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Advanced Machine Learning (BA-64061-003)

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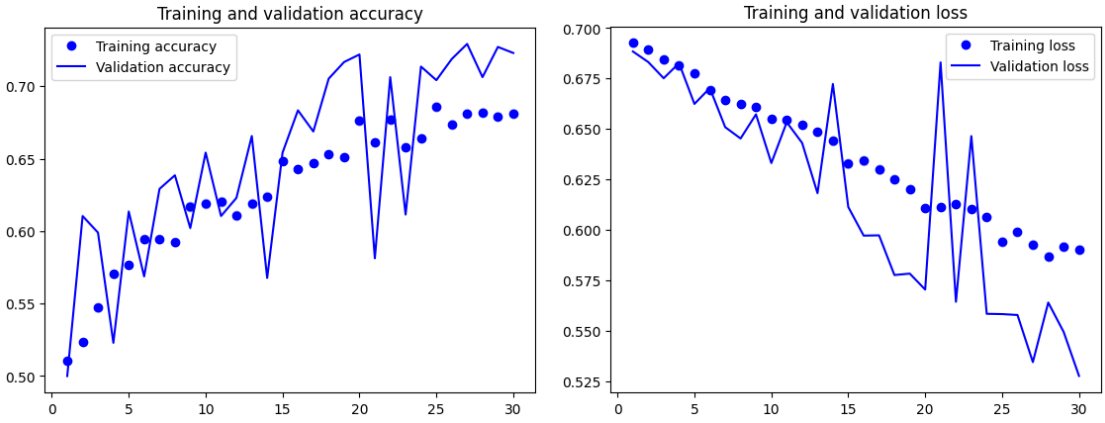
Assignment 2 Report

The use of convolutional neural networks (convnets) in image classification tasks has become increasingly important due to their ability to learn in-depth features from raw pixelated data. In this report I explore the relationship betIen training sample size and the choice of network architecture, focusing on the cats vs dogs classification Kaggle example. Our objective is to evaluate how varying sample sizes impact the models performance when training from scratch and utilizing a pre-trained network.

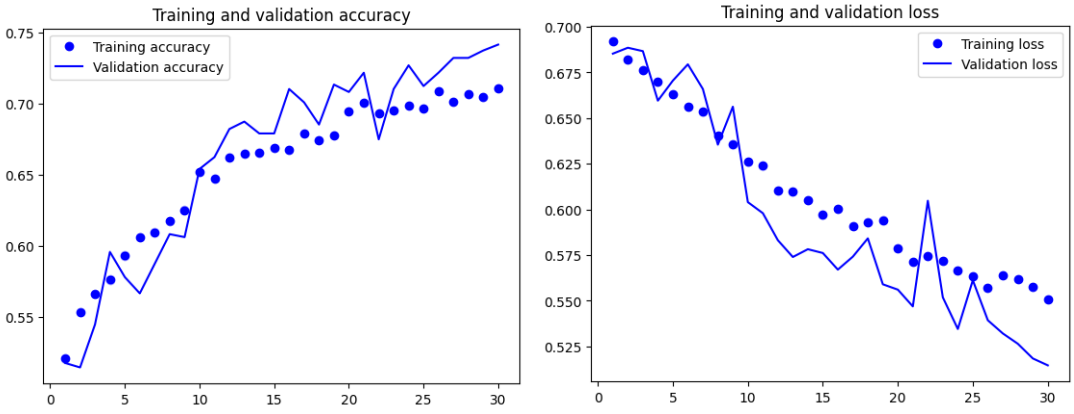
I evaluated each model by using the metrics: accuracy, loss, and validation accuracy to measure model performance on the training and validation samples. Additionally, the test accuracy is calculated on a different test sample to understand the ability of the model to handle new and random data.

Report Structure:

- Step 1 involves training a model from scratch with a small training sample size of 1000 images and validation/test sample sizes of 500 images each.
    - In Step 1, I used an image size of (150, 150) and a batch size of 64.
    - This resulted in 68% training accuracy, 72% validation accuracy, & 71% test accuracy.

