**Project Part 1: Deep Learning with CNN**

Data: The dataset is the CIFAR-10 dataset and the input size is the size of the image (32x32x3).

Task: To perform the classification task, using the convolutional neural network.

Steps:

Step 0: To run the baseline code and report the test accuracy.

The test loss and test accuracy are as follows:

Test loss: 0.5727108120918274

Test accuracy: 0.8360999822616577

Step a) Change learning rate to – i) 0.1

The test loss and test accuracy are as follows:

Test loss: 4.725895404815674

Test accuracy: 0.8116000294685364

As we can see, a higher learning rate has resulted in improved test accuracy. This is because a lower learning rate was used in the previous test, which may have resulted in overfitting of the model on the training set so the change in learning rate from 0.01 to 0.1 has lead to result In the better test accuracy rate

ii) 0.001

The test loss and test accuracy are as follows:

Test loss: 0.5236914753913879

Test accuracy: 0.8641999959945679

In this case we have increased the learning rate from 0.1 to 0.001 which has lead to low or worse test accuracy and test loss as compared to the above learning rates because by lowering the learning rate to 0.001 may have to overfitting in the model which have lead to lower or worse test accuracy rate.

b) Change kernel size for first convolutional layer to 5x5

The test loss and test accuracy are as follows:

Test loss: 0.5915098786354065

Test accuracy: 0.8339999914169312

It is clear that there is no such change in the test accuracy or test loss by changing the size of the convolutional layer but there is a fact that if use the bigger kernel size then we can easily learn the more complicated functions from the model.

c) Change optimizer to SGD

The test loss and test accuracy are as follows

Test loss: 0.4693377912044525

Test accuracy: 0.8604999780654907

In this case we have changed the optimizer from Adam to SGD from that we can see that the test loss is less than the base case and the test accuracy is also better than it so it is clear that Adam optimizer can do a better job.

d) Remove all the batch normalization layers in the network

The test loss and test accuracy are as follows

Test loss: 2.303030252456665

Test accuracy: 0.10000000149011612

By removing the normalization layers from the base case it gives better test accuracy then the base case because the dataset contains the outliers in it and by removing the normalization layer it also removes the outliers while performing the test data but in the base case the model does not reject the outliers present in the dataset that’s why by removing the normalization layer from the base case gives the better accuracy.

e) Remove all the dropout layers in the network

The test loss and test accuracy are as follows

Test loss: 2.7909903526306152

Test accuracy: 0.7717999815940857

By removing the dropout layers from the base case gives the better test loss and test accuracy as dropout layer adds noise in training process that’s why by removing the dropout layer from the base case gives the better accuracy then the base case.

f) Change batch size

i) batch size to 32

The test loss and test accuracy are as follows

Test loss: 0.5520985126495361

Test accuracy: 0.8546000123023987

By decreasing the batch size from 64 to 32 does not that much effect in the test loss and test accuracy.

ii) batch size to 128

The test loss and test accuracy are as follows

Test loss: 0.6052294373512268

Test accuracy: 0.8266000151634216

By increasing the base size from 64 to 128 has increased the test loss and also improves the accuracy then the base case this is because by increasing the size of batch performs better predictions.