

# DLCV, LAB -3

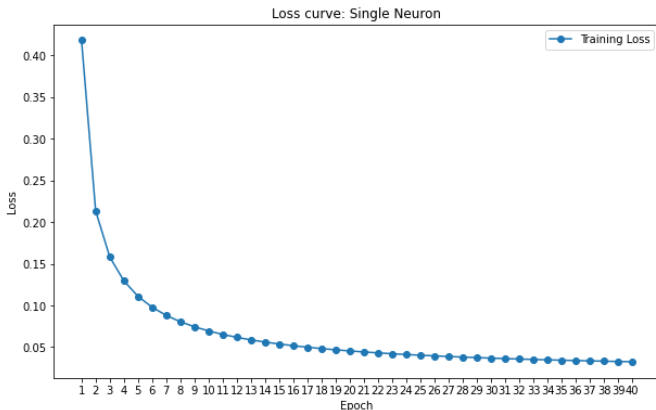
Neural Network in Keras

Gupta Kush

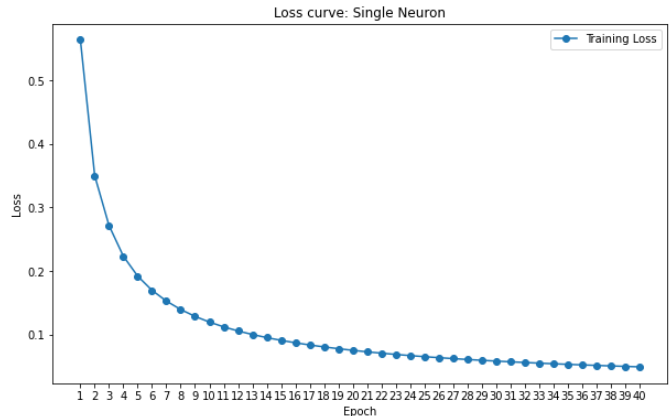
## 1. Single Neuron:-

Run	Epochs	Batch_size	Test_Accuracy
1	40	1000	99.21
2	40	2500	98.97
3	40	5000	98.38
4	40	10000	97.74

