Indian Institute of Technology Jodhpur

CNN Model on MNIST Handwritten Digit Classification Dataset

Submitted by

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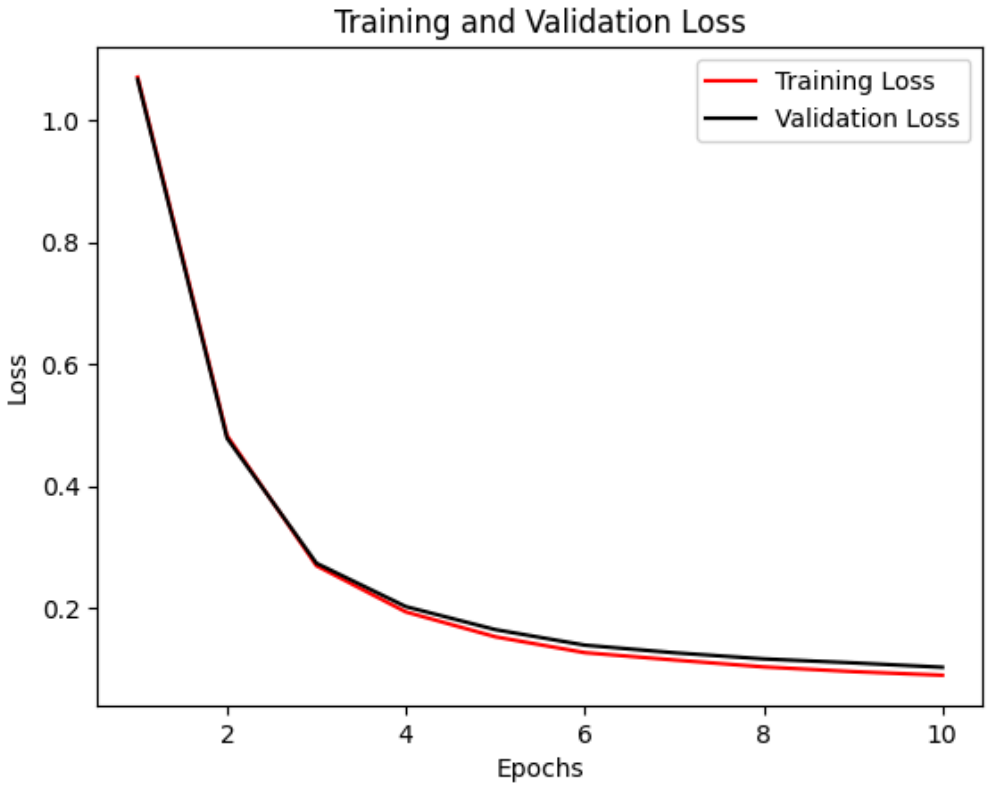
Google colab link:
https://colab.research.google.com/drive/1gJTV_xUi-cAFbXJ5wU_HK0OkzOXIpiBY?usp=sharing
Each file is extracted on a local machine and then the IDX file is converted to tensor.

