CS-671

Deep Learning and its Applicatopms

Assignment-2 Part-1

Foundations of Convolutional Neural Networks

submitted by

Anmol Passi B16092

Rajan Bajaj B16072

Sarthak Shekhawat B16033

SCHOOL OF COMPUTING AND ELECTRICAL ENGINEERING

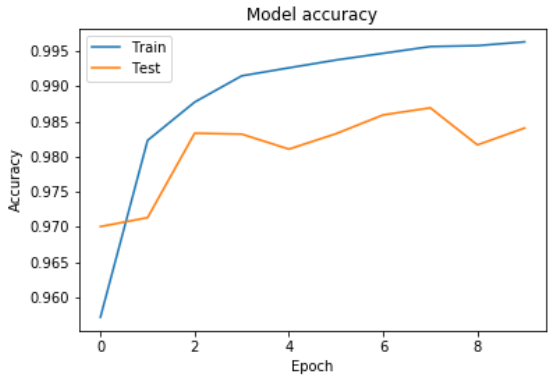
INDIAN INSTITUTE OF TECHNOLOGY MANDI, MANDI

November 2019

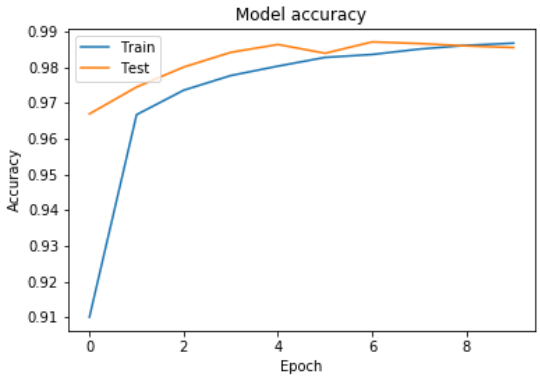
Note that each model of Question-1 is trained for 10 epochs so it it could reach a saturation level and over-fitting curves can be easily studied. Its not always a got idea to stop the iterations when learning rate suddenly decreases to avoid over-fitting but other methods such as normalization, dropouts, regularization, etc. should be used. It is explained through accuracy and loss curves in later sections.

1 Graphs

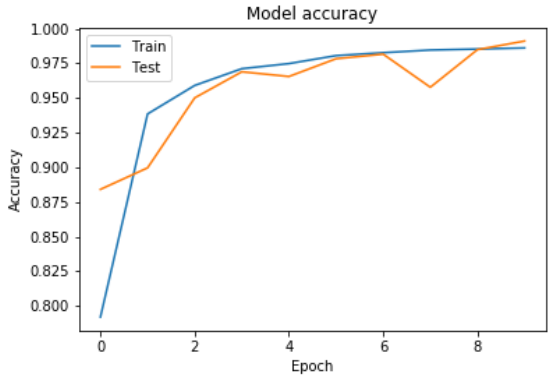
1.1 Learning curves (accuracy)



