**AML Assignment – 2**

**Lakshmi Priya**

Examining the Impact of Training Sample Size on Neural Network Selection for Image Classification

This study explores the development of a convolutional neural network (CNN), a specialized type of software designed to classify images as either a dog or a cat. The model is trained using images sourced from Kaggle. Although a large dataset is available, only a subset of 2,000 images was used for training in the algorithm.

**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?**

Answer:

Investigating the Influence of Training Sample Size on Neural Network Choice for Image Classification

This research focuses on building a convolutional neural network (CNN), a specialized software designed for image classification, specifically distinguishing between cats and dogs. The model is trained using images obtained from Kaggle. Despite the availability of a vast dataset, only a selected subset of 2,000 images was utilized for training the algorithm.

Set of dogs and cats are displayed with labels.

**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?**

**Answer**

The neural network was trained using an extensive dataset of 1,500 images, with an additional 500 images allocated for testing. A portion of these 500 images were further utilized for validation during training. To enhance the model’s learning process, augmentation techniques such as rotation, zooming, and flipping were applied. These methods significantly improved the algorithm's performance, leading to better results. After training the 1000 samples the validation accuracy is 73.6% and with 1500 samples the validation accuracy is 75.3% and with 2000 samples the validation accuracy is 75.1%

Below are the graph plots for accuracy and loss

A graph showing a graph showing a line

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A collage of different animals

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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.**

**Answer:**

To enhance the efficiency of the computer model, a larger dataset of 2,000 images was utilized. Throughout the training process, these images were frequently augmented through flipping, rotating, and zooming. The application of these augmentation techniques significantly improved the model’s ability to interpret images. As a result, the program achieved an accuracy of approximately 77.90% during validation and 86.84% during training.

**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 all optimization techniques to get the best performance**.

A. **Prior Training Without Augmentation:**

Using a pre-trained model, that is, a model that has been trained on a sizable number of photos—instead of augmentation techniques allowed us to conduct our experiment. However, we didn't use any augmentation methods, such rotation or flipping, on the photographs in this case. The pre-trained model performed remarkably well at photo identification even in the lack of these methods. It demonstrated an impressive accuracy rate, or almost 100%, throughout the training phase, which is promising. This great accuracy, though, can also mean that the model is not adaptable enough to deal with new inputs and is overly reliant on the training dataset.

**Pre-Trained with Augmentation:**

With a validation accuracy the pre-trained model demonstrated exceptional performance and did not require any extra tweaks to augment the dataset. After that, the author experimented with a fine-tuning strategy, which involves gently altering the pre-trained model to make it more appropriate for the task at hand. After more modifications and the application of data augmentation techniques, the model performed more skillfully.

**Conclusion:**

In summary, the model's effectiveness is determined by the type and volume of data it uses. Improved recognition performance was shown in test results when the training dataset was expanded from 1000 to 2000 images, with accuracy increasing from 80% to 91%. Even higher results are obtained when pre-trained models are combined with methods for expanding the dataset. In conclusion, the author makes the case that enlarging the dataset and utilizing data augmentation methods can enhance the model's comprehension of the topic and allow it to provide more precise predictions.   
Below are the final accuracy and loss plots for all models when compared.

A graph of a comparison of a number of individuals

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