Traffic sign detection and recognition using capsule networks

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Agenda

- Importance of traffic sign detection and recognition
- Dataset
- Our implementation using Capsule Network
- Our implementation using Convolutional Neural Network

Traffic sign detection

- Increased importance of automobiles
  - More dense and complex traffic
  - Bigger number of annual traffic accidents
  - Most common causes of car accidents: distracted driving, reckless driving, speeding
- Advanced driver-assistance systems (ADAS) for increasing car and road safety
  - Traffic sign recognition
  - Interesting as it depends on the lighting conditions, weather conditions and also presence of other objects

Dataset

- **German Traffic Sign Recognition Benchmark dataset**
  - More than **50000 images** in total
  - More than **40** different **classes**
  - Each **class** represents a **meaning of a traffic sign**: “Stop”, “Speed limit (20km/h)” etc.
  - Each image only includes one traffic sign
  - Size of the images varies
  - Traffic sign might not be in the center of the image

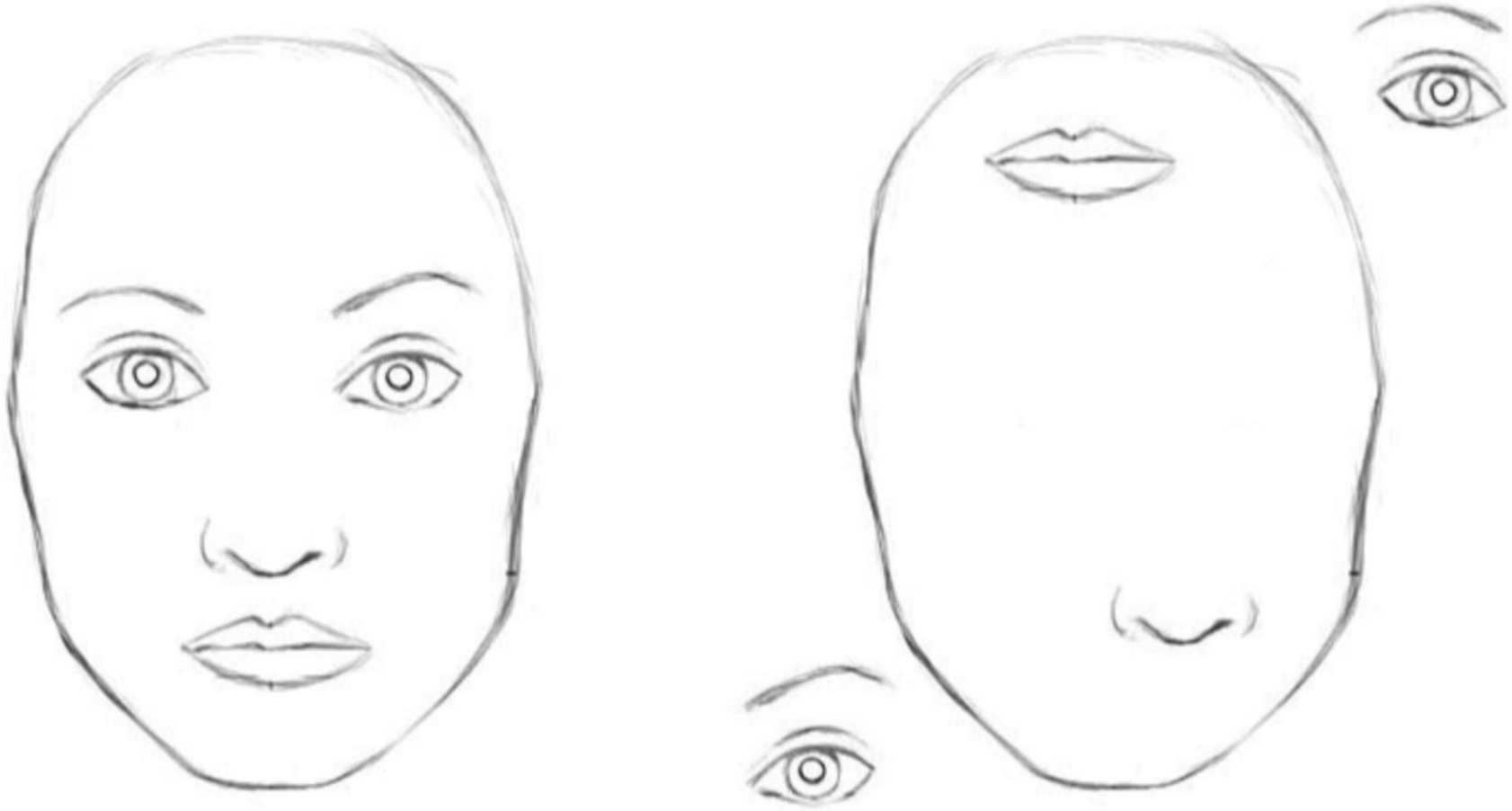


Capsule Network

Traffic Sign Prediction using Capsule Networks

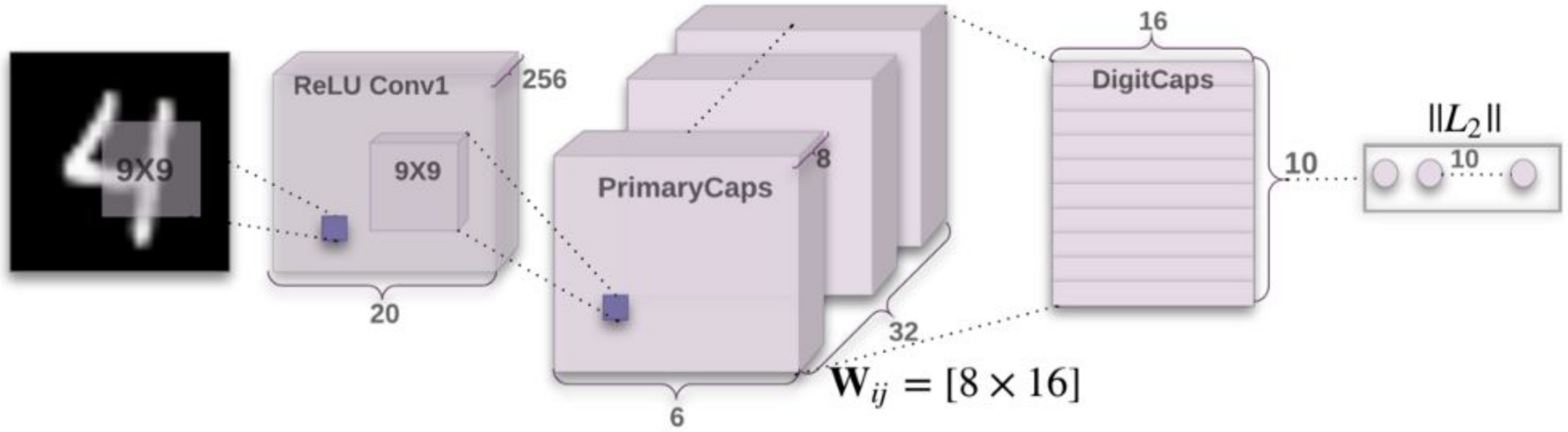
Convolutional vs CapsNet

Convolutional Neural Networks DO NOT consider the relational positions of the components



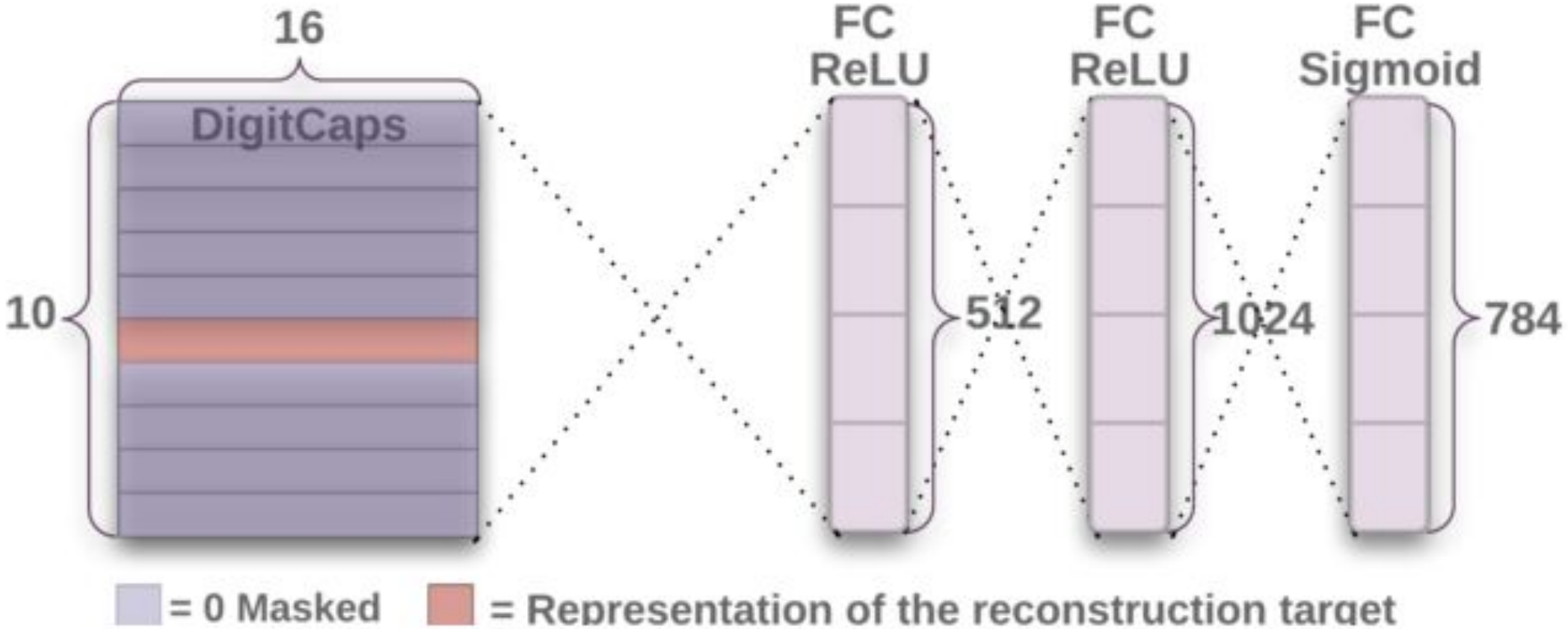
CapsNet Encoder

- Output size of DigitCaps for Traffic Sign Dataset: [43, 16].
- Largest vector is the predicted class.



https://towardsdatascience.com/capsule-networks-the-new-deep-learning-network-bd917e6818e8

