**ADVANCED MACHINE LEARNING**

**Assignment 3: Convolution Neural Networks**

Convolution Neural Networks (CNNs) are a particular type of neural network that develops at processing multi-dimensional input, including images. Convolution , pooling , connecting layers and fully convolution layers are among the layers utilized by CNNs. In order to extract features from the input image or data, the convolution layers apply filters, while the pooling layers reduce the convolution layers' output dimension. From that, the collected attributes are used by the fully connected layers to provide a forecast or classify an issue. The capability of CNNs to learn hierarchical models for the input data, with higher-level features resulting from lower-level features, is one of their main advantages. Because the network can learn to recognize individual elements of an item before merging them to recognize the entire object, CNNs are particularly successful for tasks like object recognition. By using this we have to classify the dogs and cats dataset and training the model from scratch to reduce overfitting so for that we using augmentation and pretrained techniques . so for that firstly i

1. Initial training the using train sample (1000), validation sample (500) and test sample (500), without using any techniques. From the plot i got the optimal number of epochs 6 the validation accuracy is 0.694 and test accuracy is 0.688 compare in the both accuracy, test accuracy is very less. After I tuning the same model but this time I used augmentation and adjusting the drop out values so from that I got validation accuracy is 0.704 and test accuracy increased from 0.688 to 0.738 at this moment validation accuracy does not showed any development compare with scratch model. We can see below table

Train sample : 1000

|  |  |  |
| --- | --- | --- |
| Accuracy Types | Scratch Model | Augumentation dropout |
| Validation | 69.4 | 70.4 |
| Test | 68.8 | 73.8 |

2. Increasing the train sample 1000 to 2000 without change the validation and test sample to know the performance of the training model. So from that I got both accuracy same by using augmentation.

Train sample : 2000

|  |  |  |
| --- | --- | --- |
| Accuracy Types | Scratch Model | Augumentation dropout |
| Validation | 71.90 | 77.30 |
| Test | 72 | 77.39 |

3. Increasing the train sample 4000 to training the model , with and without any techniques it show results at this moment from the graph at the epochs number 6 the optimal values at become overfitting after apply augumentation techniques to the model, than it show the result is test accuracy decreased compare to validation accuracy. We can see below table.

Train sample: 4000

|  |  |  |
| --- | --- | --- |
| Accuracy Types | Scratch Model | Augumentation dropout |
| Validation | 83.50 | 81.52 |
| Test | 84.2 | 77.20 |

4. Increasing the train sample 8000, After changing the sample we can see the test accuracy of the model was reduced as the training sample was increased. Therefore, the samples would be a perfect amount of samples for the training set, we can see in below table.

Train sample: 8000

|  |  |  |
| --- | --- | --- |
| Accuracy Types | Scratch Model | Augumentation dropout |
| Validation | 89.60 | 85.30 |
| Test | 87.9 | 87.3 |

5. Finally training the model by increasing the train sample 10000

Train sample: 10000

|  |  |  |
| --- | --- | --- |
| Accuracy Types | Scratch Model | Augumentation dropout |
| Validation | 89.40 | 79.60 |
| Test | 87.77 | 86.3 |

6. After that using the pretrained network and the running the model with best train sample 8000 compare with other sample. To find the optimal number of epochs to get best accuracy. After applied all techniques we used pretrained network to increase the accuracy at the finally we get best accuracy of 98.01%.

|  |  |  |  |
| --- | --- | --- | --- |
| Accuracy Types | Scratch Model | Augumentation dropout | Pretrain |
| Validation | 89.60 | 85.30 | 97.80 |
| Test | 87.9 | 87.3 | 98.01 |

Overall summary, we can see from the results shown above, there is a significant connection between the training sample size and the network model selection. It significant improvement in the model's performance on the test set as the training sample is expanded. After a certain point, overfitting of the model causes the accuracy to decline if we keep expanding the training sample size. The ideal training sample size for the model is that at which it performs most accurate without underfitting or overfitting.t the above results. When we using the pretrained model on choose best training model we get best accuracy. VGG16 network architecture pre-trained model. These pre-trained models may identify complex characteristics and can reduce model training time because they have previously been trained. Because the VGG16 model was pre-trained on a particularly large dataset with more than a million images, its pre-trained weights can be used to transfer learning to other image task classifications with smaller datasets. It save time to training the model and get best performance.We can see above pre-trained the model from set best accuracy model was able to achieve 98.01% accuracy with significantly less training.