Analysis of the Evolution of ML Algorithms for Image Classification

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ABSTRACT

Machine learning algorithms have evolved over the years. We will analyze why some algorithms are preferred over others in the image classification problem domain. We will analyze the performance of historical and modern ML algorithms used for image classification in terms of training time and classification accuracy. We will also examine whether particular test set examples are difficult to classify for a particular algorithm and the nature of such examples. Finally, we will also compare performance across grey scale and color image domains.

PROPOSED PROBLEMS

- How does the accuracy compare between optimized CNN, NN, and SVM algorithms when applied to a image classification problem?
- What is the difference in training time between these algorithms? How does the training time change when using a color dataset compared to a grey scale dataset?
- Does using color images improve the accuracy of the algorithms?
- Which training/test examples did each of the algorithms have difficulty with? Is there some property that these problematic training images share? Are the same images difficult to classify with all 3 algorithms?

DATASETS

MNIST-Fashion[1]:
The fashion-MNIST dataset was created to be backward compatible with the MNIST dataset. It has the same image dimensions, number of training and test examples, and the same number of classes as the original mnist digit set. It was created since the original MNIST digits data set became overrused in the ML community. This dataset contains 60,000 labelled training examples and 10,000 labelled test examples. The images are grey scale and have dimension 28x28 pixels. There are 10 different image classes.

CIFAR-10[2]:
The CIFAR-10 dataset is a subset of the 80-million tiny images data set[3] It contains 60,000 labelled color images with dimensions 32x32 pixels. It is subdivided into 50,000 training images and 10,000 test images. It has 10 image class labels that are balanced in the training and test sets.

CLASSIFICATION ALGORITHMS

Support Vector Machine:
To classify the data, SVMs will attempt to select the best hyperplane decision boundary that linearly separates the classes in either the current space or in a higher-dimension space (depending on the kernel used).

Fully-Connected Neural Network:
The neural network uses a network of perceptrons to perform classification. Unlike a CNN, it considers each pixel without regard to the proximity of that pixel to other pixels.

Convolutional Neural Network:
The CNN is similar to the NN since it also relies on a network of perceptrons. However, the CNN is the obvious choice for image classification since it also accounts for the proximity of adjacent pixels.

REFERENCES

1. Han Xiao and Kashif Rasul and Roland Vollgraf, Fashion-MNIST: a Novel Image Dataset for Benchmarking Machine Learning Algorithms, *arXiv:1708.07747* (accessed Nov 2019)
2. Alex Krizhevsky, Learning Multiple Layers of Features from Tiny Images, *https://www.cs.toronto.edu/ kriz/cifar.html* (accessed Nov 2019)
3. Torralba A., Fergus R. and Freeman W., 80 million tiny images: a large dataset for non-parametric object and scene recognition, *https://people.csail.mit.edu/torralba/publications/80millionImages.pdf* (accessed Nov 2019)