CapsNet Decoder



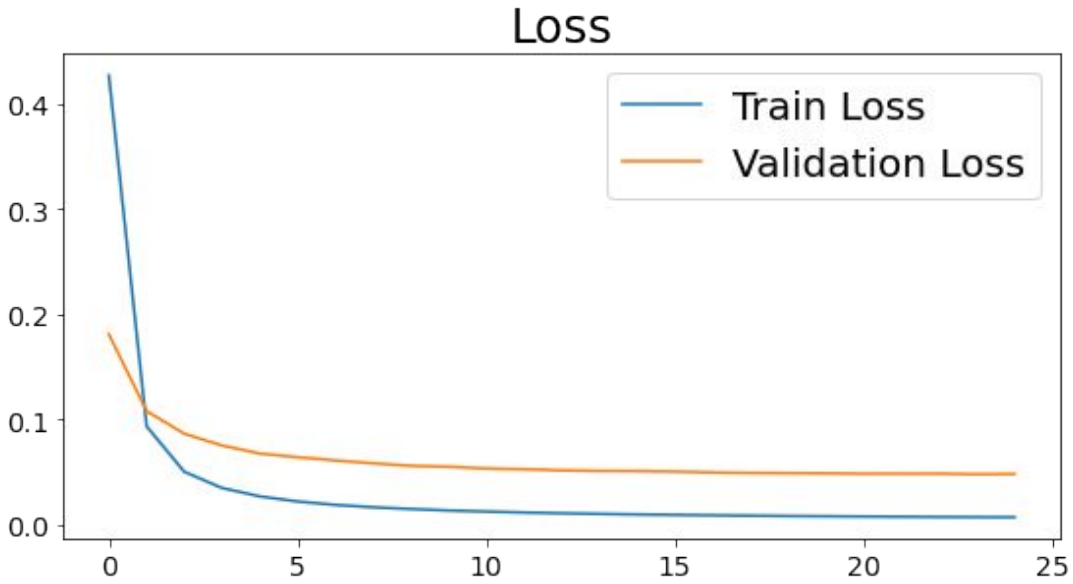
https://towardsdatascience.com/capsule-networks-the-new-deep-learning-network-bd917e6818e8

