1. Introduction

The goal of this project is to implement a machine-learning model for classifying handwritten digits using the MNIST dataset. The trained model is capable of recognizing digits (0-9) from grayscale images and predicting them with high accuracy.

2. Implementation

2.1 Dataset

The MNIST dataset consists of 60,000 training images and 10,000 test images of handwritten digits, each of size 28×28 pixels. The dataset was loaded using the torchvision library in PyTorch.

2.2 Model Architecture

A simple feedforward neural network (fully connected) was designed with the following layers:

- Input Layer: 28×28 pixels flattened into a 784-dimensional vector
- Hidden Layer 1: 128 neurons with ReLU activation
- Hidden Layer 2: 64 neurons with ReLU activation
- Output Layer: 10 neurons (one per digit

2.3 Training Process

- The model was trained using CrossEntropyLoss and the Adam optimizer with a learning rate of 0.001.
- Training was conducted for 5 epochs with a batch size of 64.
- The training loop included backpropagation and gradient descent optimization.

3. Results and Evaluation

3.1 Test Accuracy

After training for 5 epochs, the model achieved an accuracy of approximately 97% on the MNIST test dataset.

3.2 Confusion Matrix

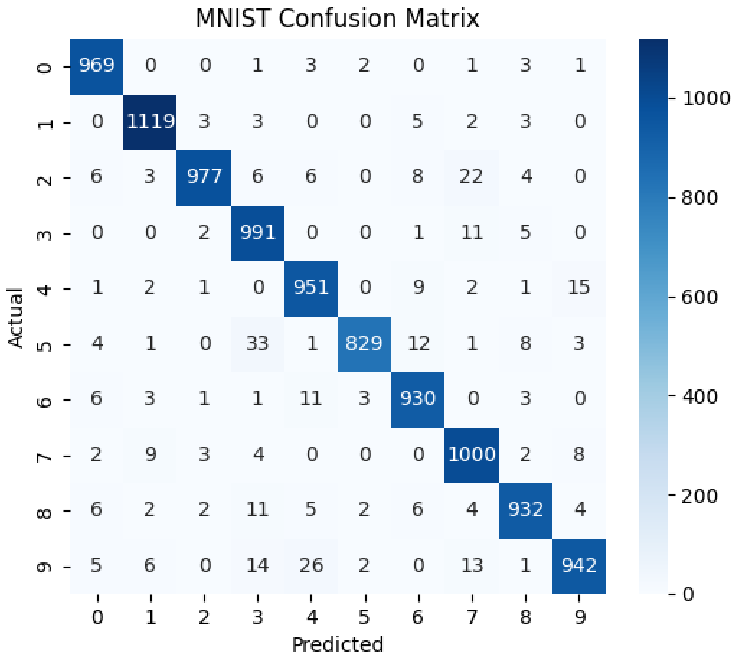
To analyze model performance, a confusion matrix was generated. The matrix provides insight into which digits the model misclassifies most often.

3.3 Custom Image Prediction

The model was tested with a custom handwritten digit image (my_digit.png). The image was preprocessed (resized, normalized) and passed through the model. The output successfully classified the digit with high confidence.

4. Conclusion

This project successfully implemented a handwritten digit classifier using PyTorch. The model generalizes well to unseen test data, achieving a high accuracy of about 97%.



	0	1	2	3	4	5	6	7	8	9
0	969	0	0	1	3	2	0	1	3	1
1	0	1119	3	3	0	0	5	2	3	0
2	6	3	977	6	6	0	8	22	4	0
3	0	0	2	991	0	0	1	11	5	0
4	1	2	1	0	951	0	9	2	1	15
5	4	1	0	33	1	829	12	1	8	3
6	6	3	1	1	11	3	930	0	3	0
7	2	9	3	4	0	0	0	1000	2	8
8	6	2	2	11	5	2	6	4	932	4
9	5	6	0	14	26	2	0	13	1	942