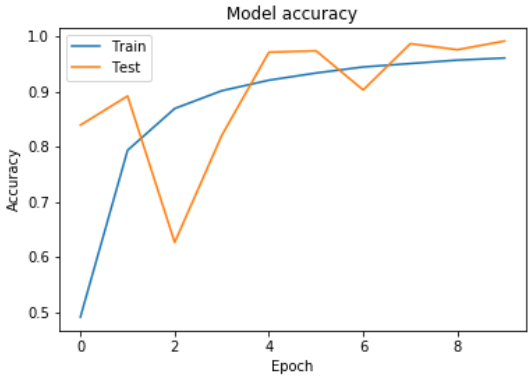
(a) mnist-1.2.1



(b) mnist-1.2.2



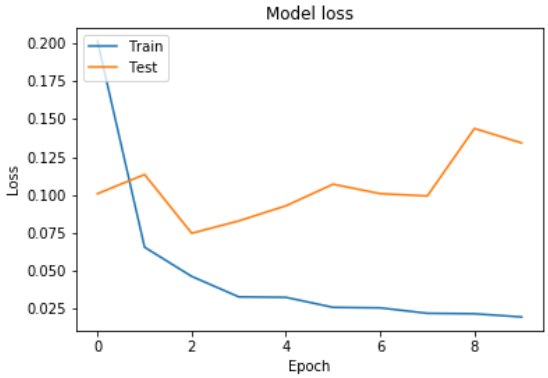
(c) line-1.2.1



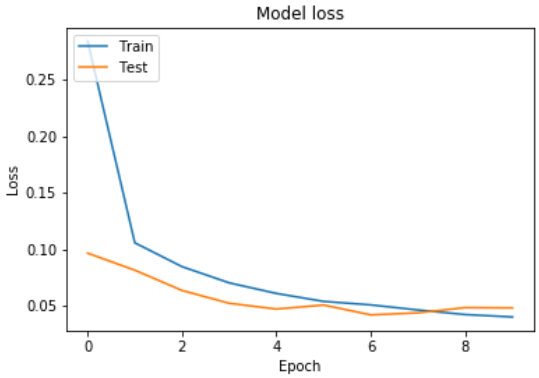
(d) line-1.2.2

The accuracy of mnist-1.2.1 model(architecture given in question) is 0.9848 whereas for mnist-1.2.2 model is 0.9877 on the test data that means the second model outperforms the first on mnist data set. The accuracy of line-1.2.1 model is 0.9943 and of line-1.2.2 is 0.9920. Also The second model takes less time and less computational power to train, because it is Deep network which used 1X1 convolutions to reduce the spacial depth of feature maps from 64 – 8 – 32 rather than 64 – 32. The number of parameters in model 1.2.1 are more than 64,00,000 where as in model 1.2.2 they are around 60,000 that means the second model have 100 times less parameters to learn and hence less time required to train and less computation.

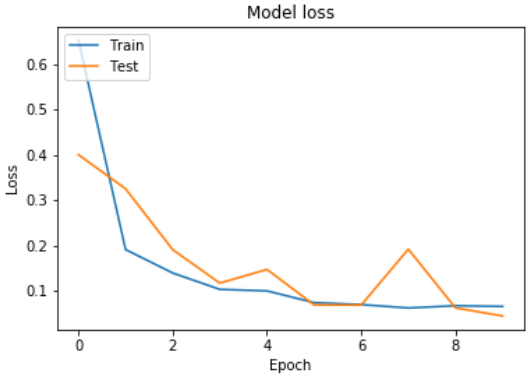
1.2 Learning curves (loss)



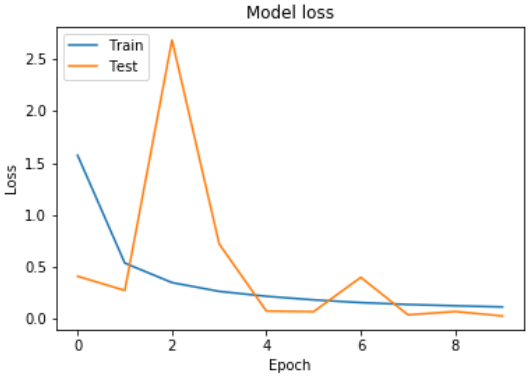
(e) mnist-1.2.1



(f) mnist-1.2.2



(g) line-1.2.1



(h) line-1.2.2

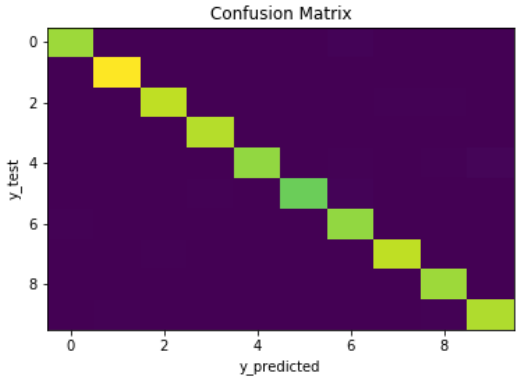
These are the learning curves for loss function and has an inverse relation to that of accuracy. The loss on test data for mnist-1.2.1, mnist 1.2.2, line-1.2.1 and line-1.2.2 models are 0.1197, 0.0450, 0.0237 and 0.0264 respectively. The inverse relation to accuracy can be clearly observed from these values.

By observing the curve for line-1.2.2, it can be said that the curve went to very maximum loss at epoch 2 or minimum accuracy at that stage, but due to regularization technique used helped the network to learn when some neurons of layers are not active at some moment. This technique is known as dropout. The dropout is set to 0.2.

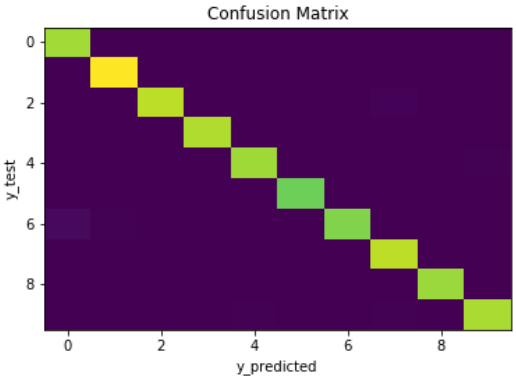
1.3 F scores

F scores are calculated using sklearn.metrices library function f1_score(). The fscores of mnist-1.2.1, mnist 1.2.2, line-1.2.1 and line-1.2.2 models are 0.9846, 0.9875, 0.9943 and 0.9919 respectively. It is the level of precision up to which the model is able to predict over testing data.

