Traffic Sign Recognition

Build a Traffic Sign Recognition Project

Data Set Summary & Exploration

The size of training set is 34799

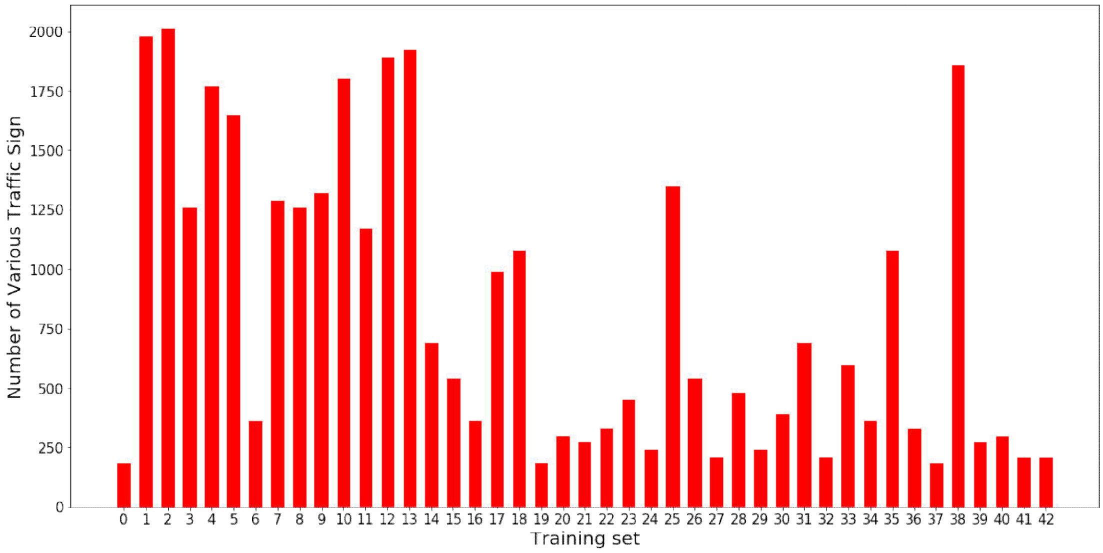
The size of the validation set is 4410

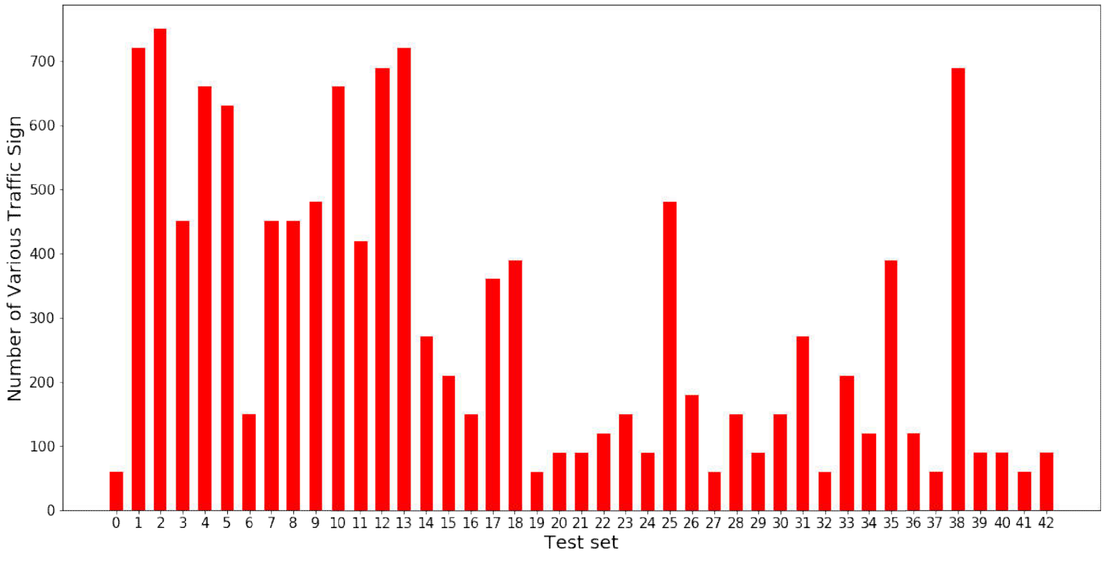
The size of test set is 12630

The shape of a traffic sign image is 32*32*3

The number of unique classes/labels in the data set is 43

Here is a bar chart showing how the data distribution. We can see the data is not balanced. Some traffic signs have more example than others. But training set has the same distribution as the test set.