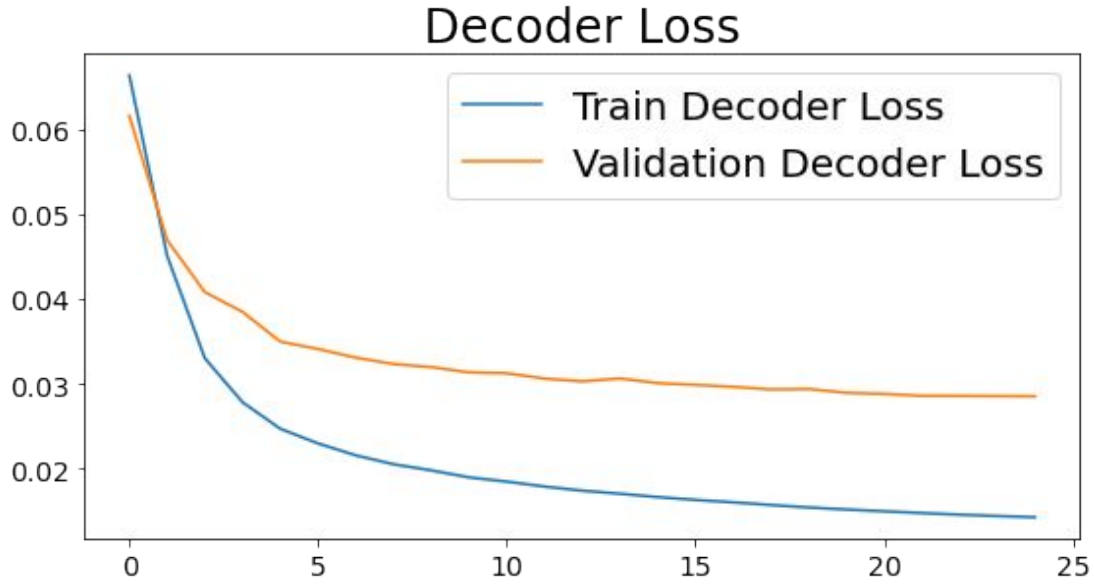
CapsNet Decoder for our dataset

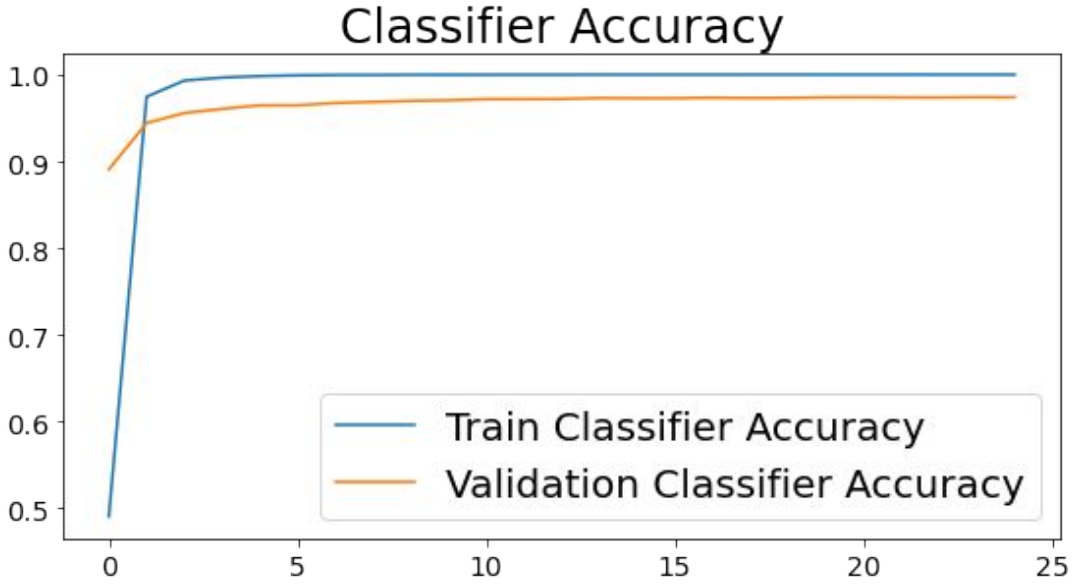
- `Dense(512, activation='relu', input_dim= 43 * 16 )`
- `Dense(1024, activation='relu')`
- `Dense(4096, activation='relu')`
- `Dense((56 * 56 * 3), activation='sigmoid')`
- `Reshape(target_shape=(56, 56, 3))`

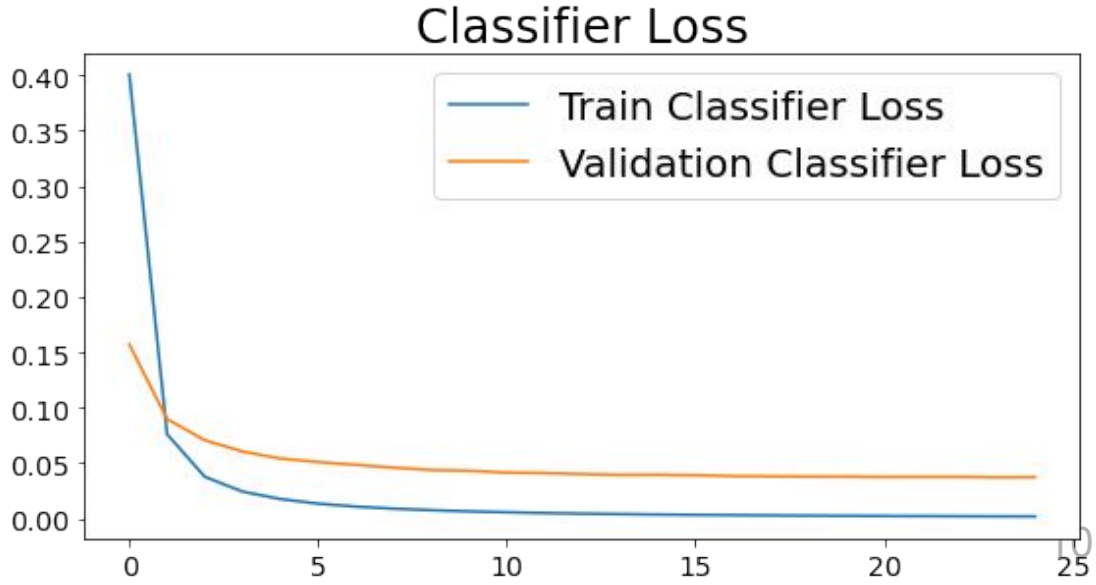
Link to the Jupyter Notebook: https://colab.research.google.com/drive/1lFe-L7AI0cG7CQsr_qhDoCtHLOHJynVC

CapsNet Training Log Plot









CapsNet Accuracy and F1-Score

- Train
  - Accuracy: 100 %
  - F1-score: 100 %
- Validation
  - Accuracy: 96 %
  - F1-score: 92 %
- Test
  - Accuracy: 97 %
  - F1-score: 95 %

