**CONVOLUTION NEURAL NETWORKS**

Assignment-02:

Convolutional Neural Networks (CNNs) are artificial neural networks that are specifically developed for processing grid-like input such as photos and movies. It is a type of deep learning model that has proven to be extremely effective in computer vision tasks, however it also has applications in other disciplines.

**Observation and Analysis:**

1. The Cats and Dogs dataset consisting of 25,000 images of cats and dogs is used in this assignment. The dataset is divided into 3 sets namely a training set of 1000 images, a validation set of 500 images and a test set of 500 images. Images are trained using the convolution network to predict the test images. Data augmentation is the technique used to reduce the overfitting and improve the performance of the model. The network achieved an accuracy of 71.3% on the test set and 0.5677 validation loss.
2. Now increase the training sample size from 1000 to 2000 and train the model. Optimize the network and reduce overfitting. Now, an accuracy of 72% on test set is achieved and a there is a validation loss of 0.5587.
3. Now sample sizes of 3500,4000,4500 and 5000 are considered and trained. The network is optimized and using techniques overfitting is reduced. All the corresponding accuracy values of the samples are observed to find out the ideal training sample size. We observe that the ideal training sample size for cats and dogs dataset seems to be around 4500 images.
4. For the fourth question, train a pretrained network using transfer learning approach and fine tuning with the same sets used in steps 2 and 3.Optimize the model to get the best performance. Accuracy values of the samples are observed to find out the ideal training sample size. We observe that the ideal training sample size for cats and dogs dataset seems to be around 5000 images.

**Results:**

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| --- | --- | --- | --- | --- |
| Model | Trained model from scratch | | | |
| Performance metric | Sample Size | Validation loss | Accuracy | No. of epochs |
| Initial model | 1000 | 0.5677 | 71.3% | 30 |
| Data augmentation model | 1000 | 0.4519 | 82.5% | 80 |
| Increased training data model | 2000 | 0.5587 | 72% | 30 |
| Optimal training data model | 4500 | 0.6111 | 97.9% | 20 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Pre-trained network | | | |
| Performance metric | Sample Size | Validation loss | Accuracy | No. of epochs |
| Initial model | 500 | 0.0133 | 93.9% | 20 |
| Data augmentation model | 500 | 0.1707 | 99.2% | 50 |
| Increased training data model | 1500 | 0.1449 | 99.7% | 20 |
| Optimal training data model | 5000 | 0.3088 | 99.8% | 20 |

The results indicate that increasing the training sample size leads to better network performance. However, the improvement declines beyond a certain point, indicating that the benefits of expanding the sample size are limited.

**Conclusion:**

When the performance of the network trained from scratch and the pre-trained network is compared, the pre-trained network is clearly superior. While expanding the training dataset can improve model accuracy, it can also increase validation loss. As a result, training a pre-trained network will result in higher performance than training a network from scratch because a pre-trained network has already learned the relevant features from large datasets that can be used for our small datasets.

In summary, as the size of the training sample increased the performance of both networks trained from scratch and pretrained networks improved. However, with smaller training sample sets, a pretrained network may achieve higher accuracy than a network trained from scratch. The appropriate training sample size was determined by the job complexity and network architecture, and for the Cats & Dogs dataset, a training sample size of around 5000 photos resulted in the best performance for both networks.