Design and Test a Model Architecture

1.Preprocess data.

As a first step, I decided to normalized the image data because it will accelerate the training of my network. And then I one-hoted the labels.
I don't add more data to my data set , because as it seems to me the existed data set have get some augmented image as extra data and I got 95% accuracy on test set with this original data set.

2. Model Architecture.

My final model consisted of the following layers:

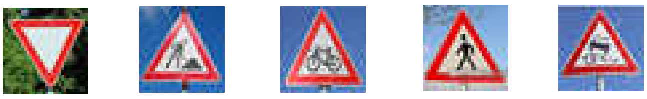
Layer	Description
Input	32x32x3 RGB image
Convolution 3x3	1x1 stride, same padding, outputs 32x32x16
RELU	
Convolution 3x3	1x1 stride, same padding, outputs 32x32x32
RELU	
Max pooling 2x2	2x2 stride, outputs 16x16x32
Convolution 3x3	1x1 stride, same padding, outputs 16x16x64
RELU	
Convolution 3x3	1x1 stride, same padding, outputs 16x16x128
RELU	
Max pooling 2x2	2x2 stride, outputs 8x8x128
Flatten layer	Outputs:8192
Fully connected	Outputs:4096, Activation:Relu
Drop out	Keep prob = 0.7
Fully connected	Outputs:1024, Activation:Relu
Drop out	Keep prob = 0.7
Softmax	Outputs:43

3.Model training and Summary.

To train the model, I used adam as optimizer. I set 0.001 as learnning rate. As the cost stopping drop in epoch5, I train the model for epochs of 5. I was using a AWS server with K-80 GPU so I set the batch size pretty big as 512 to accelerate the training.
However the result is not very good at the beginning. My network is overfitting. So added drop out layer and results became better.
My final model results were:
My network is a simplified VGG network. Because VGG is working so good on various image classification problem, it's not a bad idea to copy some of it's architecture. As our data image is only 32*32*3, quite small, I think it's enough to use a shallower network. In fact, I achieved XXX accuracy on validation data set and 95% accuracy on test set.

Model Testing

Here are five German traffic signs that I found on the web:



All five images have some sort of distortion. Because when I cut them for net image, I'm using rectangle. But I have to convert the image into square 32*32 so my network could be working. And there is shadow on some of the signs but it's not that obviously after I shrink the images.

Image	1	2	3	4	5
Correct label	13	25	29	27	23
Correct Sign names	Yield	Road work	Bicycles Crossing	Pedestrians	Slippery road
Predicted label	13	25	25	27	17
Predicted Sign names	Yield	Road work	Road work	Pedestrians	No vehicles

The model was able to correctly guess 3 of the 5 traffic signs, which gives an accuracy of 60%. I don't understand why it gets me the wrong answer on image3. The wrong sign is quite different from the right one. But error on image 5 is forgivable. 2 sign looks pretty close due to the image is quite small.

I visualized the softmax probability for all 5 images.
As we can see, the network is pretty sure of it's predicting. 2 of 5 images got probability almost close to 1 on their answers. Rest 3 got probability than 0.8 on their answers.

