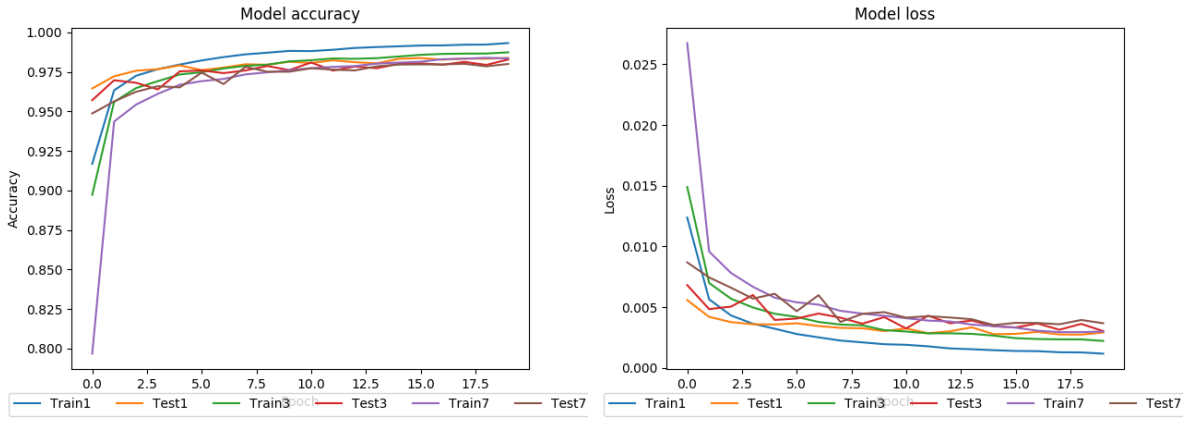


Figure 1 LEFT – accuracy comparison for FCNN model with various layers (run for 20 epochs) – Train 1: Training accuracy with original model; Test 1: test accuracy with original model; Train 2: Training accuracy with 2 layers; Test 2: Test accuracy with 2 layers; Train 3: Training accuracy with 3 layers; Test 3: test accuracy with 3 layers. RIGHT – score loss for different number of layers (run for 20 epochs)

Result for DCNN – We observe that by increasing the number of hidden layers, we increase the number of parameters which leads to a better prediction and a higher model accuracy. Furthermore, the test loss also decreases which implies that the model can predict with a higher confidence.

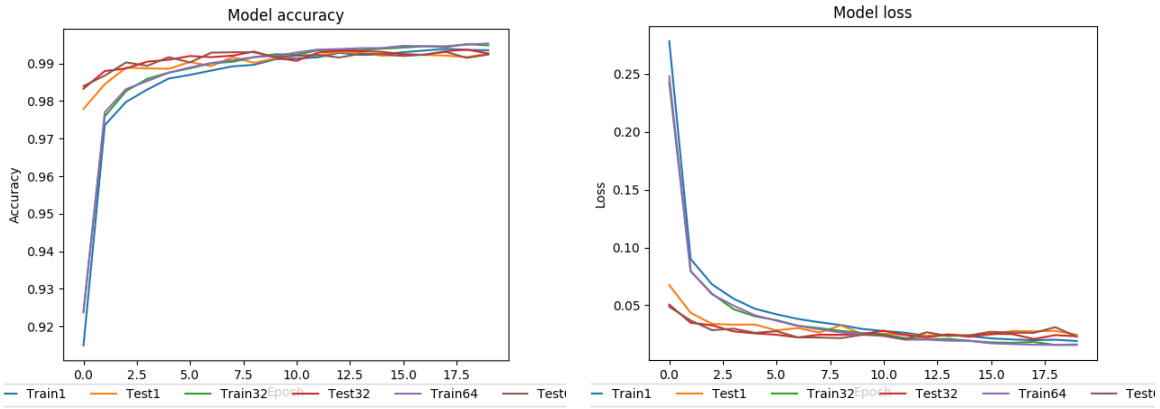


Figure 2 accuracy comparison for DCNN model with various layers (run for 20 epochs) – Train 1: Training accuracy with original model; Test 1: test accuracy with original model; Train32: Training accuracy with extra 32 filtered layer; Test32: Test accuracy with extra 32 filtered layer; Train 64: Training accuracy with extra 64 filtered layer; Test64: test accuracy with extra 64 filtered layer. RIGHT – score loss for different number of layers (run for 20 epochs)

Altering the size of mask

Result for DCNN – We observe that the highest model accuracy and least model loss is achieved when we increase the filter size from 3x3 to 5x5. For any further increment, the accuracy decreases.

