**Introduction**

This study aimed to explore the relationship between the training sample size and the choice of either training a convolutional neural network (CNN) from scratch or using a pre - trained network for the task of classifying cats and dogs images. The performance of the models was evaluated using different training sample sizes while keeping the validation and test sample sizes constant.

**Methodology**

The Cats vs Dogs Small dataset was used, with different subsets for training, validation, and testing. Training subsets with sizes of 500, 1000, 2000, and 3000 images were created. The validation set had 500 images, and the test set had 500 images. All images were rescaled to 150x150 pixels.

We will apply the following two models to the data set.

* Training from Scratch: A simple CNN architecture was designed with multiple convolutional and max-pooling layers, followed by fully-connected layers and a final sigmoid output layer for binary classification.
* Using a Pretrained Model: The VGG16 model, pre-trained on ImageNet, was used. The pre-trained weights were frozen, and additional fully-connected layers were added on top for fine - tuning.

**Results**

The accuracy of each model with different sample size on the test data show as below:

|  |  |  |
| --- | --- | --- |
| Training Sample Size | Training from Scratch (Test Accuracy) | Using pretrained model (Test Accuracy) |
| 500 | 0.774 | 0.870 |
| 1000 | 0.688 | 0.882 |
| 2000 | 0.794 | 0.876 |
| 3000 | 0.778 | 0.926 |

**Conclusion**

Increasing the sample size does not always result in improved accuracy, especially when training from scratch, where the model's performance can fluctuate due to issues like data distribution or overfitting. The pretrained model, however, generally performs more stably and effectively, particularly with smaller datasets, and reaches its peak accuracy with larger datasets.