

EE 5450 Project 02: Convolution Neural Network Classification of the Animals Data Set

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1 Introduction

The rebirth of Neural Networks (NNs) and Machine Learning (ML) has offered revolutionary approaches to intelligent tasks previously unattainable in the field of image processing and computer vision. A major area of research focus continues to be the classification of images. Image classification through classical means of image processing tend to suffer due to problems with the wide variance in images to be classified



2 Methods and Results

2.1 ShallowNet

For baseline comparisons we will use the code provided by Dr. Rosebrock [1] which is a simplistic implementation of a Convolutional Neural Network designed with the goal of classification of images in to any of the three given animal categories. The basic structure of Rosebrock's network consists of:

INPUT=>CONV=>RELU=>FC=>SOFTMAX

Even with the most basic of implementations, the network is able to provide a respectable first attempt at the classification of the images. As seen in Table 1, the network achieves an average accuracy 66%. Given that with three classes the network has a 33% probability

of randomly selecting the correct class, this is a decent first attempt. Using this as a lower bound we proceed to implement a number of other techniques that are common in CNN architectures in order to improve the performance of the network overall.

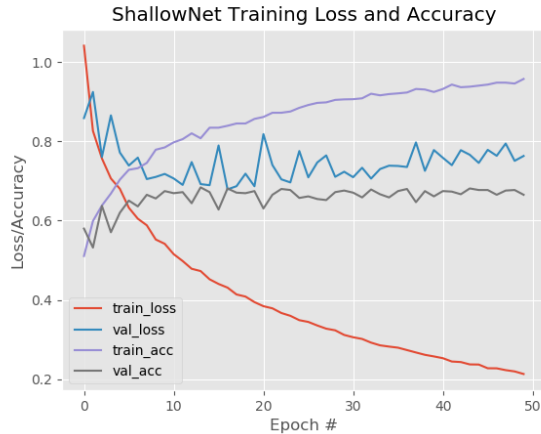


Figure 1: ShallowNet Accuracy

	Precision	Recall	F1-Score	Support
Cat	0.64	0.57	0.6	262
Dog	0.57	0.58	0.58	249
Panda	0.79	0.86	0.82	239
Avg/Total	0.66	0.67	0.66	750

Table 1: ShallowNet Results

2.2 MohlerNet2

The initial modification to the original network lies in the expansion of the architecture to incorporate key elements of CNNs, such as pooling layers and incorporation of neuron dropout prior to the fully connected layer. The general architecture of “MohlerNet2” is as follows:

INPUT=>CONV=>CONV=>MAXPOOL=>DROPOUT(0.5)=>FC=>SOFTMAX

Using the classical stochastic gradient descent approach to the optimization of the network we were able to see an immediate and reproducible increase in the ability of the network to accurately classify the three categories of animal images. From Table 2, it can be seen that the inclusion of the additional convolutional layer, pooling, and dropout was able to provide a 6% increase in the accuracy of the network. As a more objective measure of the algorithm we can view the F-1 score for each tested network. The F-1 score captures information regarding the false positives and false negatives in the classification process, this gives a more objective view from algorithm to algorithm. From this we can also see a similar increase in F-1 score between the original ShallowNet implementation and the first implementation of MohlerNet (MohlerNet2).

2.3 MohlerNet3

INPUT=>[CONV=>MAXPOOL]*2=>CONV*3=>MAXPOOL=>DROPOUT(0.5)=>FC=>SOFTMAX

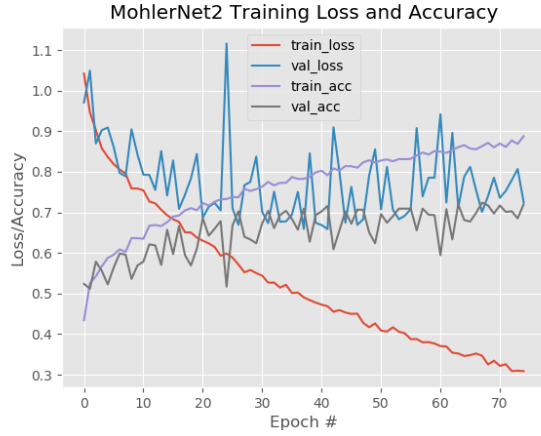


Figure 2: MohlerNet2 Accuracy, Learning Rate:0.01

	Precision	Recall	F1-Score	Support
Cat	0.67	0.75	0.71	262
Dog	0.64	0.60	0.62	249
Panda	0.88	0.82	0.85	239
Avg/Total	0.72	0.72	0.72	750

Table 2: MohlerNet2 Classification Results

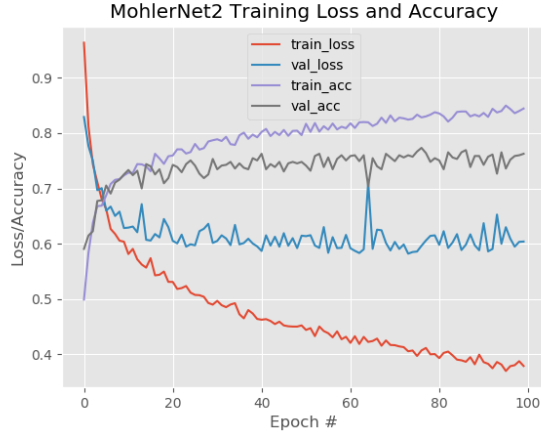


Figure 3: MohlerNet2 with Data Augmentation Accuracy, AdaGrad Optimized

	Precision	Recall	F1-Score	Support
Cat	0.75	0.66	0.71	262
Dog	0.69	0.7	0.69	249
Panda	0.84	0.93	0.89	239
Avg/Total	0.76	0.76	0.76	750

Table 3: MohlerNet2 with Data Augmentation Results

3 Conclusions

A Code Listings

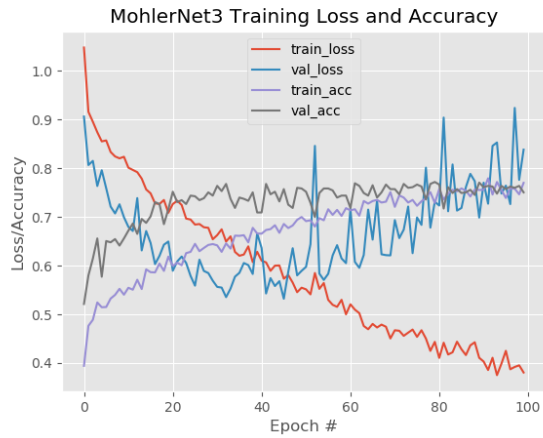


Figure 4: MohlerNet3 with Data Augmentation Accuracy, AdaMax Optimized

	Precision	Recall	F1-Score	Support
Cat	0.81	0.58	0.68	262
Dog	0.62	0.78	0.69	249
Panda	0.88	0.91	0.89	239
Avg/Total	0.77	0.75	0.75	750

Table 4: MohlerNet3 with Data Augmentation Results

References

- [1] A. Rosebrock, *Deep Learning For Computer Vision With Python*. PyImageSearch, 2017.