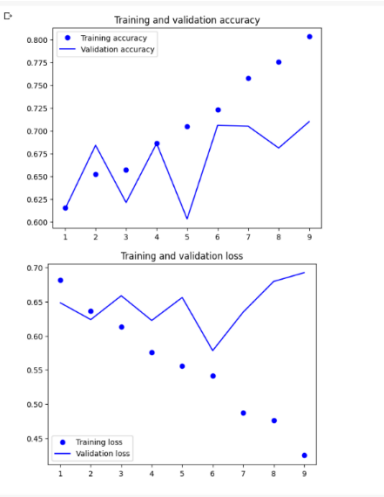
AML ASSIGNMENT-2

1.Consider the Cats & Dogs example. Start initially with a training sample of 1000, a validation sample of 500, and a test sample of 500. Use any technique to reduce overfitting and improve performance in developing a network that you train from scratch. What performance did you achieve?

1.Training sample size=1000, validation=500, test sample=500

Epoch	Drop-out	Data Augmentation	Training sample size	Validation Accuracy	Test Accuracy
9	-	-	1000	59.4	55.4



Here, from the plot, we can say that optimal epoch from the is nearly 6.

Tuning the model using dropout and data augmentation techniques for 1000 samples

Epoch	Drop out	Data Augmentation	Training sample	Validation Accuracy	Test Accuracy
6	0.5	Horizontal=0.1 Zoom=0.2	1000	64.0	62.7
6	0.1	Horizontal=0.1 Zoom=0.2	1000	65.3	65.5

After, drop out and Data augmentation and strides, accuracy has been increased. And we can observe that if we use dropout of 0.2, accuracy has been increased. Hence, we consider drop out as 0.2.

2.Increasing training sample sizes and keeping validation and test sets as constant and used optimization techniques to improve the accuracy.

Epoch	Training sample	Drop out	Data Augmentation	Validation Accuracy	Test Accuracy
6	3000	0.2	Horizontal=0.1 Zoom=0.2	74.7	80.2
6	3000	0.1	Horizontal=0.1 Zoom=0.2	76.90	78.3

Here, we have increased training sample size to 3000, and used dropout and augmentation technique to tune the model where, we can see an improve in accuracy of the model. And also further decrease in dropout to 0.1 we get better accuracy as compare.

3.Tuning the model using optimization techniques and changing the training sample size to find the ideal training sample size to get best prediction results.

Epoch	Training sample	Drop out	Data Augmentation	Validation Accuracy	Test Accuracy
6	5000	-	-	83.60	83.1
6	5000	0.1	Horizontal=0.1 Zoom=0.2	84.30	83.7
6	10000	-	-	89.5	87
6	10000	0.1	Horizontal=0.1 Zoom=0.2	85.3	89.9
6	12000	-	-	97.8	97
6	12000	0.1	Horizontal=0.1 Zoom=0.2	91.4	92.1

Now, we have increased the sample size to different sizes and see an increase in accuracy than the previous sample, but at certain level (12000) the test and validation accuracy has been started decreased after using augmentation techniques which means that the learning rate for the model is too high. Usually, For small datasets the model may overfit, hence we choose optimal training sample as 10000

4.Using pretrained model, finding optimal epochs and finding best accuracy using optimization techniques.

Pretrained model

Epoch	Drop out	augmentation	Training sample	Validation accuracy	Test accuracy
100	-	-	1000	96	96.5
100	0.5	0.1, 0.2	1000	97.1	97.5

We can observe that pretrained model has more accuracy than the scratch model with less sample size, which tells us that the model is highly recommended for the better performance.

5.Now, we check on different training samples to know how accuracy has been changing.

Epoch	Drop out	augmentation	Training sample	Validation accuracy	Test accuracy
7	0.2	0.1,0.2	3000	96.3	98.2
7	0.5	0.1,0.2	5000	97.0	97.2
7	0.2	0.1,0.2	10000	98.1	99.1
7	**0.2**	**0.1,0.2**	**12000**	**99.6**	**99.7**

Pretrained tends to give best accuracy than the scratch model which can be observed from the above results and the best accuracy is obtained at 12000 which is max dataset that I have chosen with accuracy of 99.7%

The best accuracy is observed for the training sample of 12000 with best validation accuracy of 99.6% and test as 99.7%.

CONCLUSION:

- From the observations, we can say that the choice of network and change of training samples has great impact on the accuracy, which tells that there are dependable.
- choice of network and training samples are both critical factors in determining the performance of a CNN. The selection of the appropriate structure and training data requires careful consideration and experimentation to achieve optimal results.
- The structure of CNN is determined by choice of network, including activation functions, size, and arrangement of layers and also depends on complexity and training data available.
- The choice of training samples, on the other hand, determines the specific examples on which the network is trained. Here, in image classification, they as labelled as cat, dog, cat, cat etc.,
- CNN may overfit, if the training sample is low and performs poorly on unseen data and if the training sample is high, it may become too noisy and struggles to learn patterns. We are using different optimization techniques such as drop out and data augmentation methods to improve accuracy and tune model not to overfit.
- For a scratch model, training samples must be increased to get best accuracy that to a very less accuracy compared to pretrained model.
- But for a pretrained model, it learns important features for the data set and reduce the amount of training data to achieve good performance on a new task. For large datasets, pretrained model is highly acceptable because it highly generalizes by training on large classes.
- We can observe that from the results, that pretrain require less training sample to get accuracy of 96.5% but for scratch model we need to increase the training samples to get an accuracy of 87.2%(which is highest). For a scratch model, training samples must be increased to get best accuracy that to a very less accuracy compared to pretrained model.
- Additionally, we can observe that the test accuracy has been decreasing in scratch model when it reaches to certain level, which means that the model is too complex for that model, whereas pretrained model accuracy has been increasing as the sample size increasing.

Overall, pre-trained models often have a higher accuracy compared to scratch models because they have been trained on larger and more diverse datasets, have more complex architectures, are optimized using advanced techniques. However, scratch models can still be effective if they are trained properly and have a suitable architecture for the task at hand.

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