MNIST Digit Classifier - Report

Key Findings:

The CNN-based classifier demonstrated excellent performance on the MNIST dataset, achieving over 99.4% training accuracy within just 5 epochs. The training loss decreased steadily, indicating effective learning. The confusion matrix indicates that most digits were classified correctly, with very few misclassifications.

Model Architecture and Design Choices:

The implemented model is a Convolutional Neural Network (CNN), which is well-suited for image data. The architecture includes:

- Two convolutional layers for local feature extraction.

- ReLU activations to introduce non-linearity.

- MaxPooling layers to reduce dimensionality.

- Fully connected layers to classify extracted features into 10 digit classes.

This design choice significantly boosts performance compared to a simple Feedforward Neural Network due to CNN's ability to learn spatial hierarchies in images.

Confusion Matrix Analysis:

The confusion matrix shows high classification accuracy across all digits. Some observed misclassifications:

- Digit '5' is occasionally confused with '3' and '8', possibly due to similar curvature in handwritten forms.

- Digit '9' sometimes gets confused with '4', likely due to sharp strokes in certain handwriting styles.

- Digits '7' and '1' have minor confusion, which is common due to similar vertical structures. These misclassifications are minimal and expected given handwriting variability.

Training Plots:

Training Loss

Training Accuracy

Confusion Matrix

	0	1	2	3	4	5	6	7	8	9
0	977	1	0	0	0	0	0	1	1	0
1	0	1131	1	1	0	0	0	1	0	1
2	1	2	1022	0	1	0	0	3	3	0
3	0	0	1	1005	0	3	0	1	0	0
4	0	0	0	0	975	0	1	0	0	6
5	2	0	0	6	0	881	1	0	1	1
6	4	2	0	0	2	2	948	0	0	0
7	0	6	2	0	0	0	0	1015	1	4
8	3	0	1	1	0	2	0	1	963	3
9	2	0	0	0	3	1	0	0	1	1002