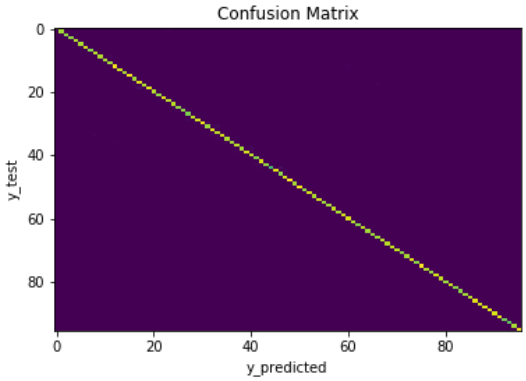
1.4 Confusion Matrices



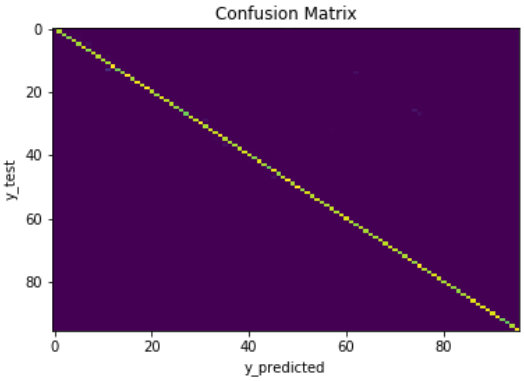
(i) mnist-1.2.1



(j) mnist-1.2.2



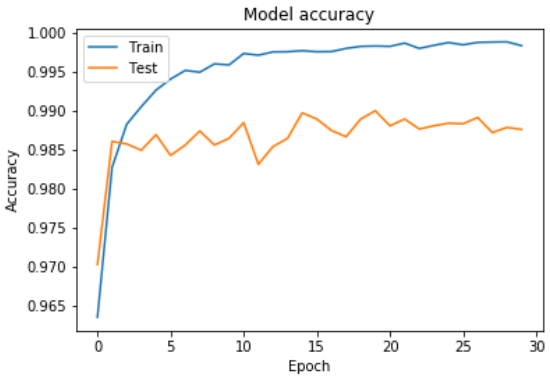
(k) line-1.2.1



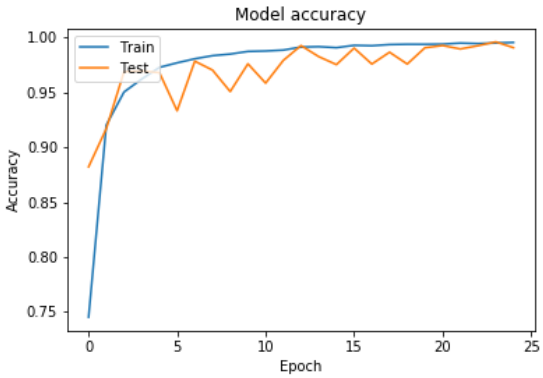
(l) line-1.2.2

1.5 Variations tried

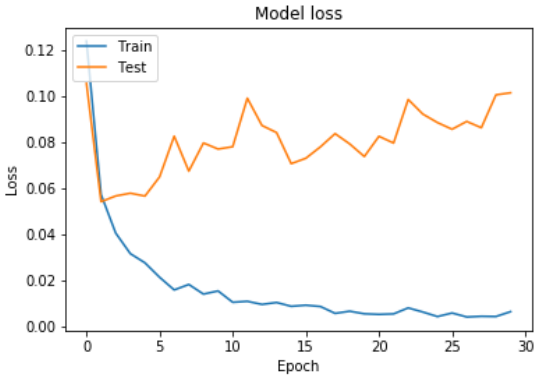
One variation was tried with 3 convolution layers one of 32, 3X3 filters and two of 64, 3X3 filters with 2X2 max-pooling and dropout of 0.5. This reduced the number of parameters to 2,22,000. This network gave accuracy of 0.6750 with a loss of 1.4247.



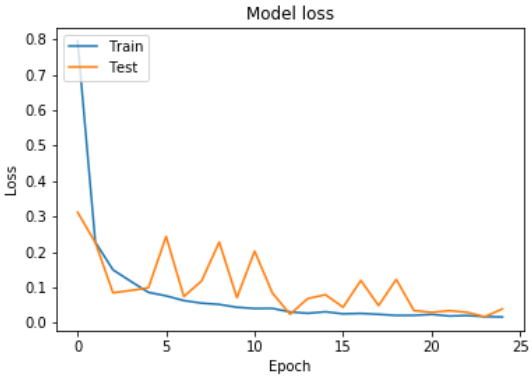
(m) mnist-acc



(n) line-acc



(o) mnist-loss



(p) line-loss

2 Conclusion

The second model is performing slightly better on mnist data set whereas first model is performing slightly better on line data-set. But in terms of training the model time for training the first model is almost 3 times greater than that of training the first model. There is a trade-off of using any one model between training time, computation and accuracy.