**AML\_Assignment-2**

Examining the Relationship Between Training Sample Size and Neural Network Selection for Image Categorization.

The development of a convolutional neural network (CNN), a type of specialized software, is covered in this document. This program's goal is to determine if a given image shows a dog or a cat. The pictures that are used to train the algorithms come from Kaggle. Even though there are many photographs accessible, the software is trained using only a selection of the 2000 available images.

**Q1: Consider the Cats & Dogs example. Start initially with a training sample of 1000, a validation sample of 500, and a test sample of 500 (like in the text). Use any technique to reduce overfitting and improve performance in developing a network you train from scratch. What performance did you achieve?**

**A**. The computer model was first trained on a dataset of 1000 photos, and it was then evaluated on 500 more images. In order to thoroughly verify the model's effectiveness, 500 more photos were used later. A unique technique called dropout was used to limit the program's dependence on the training dataset in order to avoid overfitting. The preprocessing stages included scaling the images and guaranteeing color fidelity as well as turning the picture files into a format that could be read by computers. The software performed at around 73.20% accuracy during the training phase, but it showed an accuracy rate of about 99.70% during testing.

A graph of a training and validation accuracy

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A graph of a training loss

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**Q2: Increase your training sample size. You may pick any amount. Keep the validation and test samples the same as above. Optimize your network (again training from scratch). What performance did you achieve?**

**A.** The computational model was trained using a bigger dataset that included 1500 photos. However, during the training phase, a subset of 500 photos was still used for validation in addition to an additional 500 images for testing. The program's learning skills were greatly improved by using augmentation techniques such picture flipping, rotation, and zooming. As a result, when these strategies were put into practice, the program performed better. It attained an accuracy rate of almost 50% during the training phase and again showed an accuracy rate of roughly 50% during validation.

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**Q3: Now change your training sample so that you achieve better performance than those from Steps 1 and 2. This sample size may be larger, or smaller than the previous steps. The objective is to find the ideal training sample size to get the best prediction results?**

**A.** To improve the efficiency of the computational model, a larger dataset of 2000 photos was obtained. Throughout the training process, these pictures were regularly subjected to augmentation techniques including flipping, rotating, and zooming. The program's ability to comprehend images was significantly enhanced by the use of augmentation techniques and this larger dataset. Consequently, the program's accuracy rate in the training phase was around 73.20%, while its accuracy during the validation phase was roughly 72.90%.

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**Q4: Repeat Steps 1-3, but now using a pre-trained network. The sample sizes you use in Steps 2 and 3 for the pre-trained network may be the same or different from those using the network where you trained from scratch. Again, use any and all optimization techniques to get the best performance**.

**A.** Prior Training Without Augmentation.  
Without the use of augmentation approaches, we conducted our investigation using a pre-trained model, which denotes the use of a model that has already been trained on a sizable number of pictures. Still, we didn't use any augmentation techniques, such rotation or flipping, on the pictures in this case. In spite of the lack of these methods, the pre-trained model demonstrated exceptional picture recognition ability. During the training phase, it attained an impressive accuracy rate of almost 100%, which seems promising. On the other hand, this high accuracy might be a sign of over-reliance on the training dataset and inadequate adaptability to new inputs. The model showed around 97.70% accuracy during validation, suggesting possible difficulties in extrapolating its performance outside of the training dataset.

A graph of a training and validation accuracy

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A graph of training and validation

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Pre-Trained With Augmentation:

By achieving a validation accuracy of 97.4%, the pre-trained model demonstrated excellent performance without the need of any improvements to supplement the dataset. Afterwards, the author experimented with a fine-tuning strategy, which involves making small changes to the pre-trained model to maximize its appropriateness for the particular job at hand. Once data augmentation techniques were used and the model was adjusted further, it performed with more competency. In training, it displayed an accuracy of around 98.70%, and in validation, it showed an accuracy of about 97.80%.

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Fine-Tuning with Augmentation:

After experimenting with the pre-trained model and varying the application of additional data augmentation, I later applied a method called fine-tuning to improve the model's performance even further. To maximize the pre-trained model's fit for the specific job at hand, fine-tuning entails making adjustments. As a result of augmentation techniques like flipping and rotation, the pre-trained model's layers were allowed to adjust to the newly richer dataset. Considerable progress was made throughout the fine-tuning process, which increased the model's accuracy. All through the instruction.

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**Conclusion:**

In summary, the model's effectiveness depends on the caliber and volume of data it takes in.   
Test results showed improved recognition performance when the training dataset was expanded from 1000 to 2000 photos, as the accuracy increased from 80% to 97%.   
Better results are also obtained when a pre-trained model is combined with methods for expanding the dataset. Overall, the author makes the argument that using data augmentation methods and growing the dataset can help the model make more accurate predictions and develop a better comprehension of the topic.