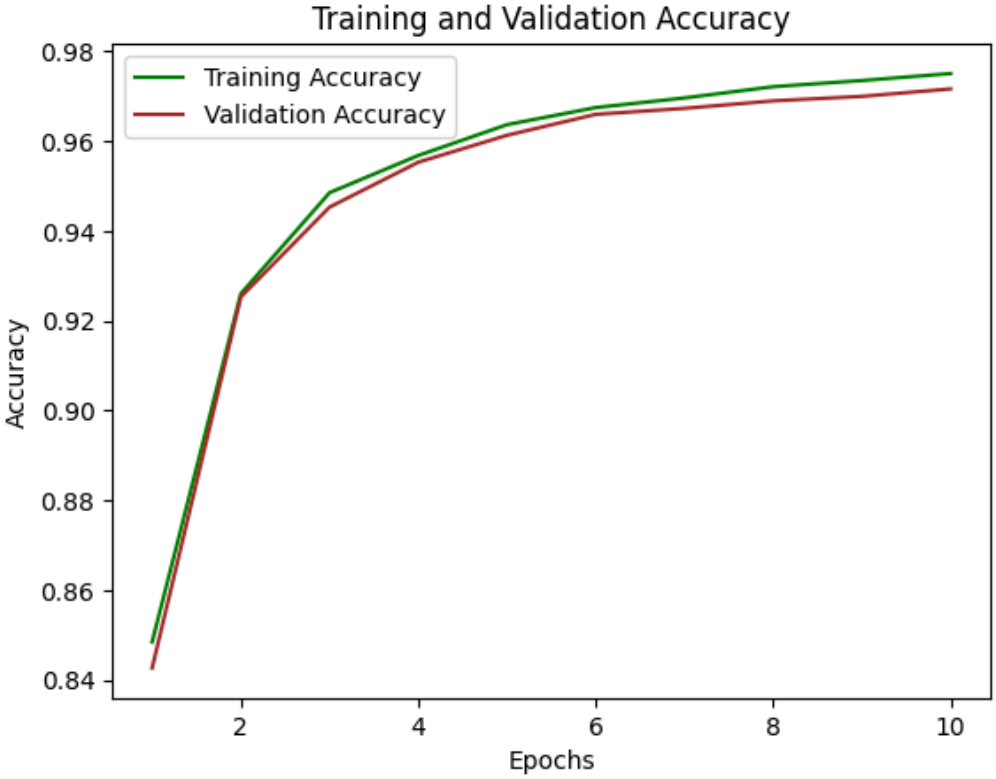
Task 1

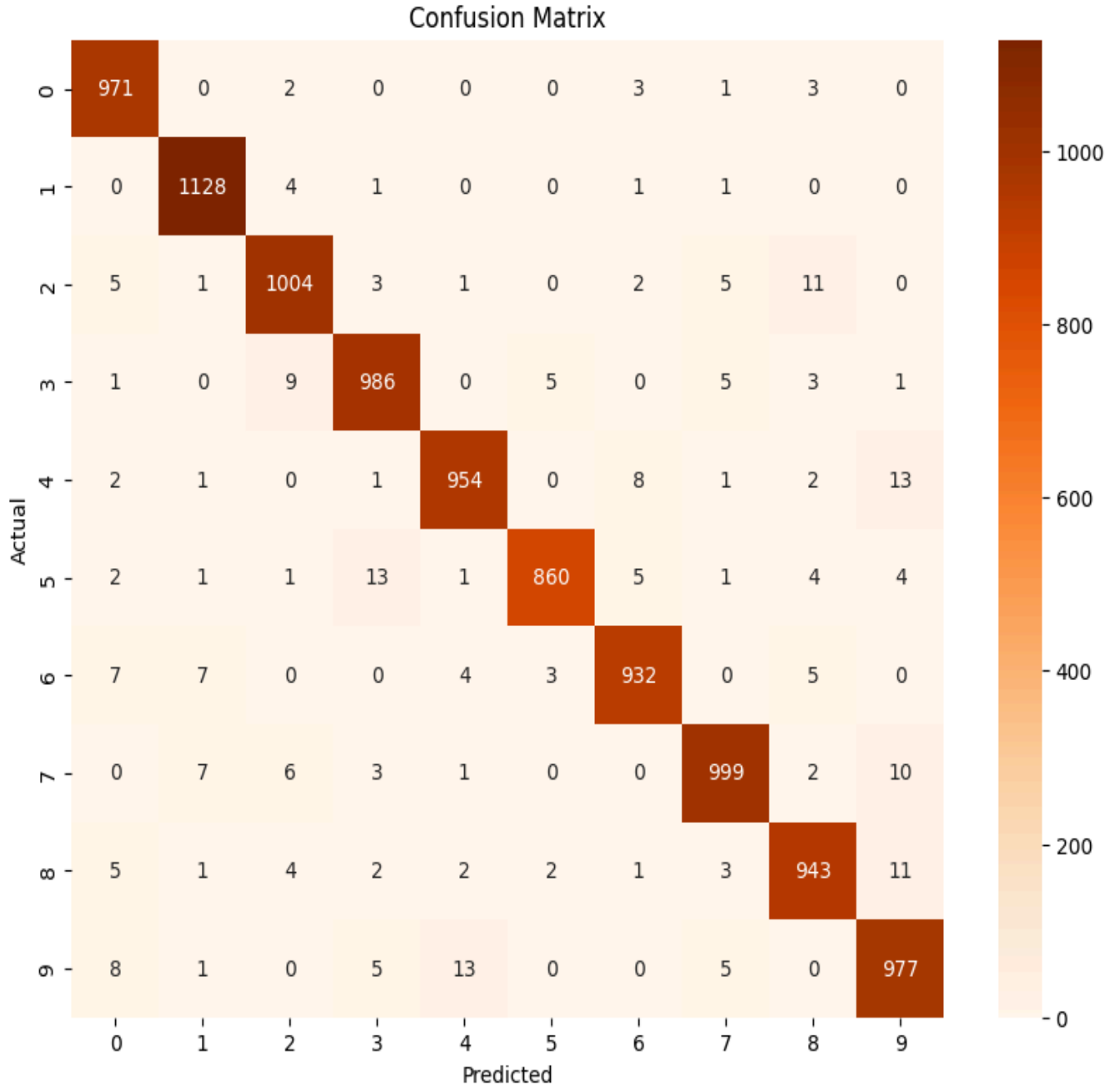
Number of training data points = 57000
Number of validation data points = 3000
Number of test data points = 10000
Total epoch = 10
Test Loss: 0.0856, Test Accuracy: 97.54%