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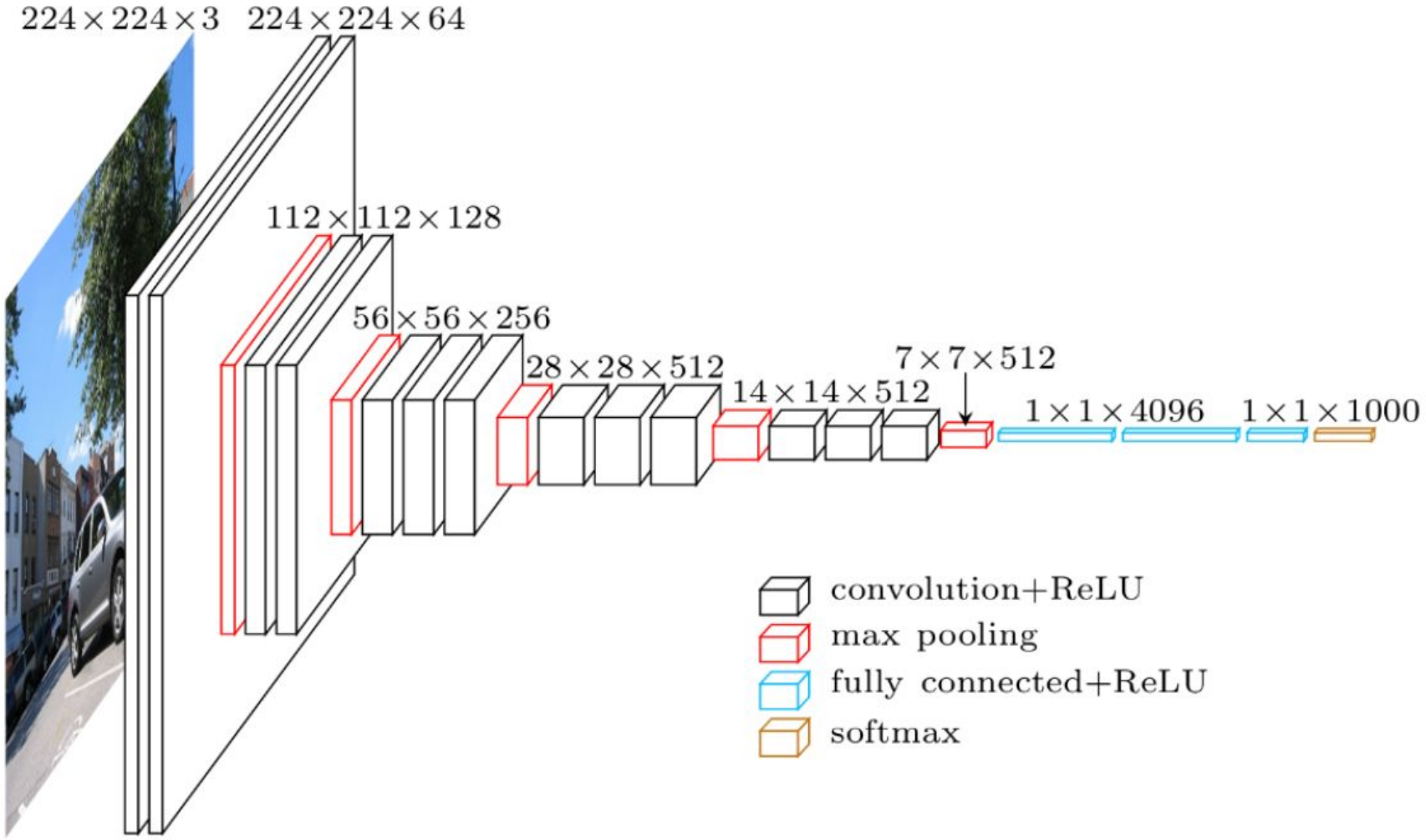
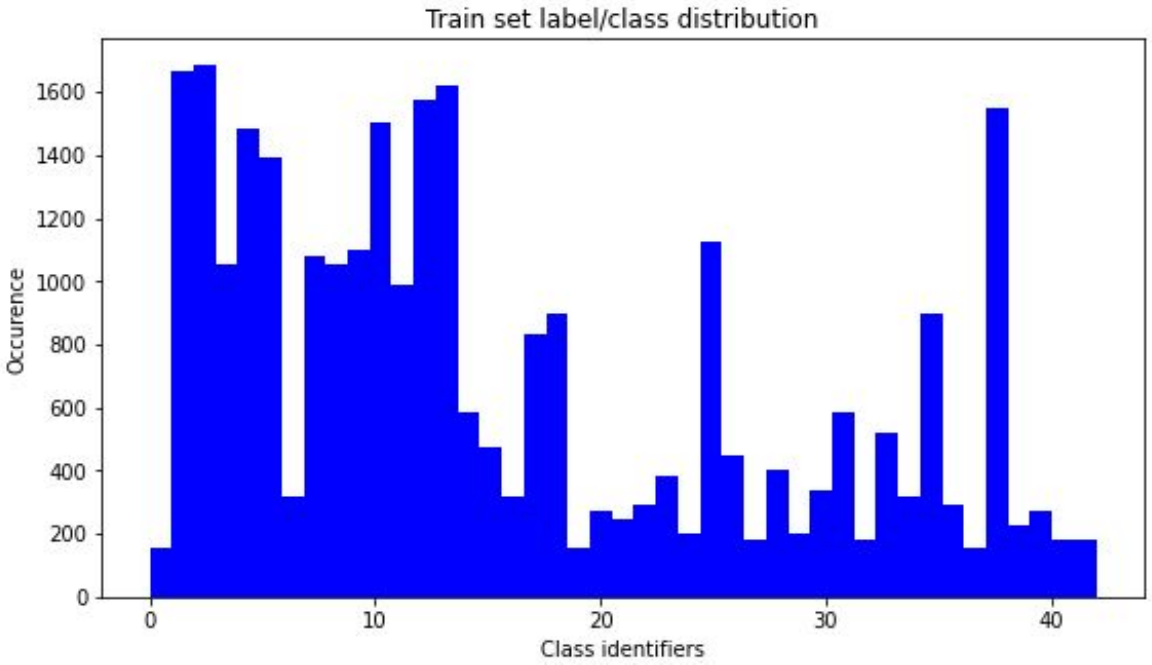
Convolutional Neural Network

