Traffic Sign Recognition

Writeup

You can use this file as a template for your writeup if you want to submit it as a markdown file, but feel free to use some other method and submit a pdf if you prefer.

Build a Traffic Sign Recognition Project

The goals / steps of this project are the following:
* Load the data set (see below for links to the project data set)
* Explore, summarize and visualize the data set
* Design, train and test a model architecture
* Use the model to make predictions on new images
* Analyze the softmax probabilities of the new images
* Summarize the results with a written report

[//]: # (Image References)

[image1]: ./examples/visualization.jpg "Visualization"
[image2]: ./examples/grayscale.jpg "Grayscaling"
[image3]: ./examples/random_noise.jpg "Random Noise"
[image4]: ./examples/placeholder.png "Traffic Sign 1"
[image5]: ./examples/placeholder.png "Traffic Sign 2"
[image6]: ./examples/placeholder.png "Traffic Sign 3"
[image7]: ./examples/placeholder.png "Traffic Sign 4"
[image8]: ./examples/placeholder.png "Traffic Sign 5"

Rubric Points
Here I will consider the [rubric points](https://review.udacity.com/#!/rubrics/481/view) individually and describe how I addressed each point in my implementation.

Writeup / README

1. Provide a Writeup / README that includes all the rubric points and how you addressed each one. You can submit your writeup as markdown or pdf. You can use this template as a guide for writing the report. The submission includes the project code.

You're reading it! and here is a link to my [project code](https://github.com/udacity/CarND-Traffic-Sign-Classifier-Project/blob/master/Traffic_Sign_Classifier.ipynb)

Data Set Summary & Exploration

1. Provide a basic summary of the data set. In the code, the analysis should be done using python, numpy and/or pandas methods rather than hardcoding results manually.

I used the pandas library to calculate summary statistics of the traffic signs data set:

* The size of training set is 29579
* The size of the validation set is 5220
* The size of test set is 12630
* The shape of a traffic sign image is 32*32
* The number of unique classes/labels in the data set is 43

2. Include an exploratory visualization of the dataset.

Here is an exploratory visualization of the data set. It is a bar chart showing how the data ...

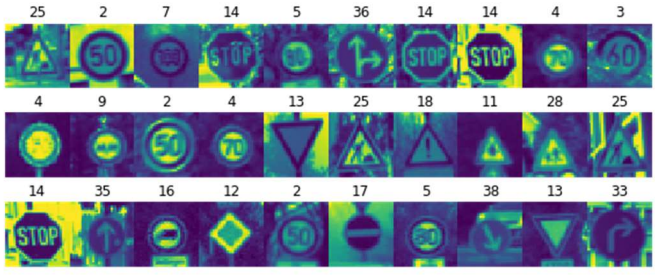
![alt text][image1]

Design and Test a Model Architecture

1. Describe how you preprocessed the image data. What techniques were chosen and why did you choose these techniques? Consider including images showing the output of each preprocessing technique. Pre-processing refers to techniques such as converting to grayscale, normalization, etc. (OPTIONAL: As described in the "Stand Out Suggestions" part of the rubric, if you generated additional data for training, describe why you decided to generate additional data, how you generated the data, and provide example images of the additional data. Then describe the characteristics of the augmented training set like number of images in the set, number of images for each class, etc.)

As a first step, I decided to convert the images to grayscale because it simplified the values of each pixel in the image and then I normalized it to make values of the pixel in the range of 0 - 1.

Here is an example of a traffic sign image before and after grayscaling and normalization



2. Describe what your final model architecture looks like including model type, layers, layer sizes, connectivity, etc.) Consider including a diagram and/or table describing the final model.

My final model consisted of the following layers:

Layer	Description
Input	32x32x3 RGB image
Convolution 3x3	1x1 stride, same padding, outputs 28x28x6
RELU	
Max pooling	2x2 stride, outputs 14x14x6
Convolution 3x3	1x1 stride, Output = 10x10x16
Max pooling	2x2 stride, outputs 5x5x6
Fully connected (Matrix Multiplication)	Used fatten function, Input= 400 and final O/p= 120
Fully connected (Matrix Multiplication)	Input= 120 and O/p= 84

3. Describe how you trained your model. The discussion can include the type of optimizer, the batch size, number of epochs and any hyperparameters such as learning rate.

To train the model, I used an Adam optimizer , learning rate of 0. 0009 , dropout rate of 0.3 and batch size of 150.

4. Describe the approach taken for finding a solution and getting the validation set accuracy to be at least 0.93. Include in the discussion the results on the training, validation and test sets and where in the code these were calculated. Your approach may have been an iterative process, in which case, outline the steps you took to get to the final solution and why you chose those steps. Perhaps your solution involved an already well known implementation or architecture. In this case, discuss why you think the architecture is suitable for the current problem.

My final model results were:
* training set accuracy of 0.9636
* validation set accuracy of 0.982
* test set accuracy of 0.9193