# CS 725: Foundations of Machine Learning (Autumn 2023)— Homework 2 Exploring Classification Using Feed Forward Neural Network

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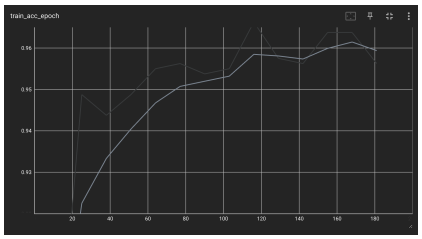
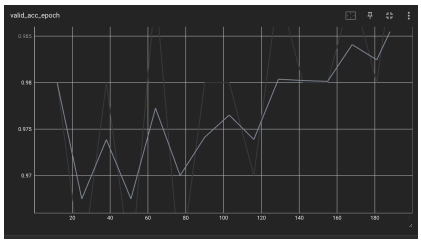
# Classification on simple(4-class) dataset



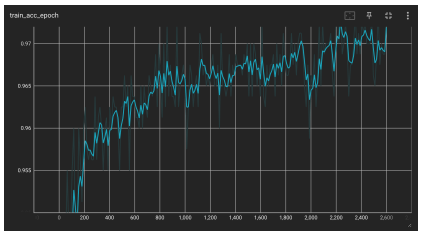

Train: LR:0.01 Epochs:500



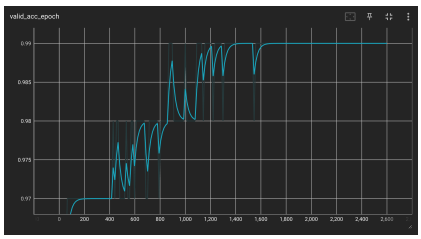

Valid: LR:0.01 Epochs:500

Figure 1.1: LR:0.01 Epochs:500

When the Learning Rate is low like 0.01 and epochs are just fine like 500, then the steps taken by the model are larger and the model try to reach the minimum faster. In the figure 1.1 we can see that there are spikes but they are after a distance, that represents the large steps taken by the model. Also when the Epochs are less that the model performs worse.




Train: LR:0.001 Epochs:200

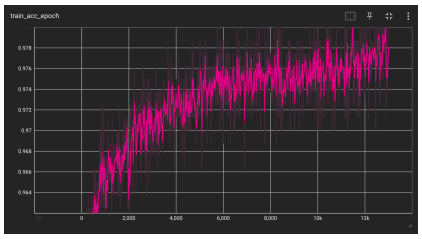



Valid: LR:0.001 Epochs:200

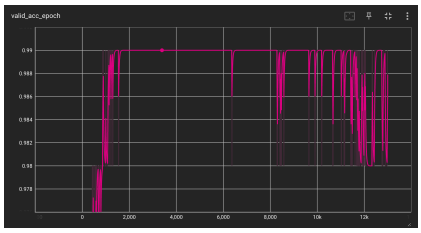
Figure 1.2: LR:0.001 Epochs:200

When the Learning Rate is just fine 0.001 and epochs are less like 200, then the steps taken by the model are accurate and the model performs better.Although due to less epochs count, it gives a little bit accuracy as it underfits.

When the Learning Rate is just fine 0.001 and epochs are more like 1000, then



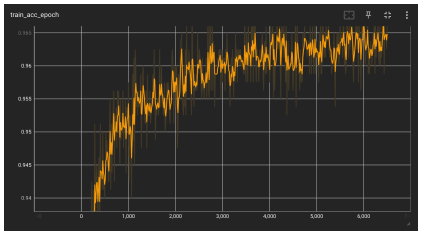

Train: LR:0.001 Epochs:1000



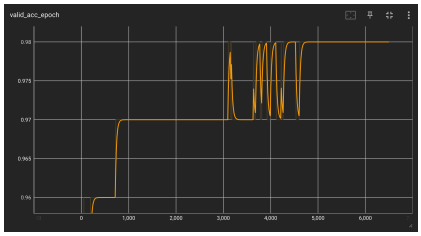

Valid: LR:0.001 Epochs:1000

Figure 1.3: LR:0.001 Epochs:1000

the steps taken by the model are accurate and the model performs great.Since there are more epochs count, it tries to overfit the model but the accuracy is nice like 0.99.