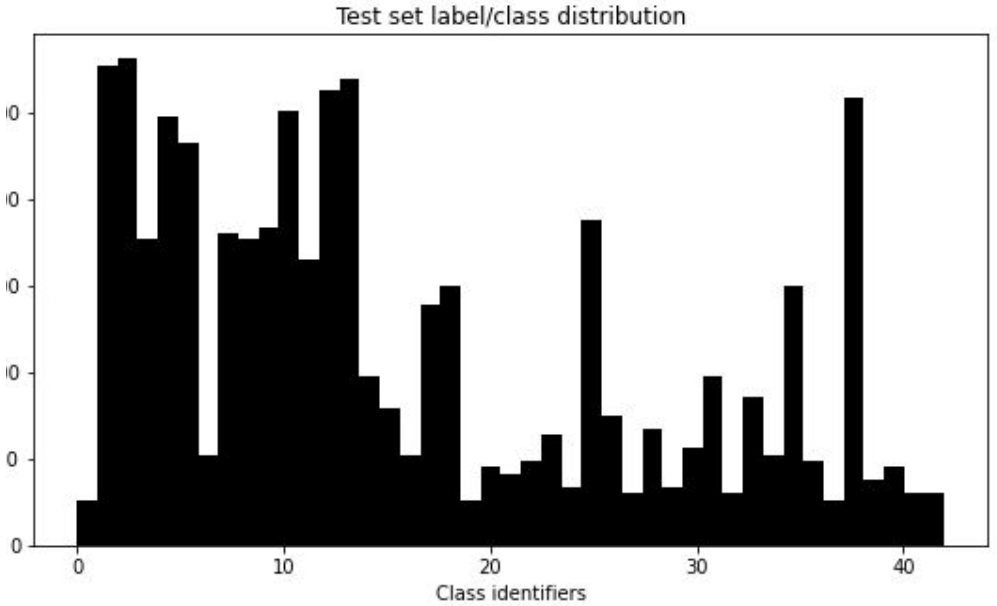
Traffic Sign Classification using CNN

Very Deep Convolutional Networks for Large-Scale Image Recognition

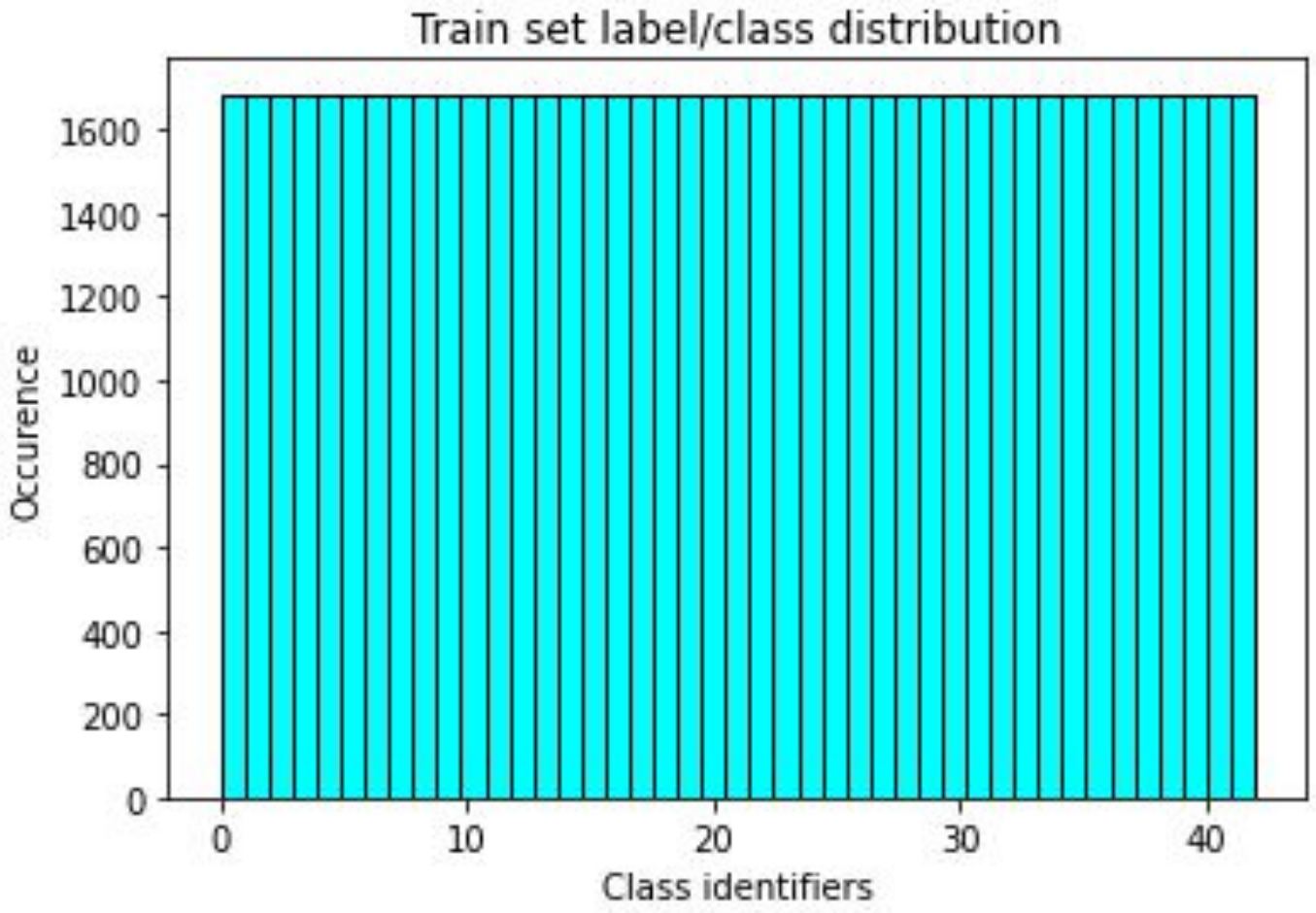


Dataset skewness

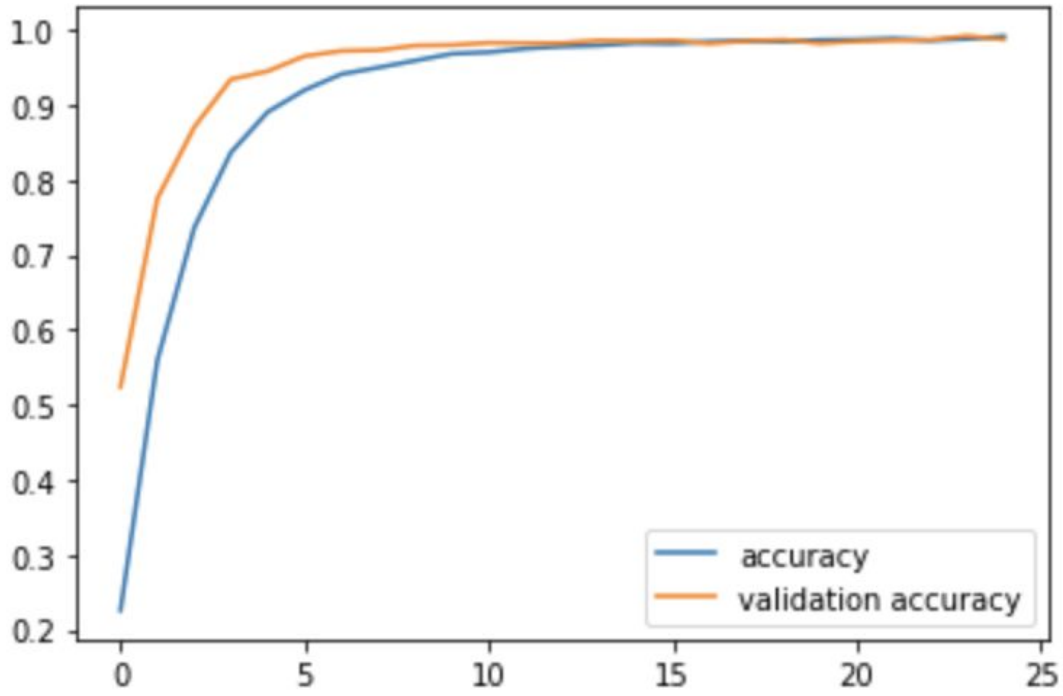