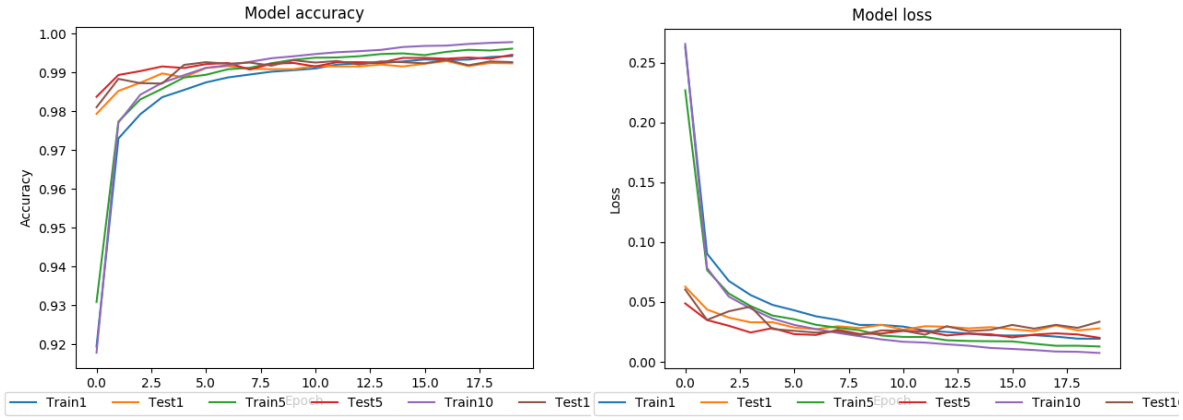
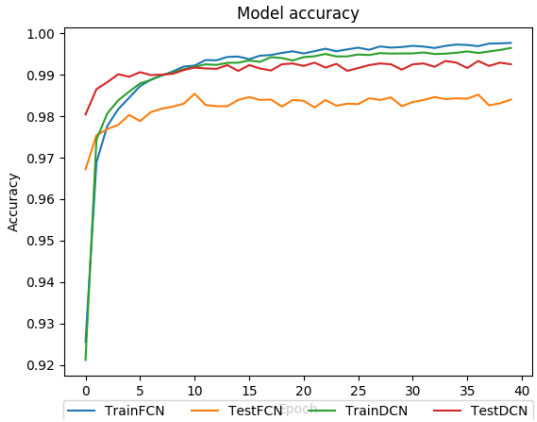


Figure 3 accuracy comparison for DCNN model with various filter sizes (run for 20 epochs) – Train 1: Training accuracy with original model; Test 1: test accuracy with original model; Train 5: Training accuracy with 5x5 filter; Test 5: Test accuracy with 5x5 filter; Train 10: Training accuracy with 10x10 filter; Test 10: test accuracy with extra 10x10 filter. RIGHT – score loss for different number of layers (run for 20 epochs)

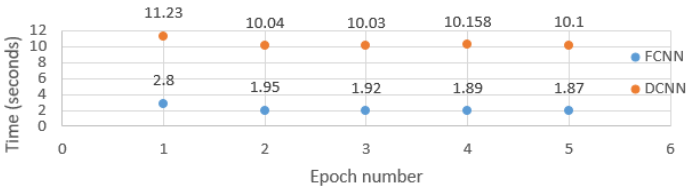
Altering the number of epochs



Result for FCNN and DCNN – As the number of epochs increase, first the performance of the model (test accuracy) increases for upto 5 - 10 epochs. Following that, for higher epochs the test accuracy gradually decreases while the training accuracy keeps on increasing.

Figure 4 Accuracy comparison for FCNN and DCNN (run for 40 epochs) – TrainFCN: Training accuracy for FCNN; TestFCN – Test accuracy for test accuracy; TrainDCN – Training accuracy for DCNN; TestDCN – Test accuracy for DCNN

Time elapsed during training



We observe that the time taken per epoch to train the DCNN is considerably higher than the time taken per epoch for FCNN.

Figure 5 Time taken per epoch

Discussion – When we **increase the size of mask**, initially the performance (test accuracy) increases and then for any further increase in mask size, it decreases (ref fig. 3). This decrease is due to overfitting. Corresponding to increase in mask size, the training accuracy keeps on increasing as we are increasing the number of parameters involved in prediction which are becoming more and more trained to correctly predicting the training data outcomes. However, this increase in number of parameters aligned with training data lead to a decrease in performance on test data.

When we **increase the number of layers**, we observe (ref fig. 1 and 2) that the training accuracy increases but the test accuracy decreases. Again, this is can attributed to overfitting as we are increasing the number of parameters and training them to fit the training data.

When we **increase the number of epochs**, we observe (ref fig. 4) that the test accuracy initially increases but then decreases while the training accuracy keeps on increasing. This can also be attributed to overfitting as we are not increasing the number of parameters, but training the existing parameters to fit the training data even more which translates to a poorer performance on test data.

The overall training accuracy for DCNN is higher than that of FCNN. However, the time take to train DCNN is considerably higher than that for FCNN. Both suffer from loss in test accuracy due to overfitting after a certain extent.