INDIAN INSTITUTE OF TECHNOLOGY DELHI

ELL 784
INTRODUCTION TO MACHINE LEARNING
Assignment 3

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THE MLP MODEL

SUMMARY

Table for Choice of No of layers

No of layers	Test Loss	Test Accuracy
2	0.467	0.856
3	0.319	0.906
4	0.318	0.901

Table for Choice of Different No of neurons in each layer

NO of Neurons	Test Loss	Test Accuracy
1024 -> 512 -> 128	0.240	0.926
1024 -> 512 -> 64	0.221	0.934
512 ->264-> 64	0.320	0.898
512 ->264-> 32	0.351	0.892
1024 ->264-> 32	0.306	0.903
2048 ->264-> 64	0.197	0.942
4096 ->264-> 64	0.183	0.947
8192 ->512-> 64	0.165	0.956

Table for Changing Learning Rate

Learning Rate	Test Loss	Test Accuracy
0.1	0.240	0.926
0.001	0.200	0.940
0.007	0.141	0.959
0.012	0.181	0.953

Table for Changing Epoch

Epoch	Test Loss	Test Accuracy
10	0.165	0.948
15	0.143	0.959
20	0.141	0.959

Red Marked Ones are the optimum Choices

CONCLUSION

- Maintaining the pyramid structure gives the best result
- 2 or 3 hidden layers is sufficient to give good results the deeper we go the better the result gets
- The no of neurons in layers if increased gives better accuracy
- There is also an issue of overfitting which can be resolved using batch normalization up to an extent.
- 15 epoch is sufficient although 10 is also a good no of epoch.
- Analyzing the misclassified results, we can see the numbers which are very closely related sometimes gave rise to error, like in the case of '9' if the tail extends upwards, it kind of seems like an '8', for '6' if the head is small, it resembles a '0'. One way we can improve on this is by looking at looking at local and global features separately and then together taking conclusion. So, It will be a twostep matching process which will give more accurate result.
- The loss function here signifies the convergence of the functions to its local/global minima. Our main goal is to minimize the loss function. As the loss function decreases, we get more and more accurate results. In our series of tests we were able to see the decrease of the loss functions which is also visible in the plots. And experimenting with the parameters we were able to significantly decrease the loss also

Finally, we can say that doing a series of test and trails we were able to reach the approximate optimum of the model. By changing the depth of the layers, changing number of neurons in each layer, fine tuning the Learning rate, adjusting the No of epochs we were able to hugely improve the accuracy of the model from a 80% accuracy score to 95.9% accuracy score, A huge improvement of 15% was achieved by fine tuning the parameters of the model.

Part 2

IMPROVING THE ACCURACY SCORE

My first approach was , I took the Fourier transform and applied a low pass filter so the we get the refined edges only ,and then applied the MLP on it to improve the accuracy score , but it did not work and gave result with less accuracy around 90-91% with same model parameters.

Then on further investigation on how to improve the accuracy looking at the local and global feature I came across LSTM (Long short term memory) model .

CONCLUSION

So, using the MLP based model we were able to get from 80% accuracy to 95.9% accuracy by changing the parameters.

To improve on the accuracy score we took a LSTM based approach and were able to acquire a 99.1% accuracy score . which is a big improvement of about 3.2%

- Accuracy Scores

Unmodified MLP	Properly tuned MLP	Properly tuned LSTM Model
80%	95.6%	99.1%

In the case of different recognition scenario like postal address recognition , cheque authentication, handwritten equation recognition having a higher percentage of accuracy and low loss is very much expected . So, through this project we were able to experiment with the models hands on and were able to improve on them.