Convolution Neural Networks

**Introduction**:

The purpose of this assignment is to explore the application of convolutional neural networks on image data with a focus on the Cats & Dogs classification. The objective is to apply convents to image data and find the relationship between training samples sizes and choosing between training the convnets from scratch versus using a pretrained network.

In this assignment we evaluated the performance of multiple deep learning models created from scratch, with varying training sample sizes. The performance of these models was assessed using three essential metrics: validation accuracy, test accuracy, and test loss.

Scratch Models:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Models** | **Training sample size** | **Validation and Test sample size** | **Validation  Accuracy** | **Test Accuracy** | **Test Loss** |
| Model 1 | 1000 | 500 | 0.68 | 0.72 | 0.53 |
| Model 2 | 1000 | 500 | 0.97 | 0.98 | 0.08 |
| Model 3 | 1000 | 500 | 0.97 | 0.98 | 0.14 |
| Model 4 | 1000 | 500 | 0.97 | 0.98 | 0.22 |
| Model 5 | 5000 | 500 | 0.87 | 0.86 | 0.32 |
| Model 6 | 10000 | 500 | 0.90 | 0.88 | 0.29 |

Pre-Trained Models:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Models** | **Training sample size** | **Validation and Test sample size** | **Validation  Accuracy** | **Test Accuracy** | **Test Loss** |
| Model 7 | 1000 | 500 | 0.97 | 0.97 | 0.12 |
| Model 8 | 5000 | 500 | 0.97 | 0.97 | 0.09 |
| Model 9 | 10000 | 500 | 0.97 | 0.98 | 0.07 |

**Observations**:

* We can see differences in metrics across the scratch models trained on a short dataset of 1000 samples. Model 1 has a reasonable validation accuracy 0.68 but a low-test accuracy 0.72 and a larger test loss 0.53 which indicates overfitting as the training size is small showing potential for improvement.
* Models 2, 3, and 4, on the other hand, obtained excellent validation and test accuracies of 0.97 with low test losses, indicating robust performance.
* When the training sample size was increased to 5000 and 10,000 samples in Models 5 and 6 , we can see that there was only a slight increase in validation accuracy and decrease in test accuracy which means it has limited impact of larger datasets
* To enhance model performance, I have used the dropout method, Data Augmentation and combining both to increase model performance while keeping a fixed sample size of 1000. By doing this observed that the model trained using these methods gave improved accuracy
* When I have increased the training sample size from 5000 to 10000 it was observed that the test accuracy was high i.e., 0.98 suggests that the models are robust in their predictive capabilities.
* When I have increased the training sample size to 10000 in Pre-Trained Models the test accuracy was highest i.e., 0.98.
* We can say that regularized models seemed to provide improved accuracy compared to non-regularized model.

In conclusion training sample's size significantly contributes to enhancing model accuracy as it solves overfitting issues. Also fine-tuning hyperparameters such as max-pooling, data augmentation, and dropout techniques also contribute to further improving the model's performance. We can see that Pre trained models has substantial rise in accuracy and pretraining the model also plays a significant role along with the training sample size of the model.