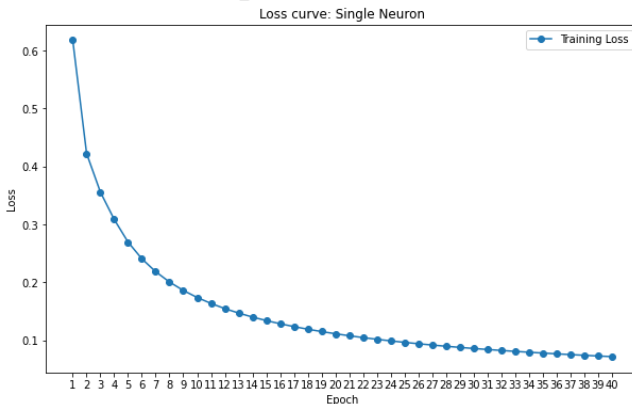
Number of Epochs:40, Batch\_size: 1000



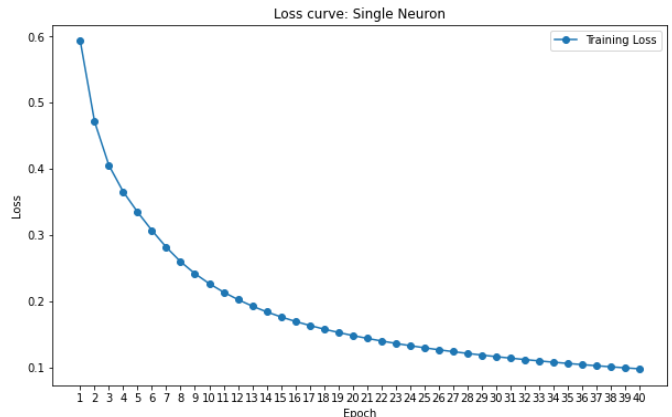
Number of Epochs:40, Batch\_size: 2500



Number of Epochs:40, Batch\_size: 5000



Number of Epochs:40, Batch\_size: 10000



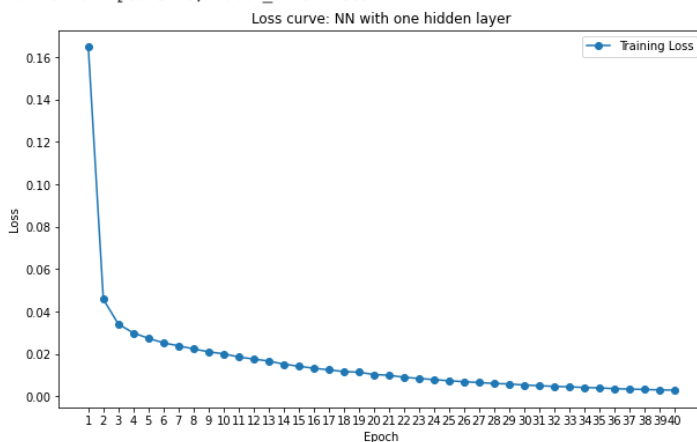
Loss Curves: Line 1: Left to right:- Run 1 and Run 2 ; Line 2: Left to right:- Run 3 and Run 4

**Observations:-** For the neural network with single neuron, using keras the accuracies for different runs with various batch sizes is shown in the table above. Also, the Loss curves can be observed above for different runs. Adam optimiser and binary\_crossentropy loss was used to compile the model. We can observe that for the given model with a lower batch size of about 1000, gives the highest accuracy (99.21%) when compared with the highest batch size of 10000. Also, the train loss is very less ( $< 0.05$ ) after 40 epochs when compared to other runs. Hence, we can conclude that **a higher batch size does not usually achieve high accuracy**, and the learning rate and the optimizer used will have a significant impact as well.

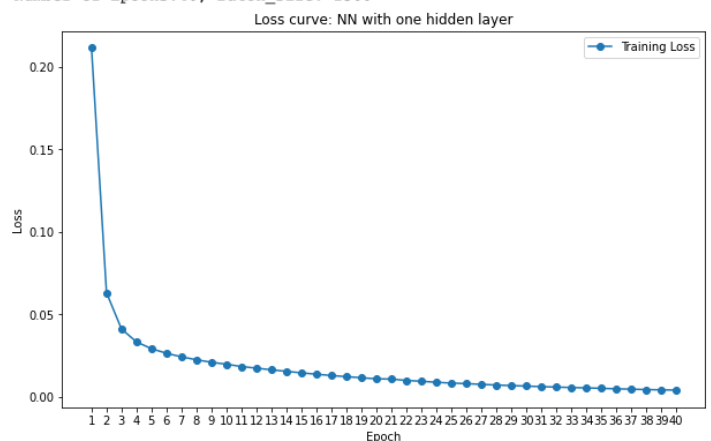
## 2. Neural Network with One hidden Layer:

Run	Epochs	Batch_size	N_Neuron	Test_Accuracy
1	40	1000	64	99.74
2	<b>40</b>	<b>2500</b>	<b>128</b>	<b>99.79</b>
3	40	5000	128	99.56
4	40	10000	128	99.58

