Assignment #7
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MSDS 422

Summary

This assignment builds off the work done with deep neural network and the MNIST dataset in Assignment #6. For this assignment, 2000 pictures of dogs and cats were used to build convolutional neural networks for binary classification. These images were much more complex than the handwritten digits in MNIST and thus require a more sophisticated learning method like convolution. Convolution is a filtering technique used for classification tasks and works better than traditional DNN models to differentiate between two different images classes. Students were asked to employ a 2x2 completely crossed experimental design. Four models were built to test different hyperparameter settings. The hyperparameter settings that could be adjusted included numbers of layers and nodes within layers and types of layers (convolutional or pooling).

Research Design

The objective of this assignment was to test different hyperparameters and find a convolutional neural network that would satisfy a website provider who is looking for a way to automatically label images provided by end-users. Within this project, the main objective for these models is achieving the highest accuracy possible. A secondary objective is to minimize training time, but this should not come at a cost for accuracy.

For this assignment, four different CNN models were tested. The first two models tested the way max pooling and average pooling affected model performance. Each model shared some basic settings: AdamOptimizer, learning rate = .001, batch size = 64, 5 hidden layers and 2 convolutional layers. The first model used five hidden layers and two convolutional layers with max pooling while the second model used the same hyperparameters but implemented average

pooling. The first model averaged training accuracy of 100% and a average testing accuracy of 65%. It took 12 min 3 seconds of processing time. The second model averaged a training accuracy of 100% and a testing accuracy of 64.75%. It took 11 min 40 seconds. The last two models tested the impact adding a dropout layer to each model (using max pooling and average pooling). It was observed that the third model averaged a training accuracy of 100% and a testing accuracy of 65%. It took 11 min 44 seconds of processing time. The fourth model averaged a training accuracy of 100% and testing accuracy of 67%. It took 11 min 40 seconds of processing time.

Programming Overview

The entire project was done in Python using the Jupyter Notebook environment. Packages that were used included pandas and numpy for data handling and manipulation. Matplotlib was used for exploratory data analysis and getting a sense of the structure of the images. Tensorflow was used to handle the machine learning aspects of the assignment. Other packages included Time for computing program execution time.

Recommendations

It is recommended that the website provider uses Model 4. However, it seems that each all four models suffer from overfitting and the testing accuracy plateaus around 68-70%. Management should investigate adjusting other hyperparameters like batch size and learning rate as adding a dropout layer had little effect on accuracy. It is recommended that there should be further experimentation on the number of convolutional/pooling layers and how they are structured. Also, these models were tested only on greyscale images. It may be the case that using color images has a positive impact on the ability for CNN models to improve performance.