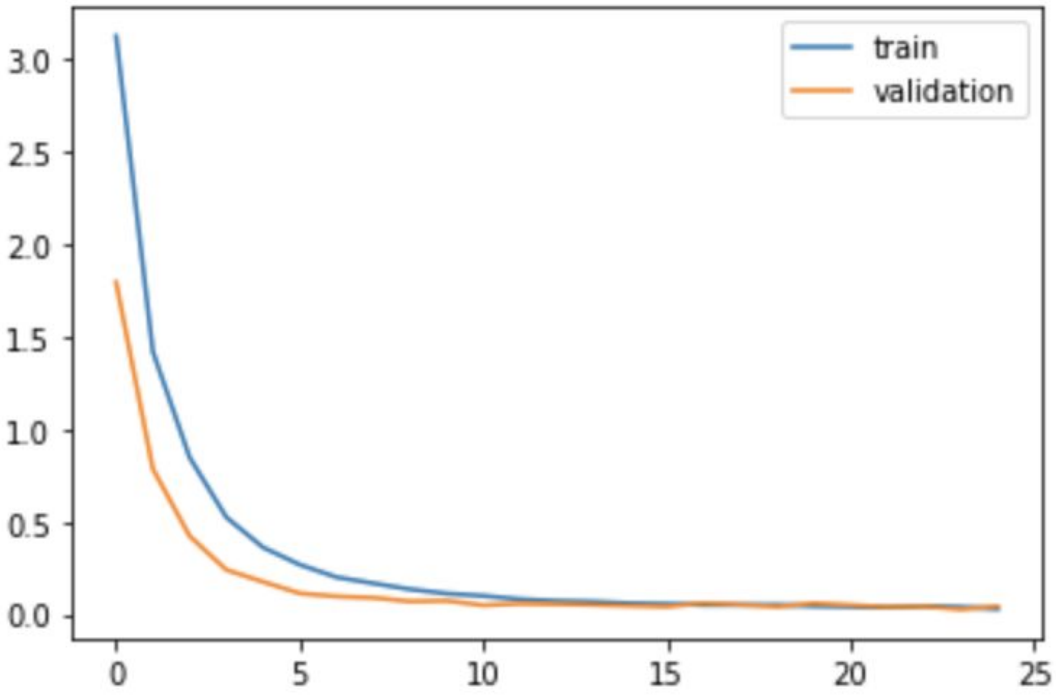


Train data after oversampling



Training for 25 epochs

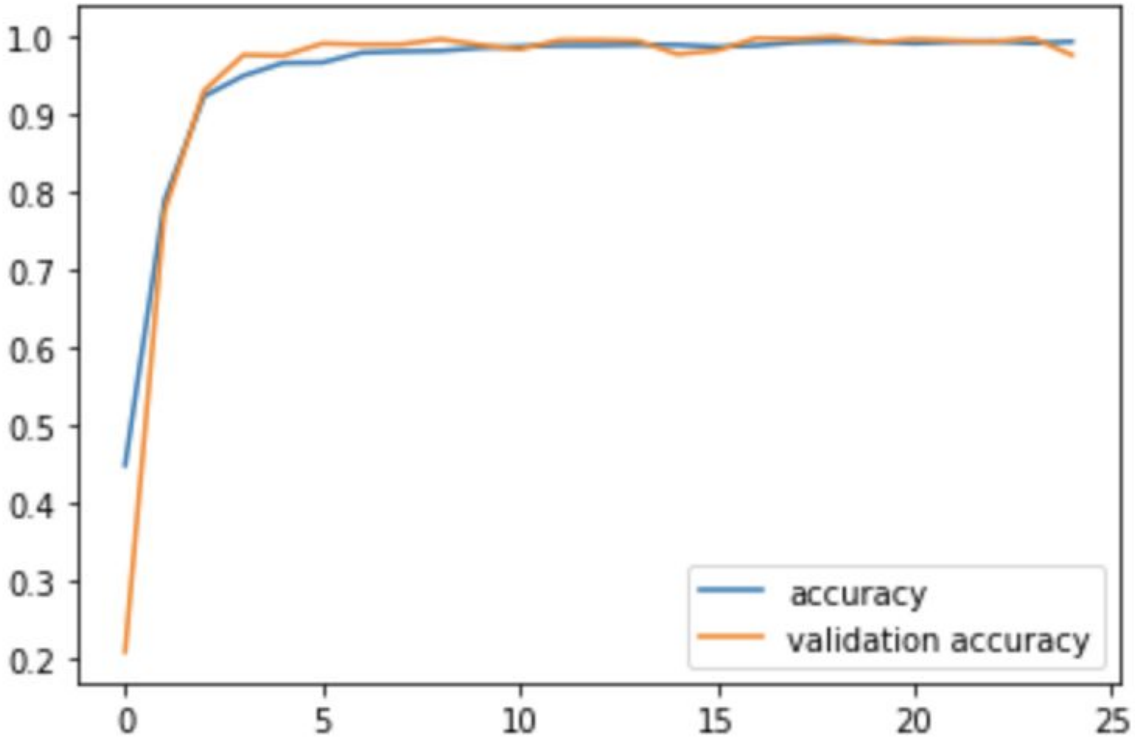


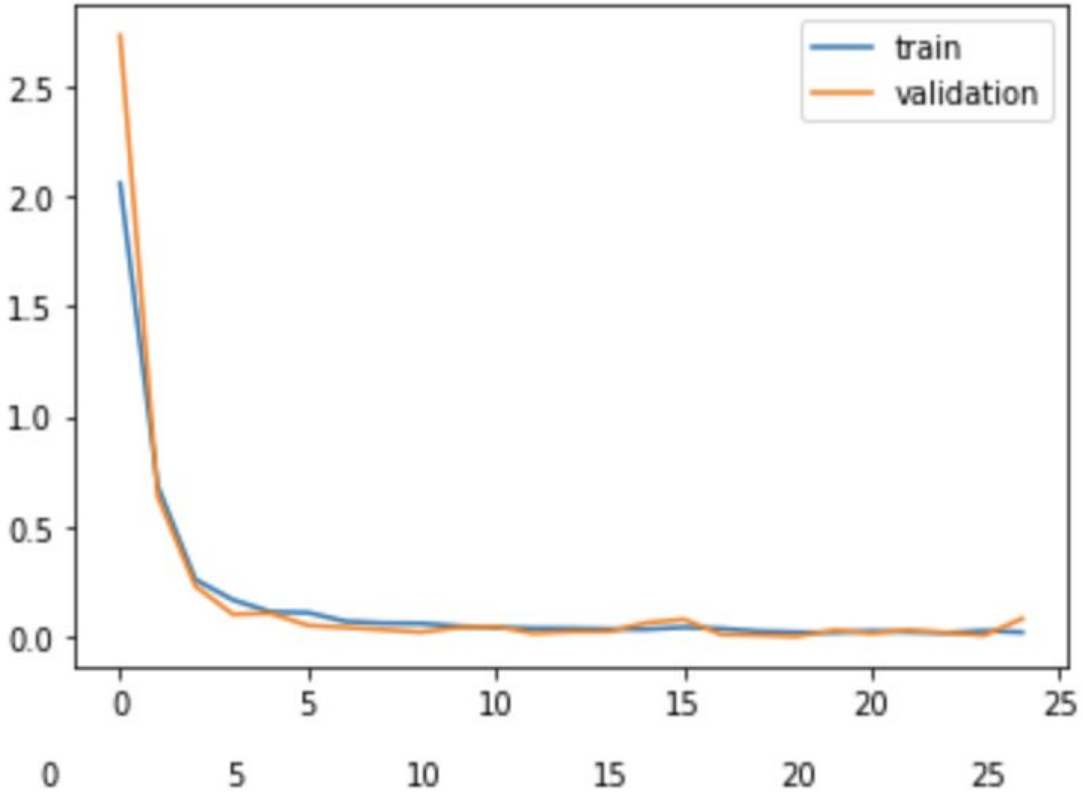


loss: 0.0373
accuracy: 0.9883

validation loss: 0.0442
validation accuracy: 0.9847

Training for 25 epochs of oversampled data





loss: 0.0110
accuracy: 0.9964

validation loss: 0.0024
validation accuracy: 0.9986

Accuracy

Test accuracy: 0.9883

Test accuracy on oversampled data: 0.9942

Thank you
for your attention!