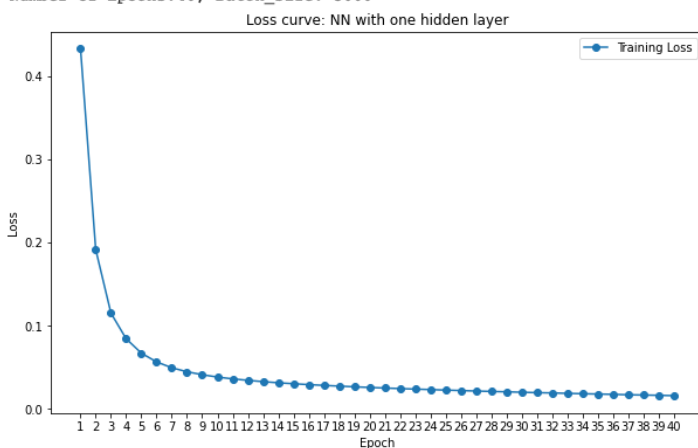
Number of Epochs:40, Batch\_size: 1000



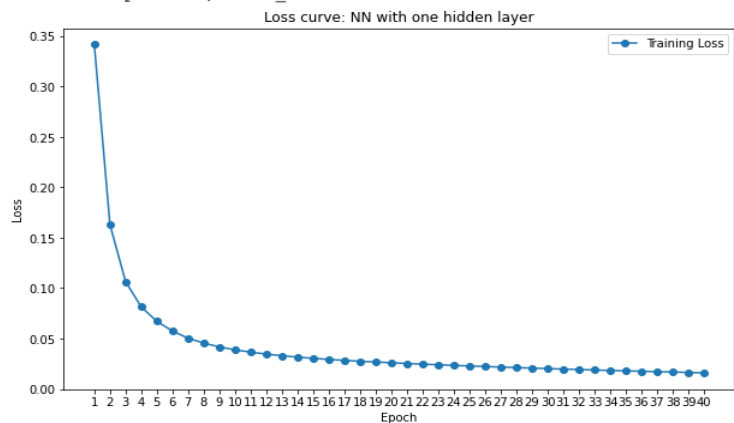
Number of Epochs:40, Batch\_size: 2500



Number of Epochs:40, Batch\_size: 5000



Number of Epochs:40, Batch\_size: 10000



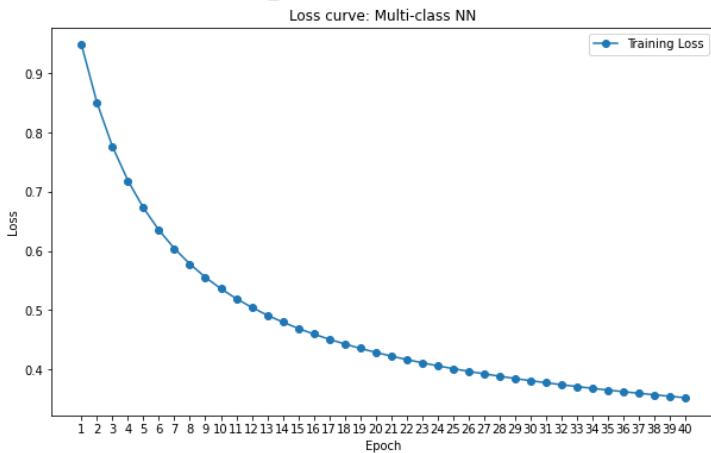
Loss Curves: Line 1: Left to right:- Run 1 and Run 2 ; Line 2: Left to right:- Run 3 and Run 4

**Observations:-** For the neural network with one hidden layer, the accuracies for different runs with various batch sizes is shown in the table above. Also, the loss curves can be observed above for different runs. Adam optimiser and binary\_crossentropy loss was used to compile the model. We can observe that for the given model with different number of neurons in the hidden layer the accuracy doesn't vary much. A lower batch size of about 2500 and 128 neuron, gives the highest accuracy (99.79%) when compared with the highest batch size of 10000 with 128 neurons in hidden layer. Interestingly, the accuracy for run 2 is almost the same compared to run 1 with 64 neurons in hidden layer and 1000 batch size. Also, the train loss is very less ( $< 0.02$ ) for runs 1 & 2 after 40 epochs when compared to other runs. Hence, we can conclude that **a higher batch size with more neurons in hidden layer does not usually achieve high accuracy**, and the learning rate and the optimizer used will have a significant impact as well.

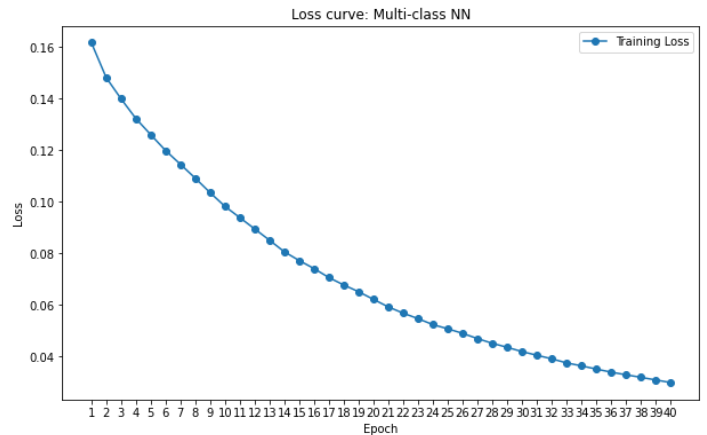
### 3. Multi-class neural network:

Run	Epochs	Batch_size	N_Neuron/Optimizer	Test_Accuracy
1	40	1000	64 / SGD	90.7
2	40	5000	128 / adam	97.79
3	<b>40</b>	<b>5000</b>	<b>128 / SGD</b>	<b>97.81</b>
4	40	10000	128 / adam	95.24

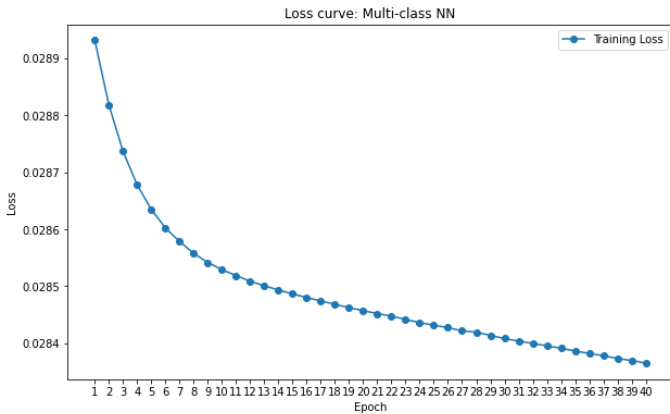
Number of Epochs:40, Batch\_size: 1000



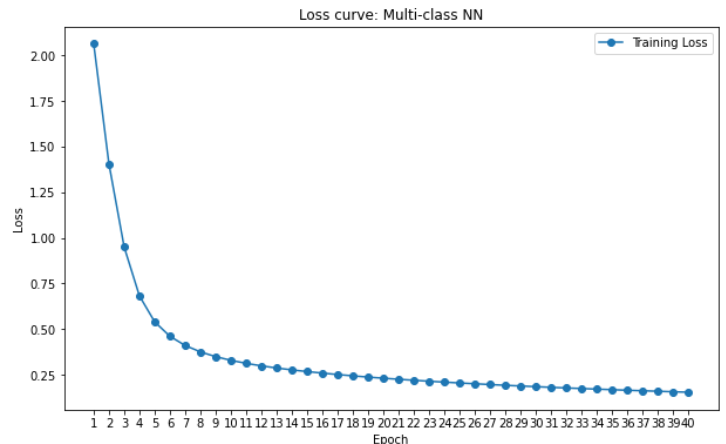
Number of Epochs:40, Batch\_size: 5000



Number of Epochs:40, Batch\_size: 5000



Number of Epochs:40, Batch\_size: 10000



Loss Curves: Line 1: Left to right:- Run 1 and Run 2 ; Line 2: Left to right:- Run 3 and Run 4

**Observations:-** For the multi-class neural network with one hidden layer (different no. of neurons), the accuracies for different runs with various batch sizes and optimizers are shown in the table above. Also, the loss curves can be observed above for different runs. Adam/SGD optimiser and categorical crossentropy loss was used to compile the model. We can observe that for the given model with different number of neurons in the hidden layer and for different optimizers the accuracy varies much. For instance a lower batch size of 1000 with 64 neurons and SGD optimizer, gives an accuracy of about 90.7% which is the lowest. The highest batch size of 10000 with 128 neurons in hidden layer and adam optimizer gives an accuracy of 95.24% which is not very high when compared to other runs. Interestingly, the accuracy (97.79%) for 2nd run with batch size 5000, 128 neurons & adam optimizer is almost the same compared to the 3rd run (97.81%) with 128 neurons, batch size 5000 and SGD optimizer. However, from the loss curves we can see that the train loss for the 3rd run (adam optimizer) is very less ( $< 0.02$ ) after 40 epochs

compared to the train loss for the 2nd run (SGD optimizer)  $< 0.04$  after 40 epochs. Hence, we can conclude that **a higher batch size with more neurons in hidden layer does not usually achieve high accuracy**, and the train loss for adam optimizer is lower compared to SGD, for the same batch size and number of neurons in the hidden layer.