Loss and accuracy after each epoch are as below:

Epoch:1
 Training Loss :1.0702, Training Accuracy :84.85%
 Validation Loss:1.0662, Validation Accuracy:84.27%
Epoch:2
 Training Loss :0.4830, Training Accuracy :92.61%
 Validation Loss:0.4787, Validation Accuracy:92.53%
Epoch:3
 Training Loss :0.2697, Training Accuracy :94.85%
 Validation Loss:0.2739, Validation Accuracy:94.53%
Epoch:4
 Training Loss :0.1941, Training Accuracy :95.68%
 Validation Loss:0.2028, Validation Accuracy:95.53%
Epoch:5
 Training Loss :0.1534, Training Accuracy :96.37%
 Validation Loss:0.1651, Validation Accuracy:96.13%
Epoch:6
 Training Loss :0.1274, Training Accuracy :96.75%
 Validation Loss:0.1397, Validation Accuracy:96.60%
Epoch:7
 Training Loss :0.1153, Training Accuracy :96.96%
 Validation Loss:0.1273, Validation Accuracy:96.73%
Epoch:8
 Training Loss :0.1040, Training Accuracy :97.22%
 Validation Loss:0.1171, Validation Accuracy:96.90%
Epoch:9
 Training Loss :0.0963, Training Accuracy :97.35%
 Validation Loss:0.1107, Validation Accuracy:97.00%
Epoch:10
 Training Loss :0.0904, Training Accuracy :97.51%
 Validation Loss:0.1035, Validation Accuracy:97.17%


Training and Validation Loss
Training Loss
Validation Loss
Loss
1.0
0.8
0.6
0.4
0.2
2
4
6
8
10
Epochs


Training and Validation Accuracy
Training Accuracy
Validation Accuracy
Accuracy
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.84
2
4
6
8
10
Epochs