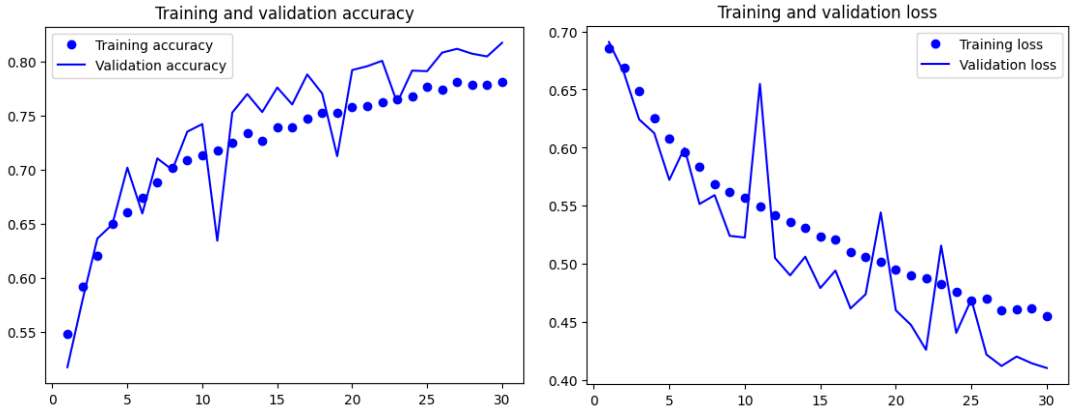


- Step 2 explores the effect of increasing the training sample size (1000 to 2000) while I train the model from scratch. (Validation/test samples remained the same size as step 1).
    - In Step 2, I used an image size of (150, 150) and a batch size of 64.
    - This resulted in 71% training accuracy, 74% validation accuracy, & 74% test accuracy.



- In step 3 I take steps to optimize the model by increasing or decreasing the training, validation, & test sample sizes.
    - In Step 3, I increased the training sample size to 3000 images and the validation and test sample sizes to 1000 images each.
    - Also, I used an image size of (150, 150) and a batch size of 64.

- This resulted in 78% training accuracy, 82% validation accuracy, & 82% test accuracy.



- Finally, in step 4 I use a pre-trained model to assess how it compares with training from scratch with different sample sizes.
  - In Step 4, I kept the training, validation, & test sample sizes the same as in Step 3.
  - Also, I used an image size of (150, 150) and a batch size of 64.
  - This resulted in 86% training accuracy, 90% validation accuracy, & 91% test accuracy.

In my analysis, I found that the impact of increasing the training sample size from 1000 to 2000 (Step 2) images and optimizing it further (Step 3) led to noticeable improvements in both the training and validation accuracies. Which in turn led to an increase in test accuracy when introducing new data into the model. This indicates that a larger training sample can help the model generalize better and achieve higher accuracy.

Through this assignment, I learned that training a model from scratch highlighted steady improvements in accuracy as the training sample size increased and optimization techniques were applied (Data Augmentation and Normalization). However, the final model's accuracy

unfortunately plateaued around 82%. In contrast, using a pre-trained model with transfer learning and fine-tuning led to significant increases in accuracies, with a test accuracy of 91%. This demonstrates the effectiveness of using pre-trained models, especially for tasks with insignificant amounts of training data.

Additionally, the relationship between training sample size and the choice of network architecture is apparent in the results. The model can be trained effectively without overfitting, with larger sample sizes and more complex convnet structures. When utilizing a pre-trained model, the impact of training sample sizes is still significant but less so when compared to training a model from scratch. A pre-trained model's ability to capture generic features and patterns from a large dataset contributes to its robustness and high accuracy levels even with smaller datasets.

In conclusion, increasing the training sample size can lead to improved model performance, but the benefits can diminish or plateau beyond a certain point. By leveraging pre-trained models, we can produce results with superior accuracy compared to training from scratch with the same or larger sample sizes. Finally, the choice of network architecture, along with optimization techniques, can play a crucial role in maximizing a model's performance when it encounters different sample sizes.