Train: LR:0.0001 Epochs:500

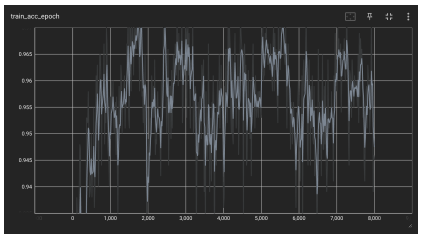



Train: LR:0.0001 Epochs:500

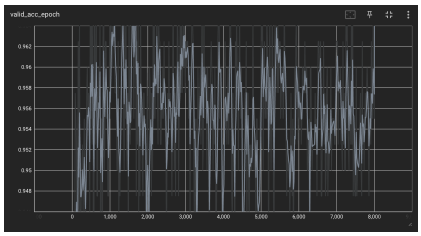
Figure 1.4: LR:0.0001 Epochs:500

When the Learning Rate is small like 0.0001 and epochs are more like 500, then the steps taken by the model are small and the model performs fine.Since there is small epoch, it converges slow but due to epochs count about 500, it eventually converges and gives a fine accuracy.

# Classification on digits dataset



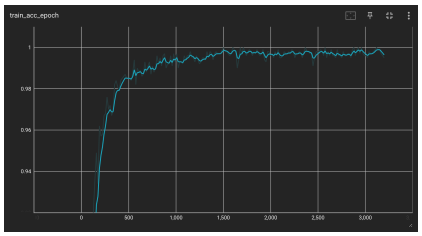

Train: LR:0.01 Epochs:500



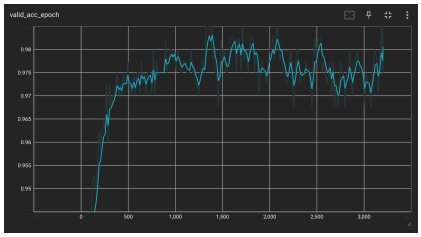

Valid: LR:0.01 Epochs:500

Figure 2.1: LR:0.01 Epochs:500

In the digits dataset, when we have learning rate as 0.01 and the epochs count are somewhat fine like 500, then the model performs relatively bad as the learning rate is high. So we can say that there is a need to reduce the learning rate and also for different epoch counts, there is less accuracy, ie, the model underfits in less epochs and overfits in large epoch count.



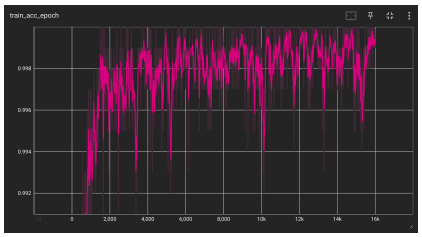

Train: LR:0.001 Epochs:200



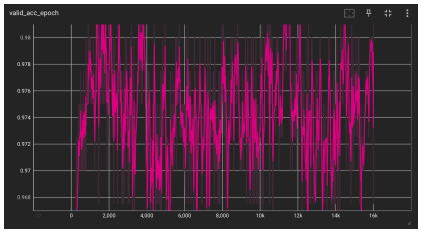

Valid: LR:0.001 Epochs:200

Figure 2.2: LR:0.001 Epochs:200

When the Learning Rate is just fine 0.001 and epochs are less like 200, then the steps taken by the model are accurate and the model performs better.Although due to less epochs count, it gives a little bit accuracy as it underfits, and the models performs best when the epochs count is like 500.



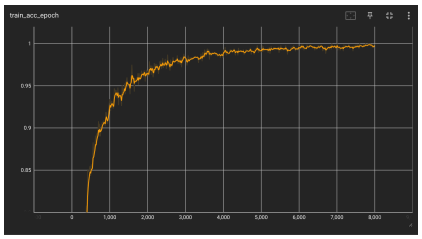

Train: LR:0.001 Epochs:1000



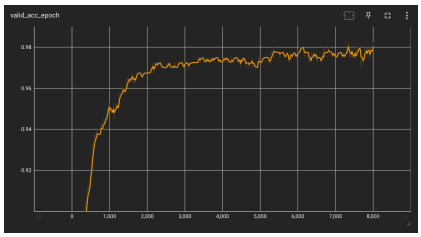

Valid: LR:0.001 Epochs:1000

Figure 2.3: LR:0.001 Epochs:1000

When the Learning Rate is just fine 0.001 and epochs are more like 1000, then the steps taken by the model are accurate and the model performs great.Since there are more epochs count, the model performs great with the highest accuracy as it gets time to train itself.




Train: LR:0.0001 Epochs:500




Train: LR:0.0001 Epochs:500

Figure 2.4: LR:0.0001 Epochs:500

When the Learning Rate is small like 0.0001 and epochs are more like 500, then the steps taken by the model are small and the model performs fine.Since there is small epoch, it converges slow but due to epochs count about 500, it eventually converges and gives a fine accuracy. So we can say that we should have a decent learning rate like 0.01 to get the best accuracy.