Project 3: Traffic Signs Classifier

Data Set Summary & Exploration

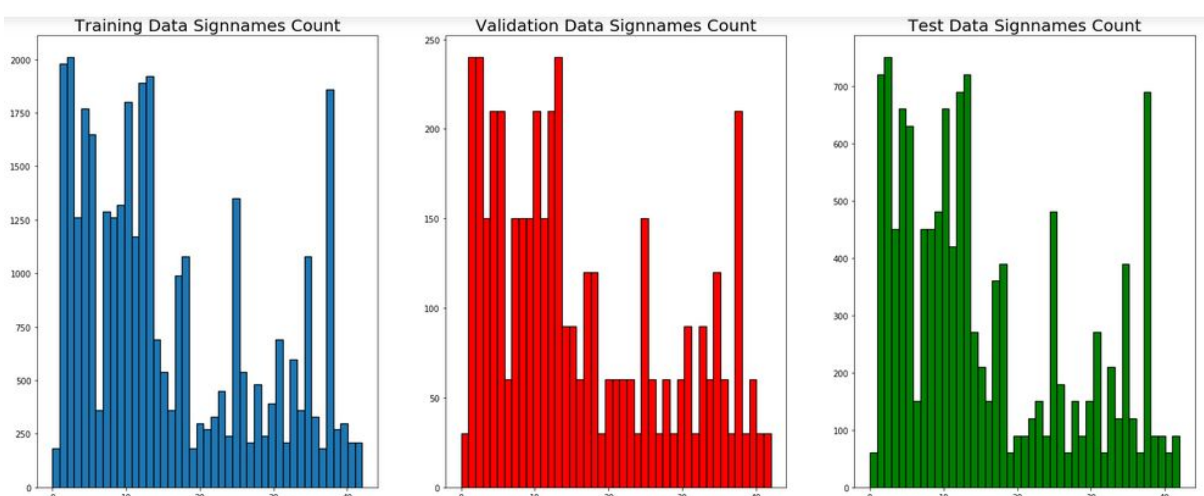
1. Provide a basic summary of the data set. In the code, the analysis should be done using python, numpy and/or pandas methods rather than hardcoding results manually.

* The size of training set is 34799
* The size of the validation set is 4410
* The size of test set is 12630
* The shape of a traffic sign image is (32, 32, 3)
* The number of unique classes/labels in the data set is 43

2. Include an exploratory visualization of the dataset.

5 Random images for all classes are displayed in the notebook. The image below is just a sample of the dataset.

A histogram displaying the number of images for each signname in the train, validation and test data was also displayed. It was noticed that some of the signnames had very less number of images as compared to some others. This was later adjusted by augmenting the available images to create new images for those signnames.



Design and Test a Model Architecture

1. Describe how you preprocessed the image data.

The overall pipeline for the image before passing to the neural net was :

Augment required classes → Preprocesses

The objective of the augmentation stage was to bring the minimum number of images of a signname to 800
In the augmentation stage, the following pipeline was followed:

1. Found out signnames whose count was less than 800
2. Took (800-count) of random images for that signname to bring the total up to 800
3. Applied augmentation processes to the random images:
    a. Translate
    b. Rotate
    c. Zoom
    d. Histogram Equalize
4. Added the augmented images to the original training data

The objective of the preprocessing stage was to average out the features of the image so as to save processing time in the neural net.
In the preprocessing stage, the following pipeline was followed:

1. Convert image to grayscale (keeping channels=1)
2. Normalize pixels in the image to be averaged around 0

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.

1. Input: 32x32x1, greyscale + normalized image
2. 5x5 Convolution, 1x1 Stride, Output Depth = 6, Valid Padding. (Output: 28x28x6)
3. RELU layer
4. Max Pooling, 2x2 stride. (Output: 14x14x6)
5. 5x5 Convolution, 1x1 Stride, Output Depth = 6, Valid Padding. (Output: 10x10x6)
6. RELU layer
7. Max pooling, 2x2 stride. (Output: 5x5x16)
8. Flatten, 5x5x16 to 400
9. Dropout, keep_prob = 0.8
10. Fully connected, 400 to 120
11. RELU layer
12. Dropout, keep_prob = 0.75
13. Fully connected, 120 to 84
14. RELU layer
15. Fully connected, 84 to 43

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.

Optimizer used: Adam
Batch Size: 180
Epochs: 70
Learning Rate: 0.001

4. Describe the approach taken for finding a solution and getting the validation set accuracy to be at least 0.93.

My final model results were:
* training set accuracy of 0.98
* validation set accuracy of 0.944
* test set accuracy of 0.917

The LeNet architecture was chosen considering the learning curve involved. In addition to this architecture, two dropout layers were added for speed and accuracy.

As I had implemented the LeNet architecture for the initial traffic signs lab and had understood its working. As it had given satisfactory results in the lab, I decided to use it for the project as well.

During implementation of the architecture, the Epochs and Batch size parameters were tuned. The accuracy after a certain number of epoch stagnates and the values with the best chance to give a validation accuracy of 0.93 were chosen. Using these values, the accuracy values pass the required thresholds.

<u>Test a Model on New Images</u>

1. Choose five German traffic signs found on the web and provide them in the report. For each image, discuss what quality or qualities might be difficult to classify.

