Traffic Sign Recognition

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

Data Set Summary & Exploration

1. Provide a basic summary of the data set

   Number of training examples = 34799
   Number of testing examples = 12630
   Image data shape = (34799, 32, 32, 3)
   Number of classes = 43

2. Visualization of all types of data set

Design and Test a Model Architecture

1. Describe how you preprocess the image data.
   convert original images to gray and normalized images

2. Describe what your final model architecture
   My final model is a night-layer VGG-like CNN:

Layer	Input size	Output size	description
Conv1	32*32*1	30*30*16	strides=[1, 1, 1, 1]
Conv2	30*30*16	28*28*32	strides=[1, 1, 1, 1]
Pooling	28*28*32	14*14*32	strides=[1, 2, 2, 1]
Conv3	14*14*32	12*12*64	strides=[1, 1, 1, 1]
Conv4	12*12*64	10*10*128	strides=[1, 1, 1, 1]
Conv5	10*10*128	8*8*256	strides=[1, 1, 1, 1]
Pooling	8*8*256	4*4*256	strides=[1, 2, 2, 1]
FullConn6	4096	2400	
FullConn7	2400	800	
FullConn8	800	400	
FullConn9	400	43	

3. Describe how you trained your model.
   I used the AWS EC2 GPU to train my model.
   - learning_rate = 0.001
   - batch_size = 128
   - training_epochs = 35
   - mu = 0
   - sigma = 0.1

4. Describe the approach taken.

My final model results were:

- Validation set accuracy is 94.6%
- Test set accuracy is 93%

Test a Model on New Images

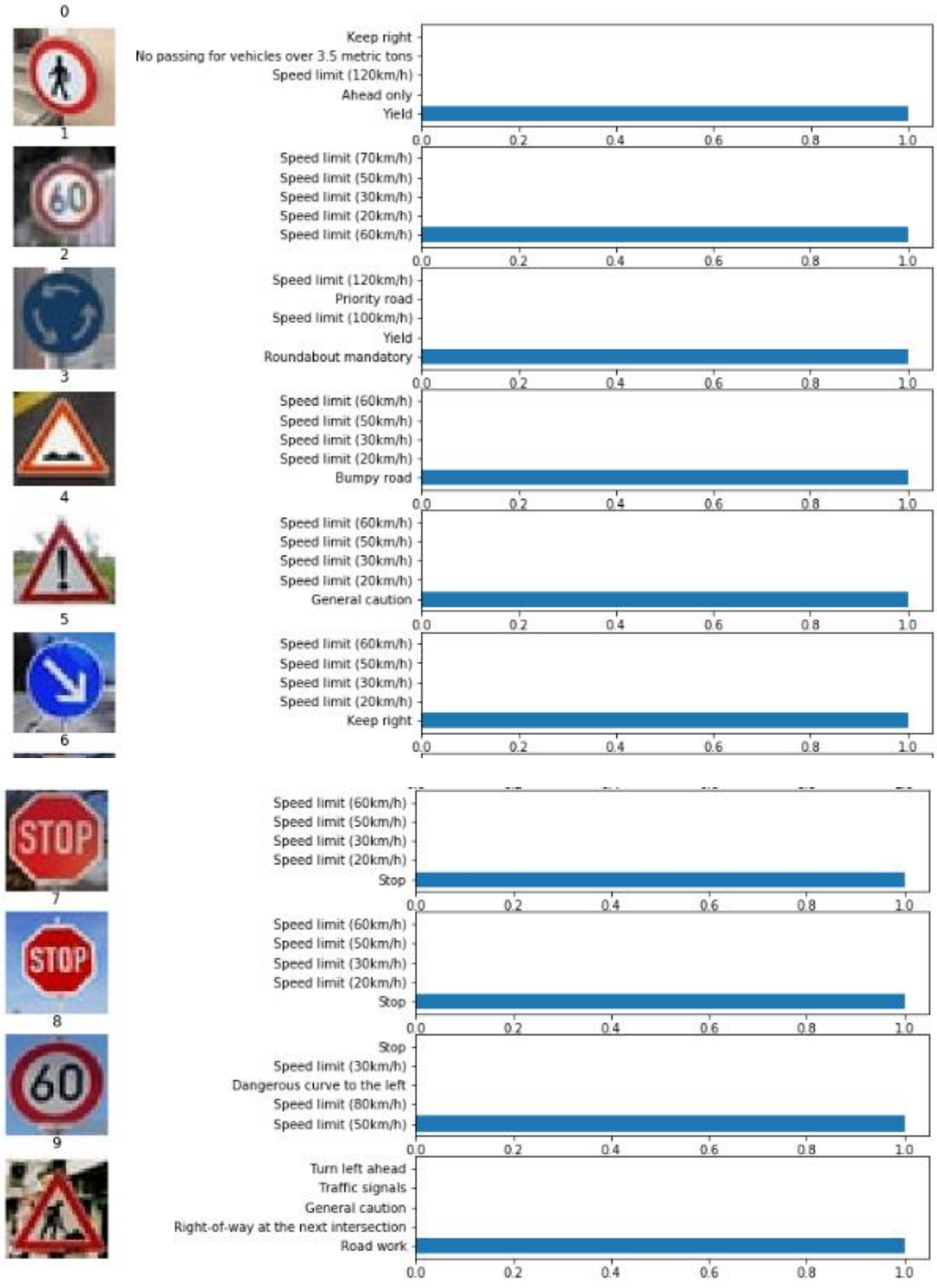
1. Choose ten German traffic signs online

2. Discuss the model's predictions on these new data

image	**prediction**
Yield	Yield
60km/h	60km/h
Roudabout mandatory	Roudabout mandatory
Bumpy road	Bumpy road
General caution	General caution
Keep right	Keep right
Stop	Stop
60km/h	50km/h
Road work	Road work

The model was able to correctly guess 9/10 traffic signs, which gives an accuracy of 90%

The top five soft max probabilities were:


0
Keep right
No passing for vehicles over 3.5 metric tons
Speed limit (120km/h)
Ahead only
Yield
1
Speed limit (70km/h)
Speed limit (50km/h)
Speed limit (30km/h)
Speed limit (20km/h)
Speed limit (60km/h)
2
Speed limit (120km/h)
Priority road
Speed limit (100km/h)
Yield
Roundabout mandatory
3
Speed limit (60km/h)
Speed limit (50km/h)
Speed limit (30km/h)
Speed limit (20km/h)
Bumpy road
4
Speed limit (60km/h)
Speed limit (50km/h)
Speed limit (30km/h)
Speed limit (20km/h)
General caution
5
Speed limit (60km/h)
Speed limit (50km/h)
Speed limit (30km/h)
Speed limit (20km/h)
Keep right
6
Speed limit (60km/h)
Speed limit (50km/h)
Speed limit (30km/h)
Speed limit (20km/h)
Stop
7
Speed limit (60km/h)
Speed limit (50km/h)
Speed limit (30km/h)
Speed limit (20km/h)
Stop
8
Stop
Speed limit (30km/h)
Dangerous curve to the left
Speed limit (80km/h)
Speed limit (50km/h)
9
Turn left ahead
Traffic signals
General caution
Right-of-way at the next intersection
Road work
0.0
0.2
0.4
0.6
0.8
1.0