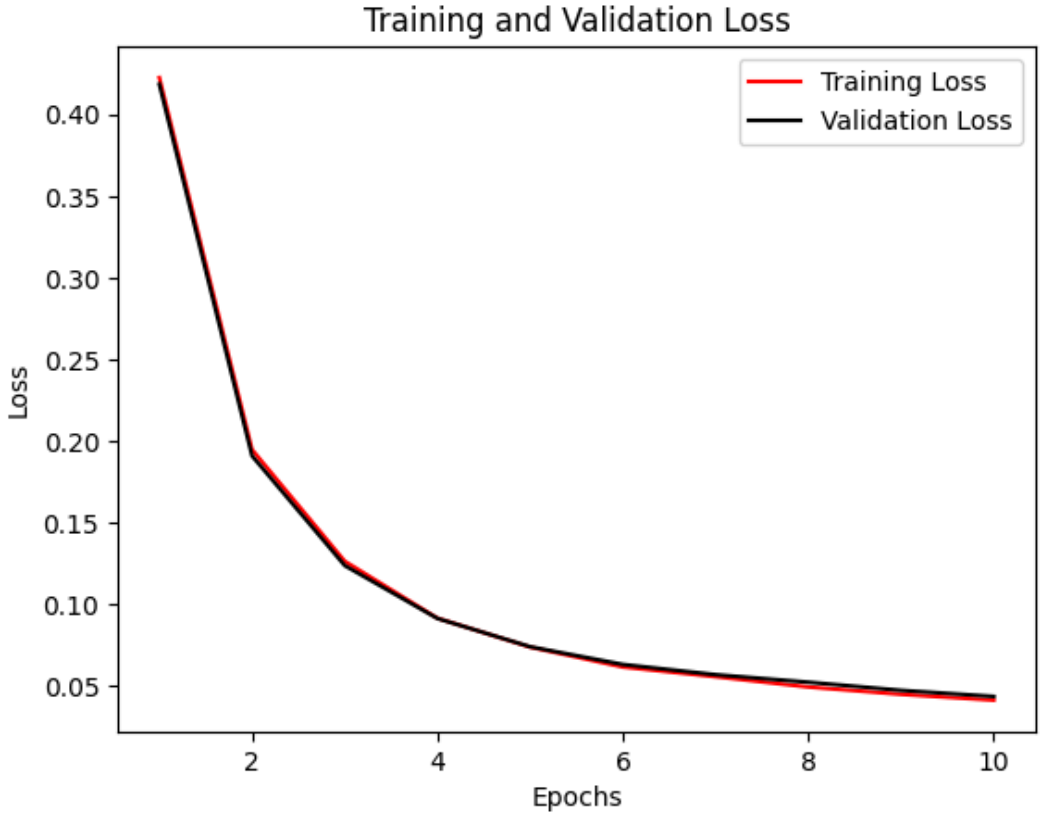
Number of trainable parameters: 4726
Number of non-trainable parameters: 7840

