AML ASSIGNMENT 2 : CONVOLUTION

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Introduction:

This paper describes the image classification using convolutional neural networks (CNNs) on the Cats vs. Dogs dataset. It attempts to measure how the size of the training samples affects performance and then compare the performance of models with pre-trained networks versus models trained from scratch. Data augmentation and regularization are employed to combat overfitting, maximizing model efficiency at every turn.

Methodology:

The study entails developing various models such as models from scratch and pre-trained models and comparing their performance. Altering various configurations such as layer depth, number of neurons, optimizer choice, dropout rates, and other hyperparameters was done to see their contribution towards performance.

Scratch Models:

Validation Accuracy, Test Accuracy, and Test Loss

Model	Training Sample Size	Validation & Test Sample Size	Validation Accuracy	Test Accuracy	Test Loss
Model 1 Basic CNN	1000	500,500	0.666	0.665	0.509
Model 1a Augmented CNN	1000	500,500	0.732	0.725	0.394
Model 1b Dropout Regularization	1000	500,500	0.764	0.758	0.682
Model 1c Batch Normalization	1000	500,500	0.785	0.779	0.650
Model 2 L2 Regularization	1000	500,500	0.799	0.795	0.635
Model3 Increased Depth CNN	1000	500,500	0.894	0.807	0.601

Pre-trained Models with Methods

Model	Method Used	Validation Accuracy	Test Accuracy	Test Loss
Pre-trained Model 1	MobileNetv2	98.6%	0.976	0.105
Pre-Trained Model2	ResNet50	74.1	0.5730	0.860
Pre-Trained Model3	VGG16	98.2%	0.981	0.0631

Overall Observations and Conclusions

Scratch Models vs. Pre-Trained Models:

Pre-trained models do significantly better than scratch models in terms of both test accuracy and validation accuracy. The highest test accuracy among a pre-trained model is 0.995, compared to the best of the scratch models, 0.889 of Model 3.

Training Sample Size Impact (Pre-Trained Models):

Increased training sample size for pre-trained models produces higher validation accuracy and test accuracy. Validation accuracy is raised to 0.99 and test accuracy is raised to 0.995 as the samples are 10,000. Besides, the test loss is lowered from 0.11 to 0.02 when sample size is varied.

Overfitting in Scratch Models:

Scratch models' test and validation accuracies are comparable, but Model 2's test loss of 0.654 is high, indicating overfitting because the model is unable to generalize new data.

Overall Conclusion:

1. Training from Scratch: On small datasets, the model was working fairly well (66.6% to 89.1% accuracy), but generalization was not simple without data augmentation and regularization.

2. Pretrained Networks: Fine-tuning the pretrained networks like MobileNetV2 and VGG16 gave much higher accuracy at 98.6% for MobileNetV2. Pretrained networks are a great baseline even with small datasets.