Following are the chosen images-

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Confirm dimensions of image data going into Neural Net:
Image Dataset Shape:  (5, 32, 32, 1)
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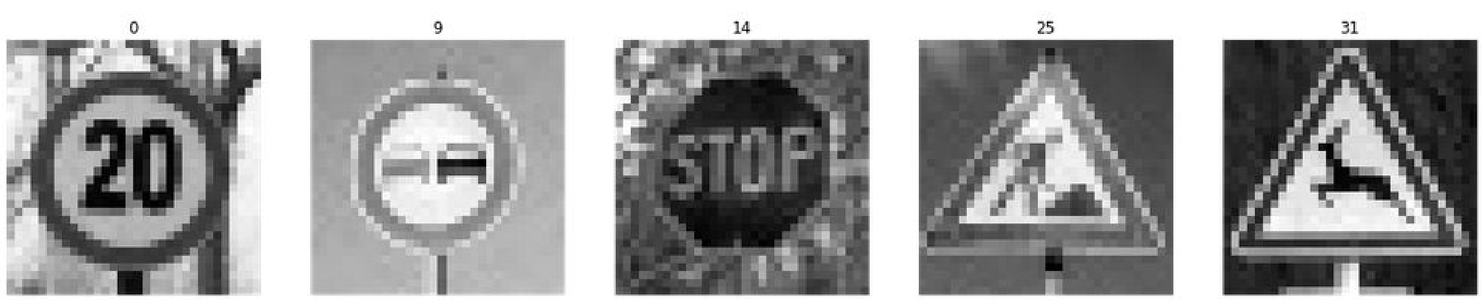
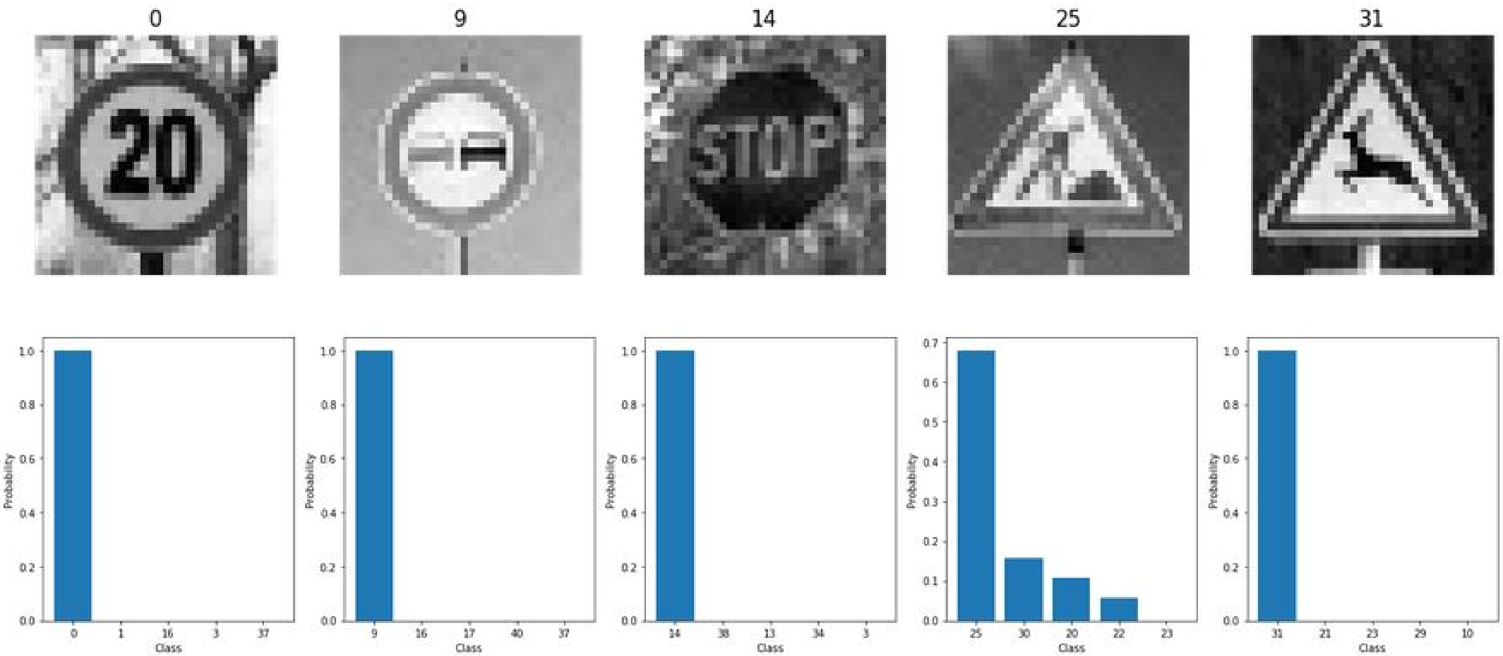


The 2nd and 4th images were expected to prove difficult to classify because of the brightness.

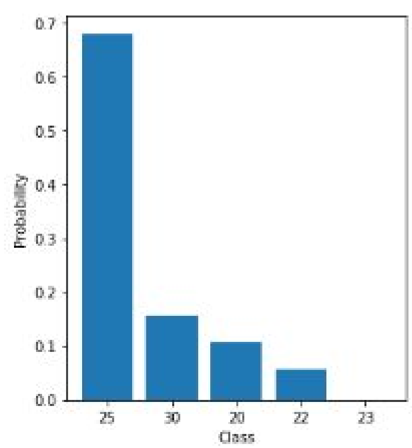
2. Discuss the model's predictions on these new traffic signs and compare the results to predicting on the test set.

20 kph - 20 kph
No passing - No passing
Stop - Stop
Road work - Road work*
Wild animals crossing - Wild animals crossing

The accuracy was 100% for this dataset.



3. Describe how certain the model is when predicting on each of the five new images by looking at the softmax probabilities for each prediction.



Even though the road work sign was classified correctly, multiple classes having relatively high probability numbers showed up. The signnames with higher probabilities were-

30: Beware of ice/snow (16%)
20: Dangerous curve to the right (12%)
22: Bumpy road (7%)