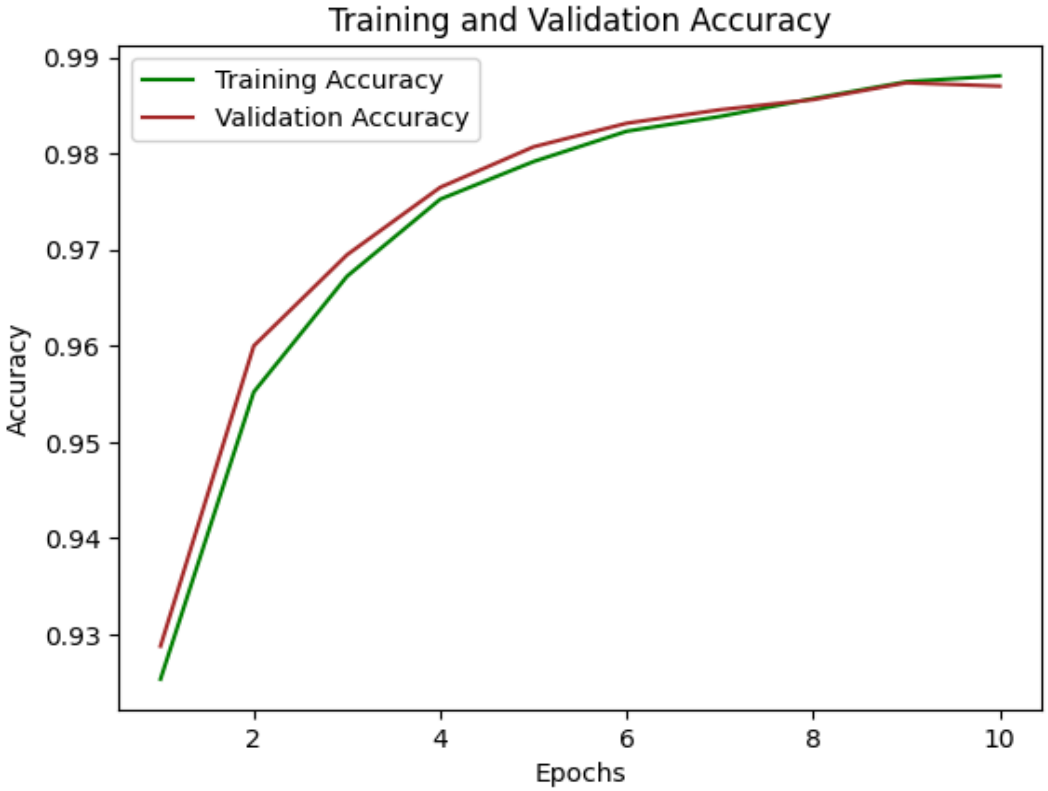
Task 2

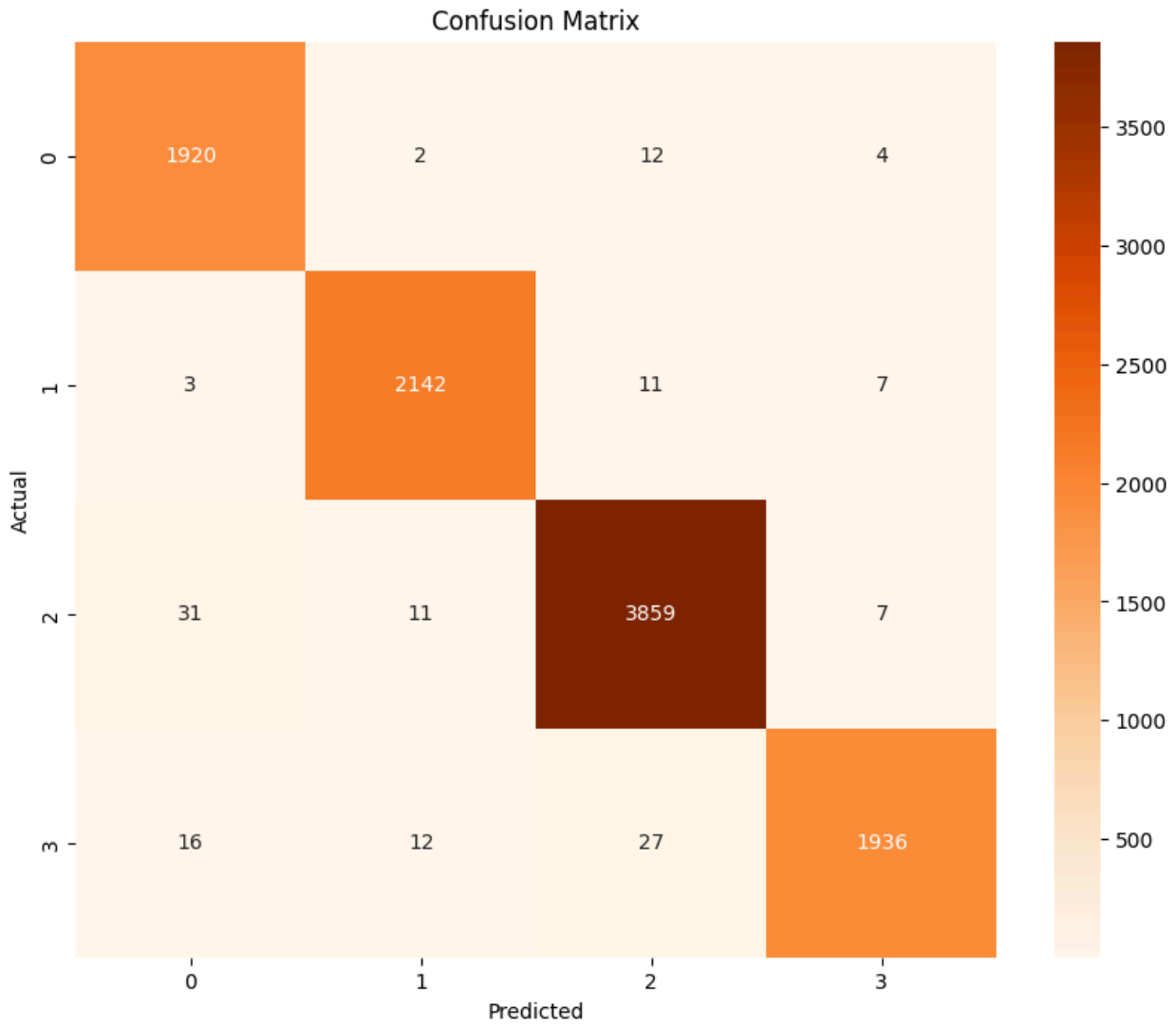
Number of training data points = 57000
Number of validation data points = 3000
Number of test data points = 10000
Total epoch = 10
Test Loss: 0.0427, Test Accuracy: 98.57%

