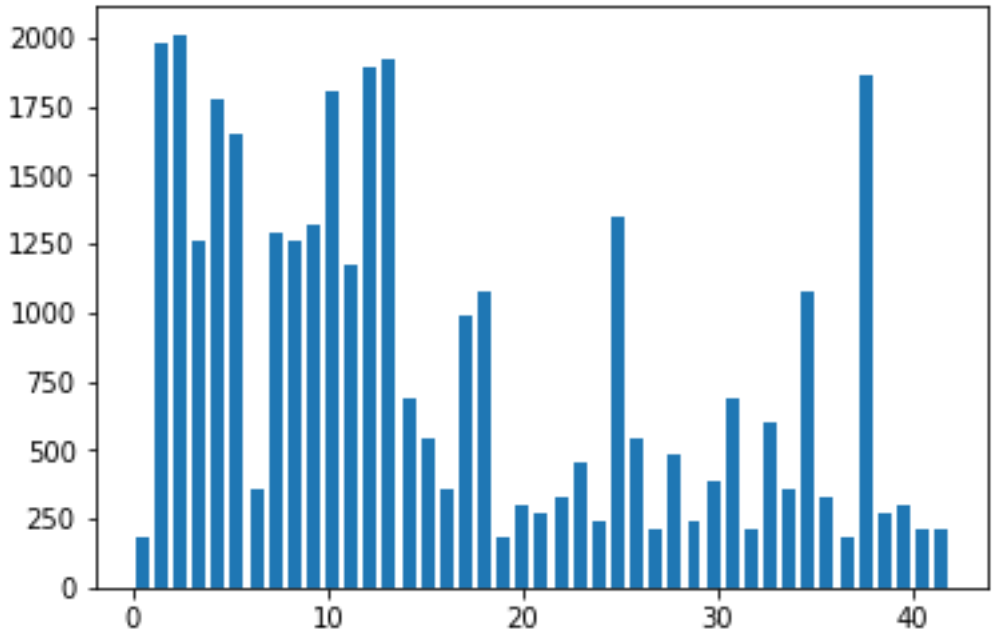
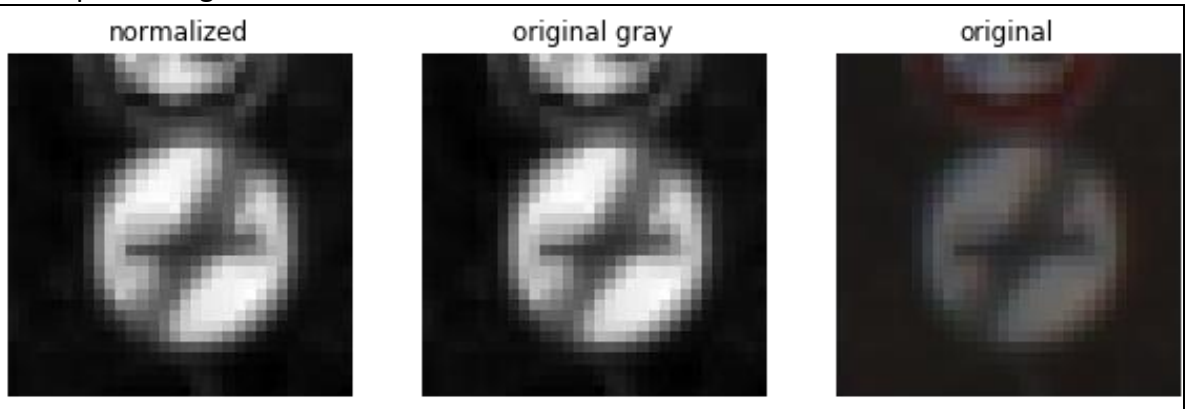
1. Data set summary:
    - Training set size: 34799
    - Validation set size: 4410
    - Test set size: 12630
    - Shape of input: pre-processing 32x32x3, post-processing 32x32x1.
    - Total number of classes: 43
2. Histogram of the data:



Plot showing the histogram of the data.

3. Preprocessing:



From left to right: normalized grayscale image, grayscale image, original color image.

4. Model description:

Input	32x32x1 pre-processed
Convolution layer	32x32x1 to 28x28x6

Relu	
Max pool	28x28x6 to 14x14x6
Convolution layer	14x14x6 to 10x10x16
Relu	
Max pool	10x10x16 to 5x5x16
Flatten layer	5x5x16 to 400
Fully connected layer	400 to 120
Relu	
Dropout	0.5 keep probability
Fully connected layer	120 to 84
Relu	
Dropout	0.5 keep probability
Fully connected layer	84 to 43

- Optimizer: Adam
- Batch size: 128
- Number of epochs: 60 (after 30, there is no significant improvement. So 30 will do.)
- Learning rate: 0.001

5. Final model results:

- Validation accuracy: 95.7 %
- Test accuracy: 93.9 %

I initially choose plain LeNet model and the accuracy wasn't great so I modified it by adding few dropout layers.

6. Test images and results

The following are the test images that I got from the web.
All the images were classified correctly. Accuracy was 100% on these images as they are clear without any distortions.

7. Soft max probabilities:

0  1  2  3  4 	Test image # 0 top guess: 3 (100.000%) 2nd guess: 23 (0.000%) 3rd guess: 2 (0.000%) 4th guess: 5 (0.000%) 5th guess: 19 (0.000%) Test image # 1 top guess: 38 (100.000%) 2nd guess: 0 (0.000%) 3rd guess: 1 (0.000%) 4th guess: 2 (0.000%) 5th guess: 3 (0.000%) Test image # 2 top guess: 11 (100.000%) 2nd guess: 30 (0.000%) 3rd guess: 1 (0.000%) 4th guess: 21 (0.000%) 5th guess: 12 (0.000%) Test image # 3 top guess: 25 (91.988%) 2nd guess: 10 (4.822%) 3rd guess: 18 (2.132%) 4th guess: 20 (0.541%) 5th guess: 26 (0.464%) Test image # 4 top guess: 12 (100.000%) 2nd guess: 40 (0.000%) 3rd guess: 42 (0.000%) 4th guess: 41 (0.000%) 5th guess: 13 (0.000%)