Quick, Draw! Image Classification

Group 3

December 6, 2018

1 Introduction

Many recent industry innovations have included neural networks. An important research area within neural networks has been image classification. One of the best techniques to classify images is Convolutional Neural Networks (CNN). We have sought to better understand industry best practices by exploring different image classification techniques with neural networks. Our exploration starts by manually performing image classification and noting the level of human accuracy. We then use a fully connected neural network to perform image classification before implementing a CNN. We implemented options for tuning and debugging the neural network while implementing each method during our process. We were able to develop an intuition for image classification best practices using neural networks after our research.

Many supervised machine learning methods often differ from those employed when constructing neural networks. These supervised machine learning methods, such as logistic regression or decision tree classification, require feature engineering to successfully classify an image. Models requiring feature engineering rely on considerable effort by subject matter experts to achieve reasonable accuracy. Neural networks allow for an approach which does not require feature engineering to achieve similar or better accuracy. Industry engineering efforts regarding feature engineering can be shifted to neural networks in some cases such as image classification. Moreover, the availability of cheap computing resources sped up a shift towards the use of neural networks.

When considering modeling approaches, we examine both fully connected and convolutional neural networks. A fully connected neural network is known to be inefficient at classifying large images. These inefficiencies in a fully connected neural network partly arise because every neuron in the $\ell - 1$ layer must be connected to the ℓth layer. This requires a series of matrix multiplications and additions across each layer ℓ. Alternatively, a CNN allows for more efficient computations by: (1) efficient and automatic feature generation using local connectivity and parameter sharing of convolution operations, (2) dimensionality reduction using pooling layers. In this project, we attempt to understand these topics in depth from an empirical stanpoint in relation to image classification using Google's "Quick, Draw!" dataset.

2 Methods

2.1 EDA

3 Results

3.1 Image Classification using Humans

3.2 Fully Connected Neural Network

3.3 Convolutional Neural Network

4 Discussion