Loss and accuracy after each epoch are as below:

Epoch:1
 Training Loss :0.4225, Training Accuracy :92.53%
 Validation Loss:0.4185, Validation Accuracy:92.88%
Epoch:2
 Training Loss :0.1947, Training Accuracy :95.52%
 Validation Loss:0.1909, Validation Accuracy:96.00%
Epoch:3
 Training Loss :0.1263, Training Accuracy :96.72%
 Validation Loss:0.1237, Validation Accuracy:96.95%
Epoch:4
 Training Loss :0.0915, Training Accuracy :97.53%
 Validation Loss:0.0913, Validation Accuracy:97.65%
Epoch:5
 Training Loss :0.0737, Training Accuracy :97.92%
 Validation Loss:0.0740, Validation Accuracy:98.07%
Epoch:6
 Training Loss :0.0616, Training Accuracy :98.23%
 Validation Loss:0.0631, Validation Accuracy:98.32%
Epoch:7
 Training Loss :0.0556, Training Accuracy :98.39%
 Validation Loss:0.0569, Validation Accuracy:98.46%
Epoch:8
 Training Loss :0.0493, Training Accuracy :98.57%
 Validation Loss:0.0523, Validation Accuracy:98.56%
Epoch:9
 Training Loss :0.0448, Training Accuracy :98.75%
 Validation Loss:0.0473, Validation Accuracy:98.74%
Epoch:10
 Training Loss :0.0413, Training Accuracy :98.81%
 Validation Loss:0.0435, Validation Accuracy:98.70%


Training and Validation Loss
Training Loss
Validation Loss
Loss
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
2
4
6
8
10
Epochs


Training and Validation Accuracy
Training Accuracy
Validation Accuracy
Accuracy
0.99
0.98
0.97
0.96
0.95
0.94
0.93
2
4
6
8
10
Epochs



Number of trainable parameters: 4504
Number of non_trainable parameters: 7840

To avoid overfitting batch normalization and drop out through the first two convolution layers has been done and it gives satisfying results on train, test and validation datasets.