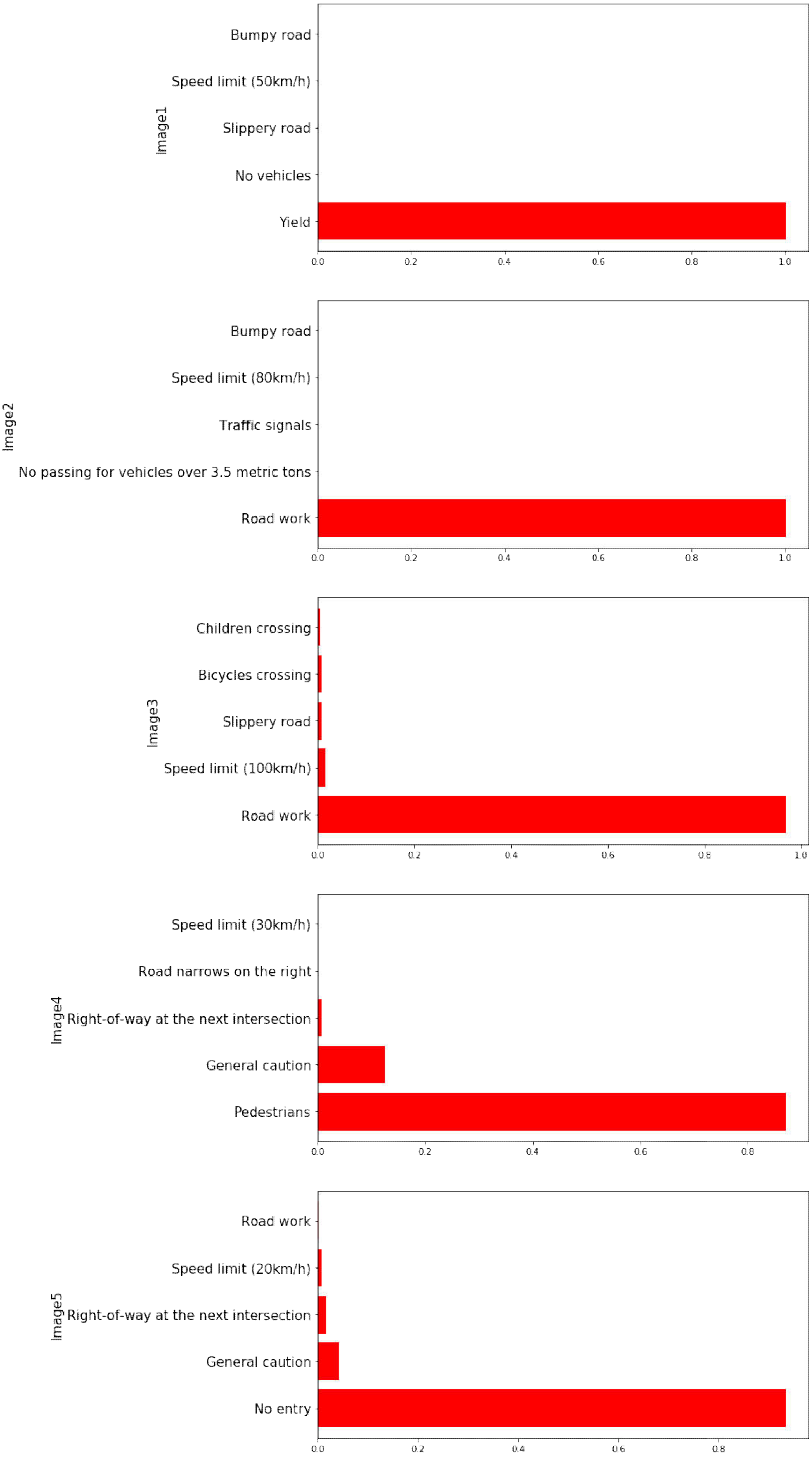


Image1
Bumpy road
Speed limit (50km/h)
Slippery road
No vehicles
Yield
0.0
0.2
0.4
0.6
0.8
1.0
Image2
Bumpy road
Speed limit (80km/h)
Traffic signals
No passing for vehicles over 3.5 metric tons
Road work
0.0
0.2
0.4
0.6
0.8
1.0
Image3
Children crossing
Bicycles crossing
Slippery road
Speed limit (100km/h)
Road work
0.0
0.2
0.4
0.6
0.8
1.0
Image4
Speed limit (30km/h)
Road narrows on the right
Right-of-way at the next intersection
General caution
Pedestrians
0.0
0.2
0.4
0.6
0.8
Image5
Road work
Speed limit (20km/h)
Right-of-way at the next intersection
General caution
No entry
0.0
0.2
0.4
0.6
0.8