Traffic Signs Classification using German Traffic Sign Dataset

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Author Note

To see the code for the project please visit the following Github link:

www.Github.com/Rxmeez/SDCND-1-TrafficSignClassifier

Abstract

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Keywords: Lorem, ipsum, dolor

Introduction

In this project we will explore and visualize the dataset, look into preprocessing steps that can improve the accuracy of the neural network. To design, train and test our convolutional neural network based on the LeNet architecture. We will also use the model to make predictions on new images, analyze the softmax probabilities of the new images. The aim of this project will be to reach the accuracy of 93% or more on the validation dataset.

The number of data provided, the number of training examples are 34799, with the testing examples being 12630. The number of classes are 43, where each class represents a traffic sign, range from 0 - 42, where the images data shape are 32 by 32 pixels with dimension values 3, represented by red, green and blue.

Literature Review

Data Exploration

Initial displaying random images from the training dataset would be the best place to start to see the images that are being displayed. This information can be extremely useful to see these images especially in preprocessing steps to bring all the images in a similar range, or if augmented images to increase the training dataset, this will provide information on what functions to such as rotation, translation and brightness. Another data exploration method would be look to look at the distribution of the number of examples in your training test, this will show if there is an imbalance in the classes. This could again influence if more data might need to be augmented.

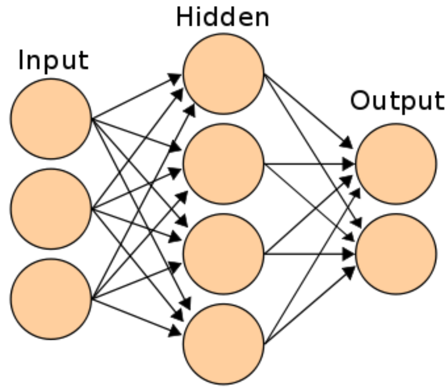
Preprocessing

There are two main preprocessing steps that are normally applied to images the first one being to make the images into a grayscale. The benefit of having images into a grayscale are signal to noise, complexity of the code, difficulty of visualization and speed.

What I mean by signal to noise is for many applications of image processing, color information doesn't help us identify important edges and other features. There are some exceptions when we need to identify objects of known hue (orange car in front of green grass), then color information could be useful. Therefore if we don't need color we can consider it as noise. If you still want to find edges in a color image you have to consider its edges based on luminance and chrominance, this create additional work, i.e additional debugging so it becomes hard to justify additional color information that isn't helpful for applications of interest. Lastly a great advantage is speed, where it is nearly 3 times faster to process grayscale image which has 1 dimensional compared to a standard RGB (Red-Green-Blue) where it will have to process the three-channel color image.

Neural Network

Neural networks are typically organized in layers, and the layers a made up of number of interconnected nodes. A diagram of a simple neural network is shown below, which consists of input nodes, hidden nodes and an output node. These individual nodes are called perceptrons, or artificial neurons, loosely modeled after the neuronal structure of the mammalian cerebral cortex but on a much smaller scale. Each one looks at input data and decides how to categorize that data with a help of an activation function, such as a softmax or ReLU (Rectified linear units) function.

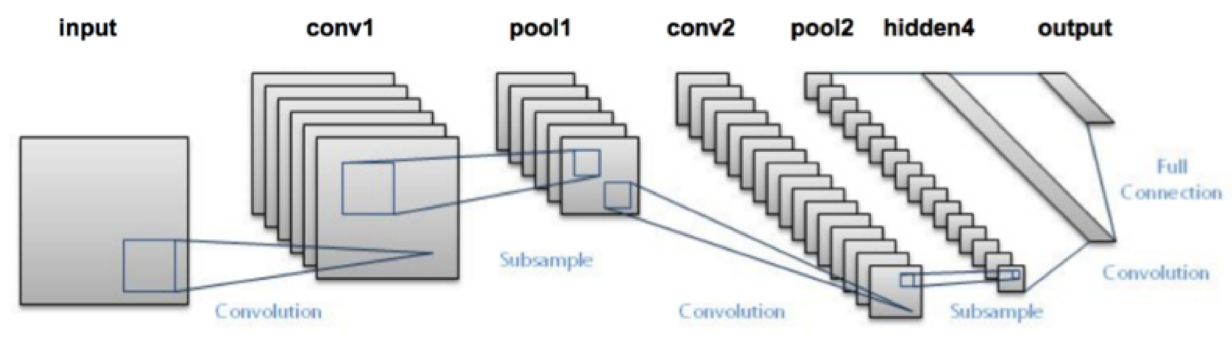


Most of Artificial Neural Network (ANN) contain some form of learning rule which modifies the weights of the connections according to the input patterns that it is presented with. In a sense, ANNs learn by examples as do their biological counterparts; a child learns to recognize cats from examples of cats.

Convolution Neural Network

A high level of Convolutional Neural Networks (CNN) of what are they and why are they important. CNN are a category of Neural Network, which have proven very effective in areas such as image recognition and classification, this could be objects, faces and even traffic signs.

LeNet was one of the very first CNNs which helped propel the field of Deep Learning, this pioneering work by Yann LeCun. The LeNet architecture (1990s) was used mainly for character recognition task such as reading postcodes, digits, etc. The image below shows LeNet architecture, where there are four main operations in CNNs as shown in the image:



1. Convolution
2. Non Linearity (ReLU)
3. Pooling or Sub Sampling
4. Classification (Fully Connected Layer)

These Operations are the basic building blocks of every CNN. The primary purpose of Convolution in case of CNN is to extract the features from the input image, to preserve the spatial relationship between the pictures. The purpose of ReLU is to introduce non-linearity in our CNN since most of the real-world data we would want the CNN to learn would be non-linear. Other non-linear function are tanh or sigmoid which can be used instead of ReLU. The function of Pooling is to progressively reduce the spatial size of the input representation, which makes the input representation smaller and more manageable as well as reduce the number of parameters and computations in the network. The Fully Connected uses the theses features for classifying the input images into various classes based on the training dataset, which will lead to your final output. This is a explanation of the main concepts behind CNNs in simple terms, there are several details that I have oversimplified/ skipped, but hopefully you have some intuition around how they work.

Results

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Validation

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Test

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New Pictures

Discussion

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References

Lastname, C. (2008). Title of the source without caps except Proper Nouns or: First word after colon. *The Journal or Publication Italicized and Capped*, Vol#(Issue#), Page numbers.

Lastname, O. (2010). Online journal using DOI or digital object identifier. *Main Online Journal Name*, Vol#(Issue#), 159-192. doi: 10.1000/182

Lastname, W. (2009). If there is no DOI use the URL of the main website referenced. *Article Without DOI Reference*, Vol#(Issue#), 166-212. Retrieved from http://www.example.com