MNIST Digit Classifier – Report (Feedforward Neural Network)

Objective

To train a neural network using **PyTorch** that can accurately classify handwritten digits (0–9) from the MNIST dataset. The model should be evaluated for accuracy and performance using appropriate visualizations.

Model Architecture and Design Choices

- **Model Type**: Feedforward Neural Network (Fully Connected)

- **Input Layer**: 28×28 image flattened to a 784-dimensional vector

- **Hidden Layers**:

    - Layer 1: 128 neurons + ReLU

    - Layer 2: 64 neurons + ReLU

- **Output Layer**: 10 neurons (one for each digit class)

- **Loss Function**: CrossEntropyLoss (suitable for multi-class classification)

- **Optimizer**: Adam with learning rate = 0.001

- **Training Epochs**: 10

- **Batch Size**: 64

- **Data Normalization**: Mean = 0.1307, Std = 0.3081 (MNIST standard)

Key Findings

- The model achieved **97.35% test accuracy** after 10 epochs of training.

- The training loss consistently decreased over epochs, indicating good convergence.

- The confusion matrix showed that the model performed well on all classes, with a few confusions primarily between similar-looking digits like **5 and 3**.

- A simple fully connected model can perform quite well on MNIST, though CNNs may improve performance further.

Plots & Visual Results

◆ **Loss vs. Epochs**
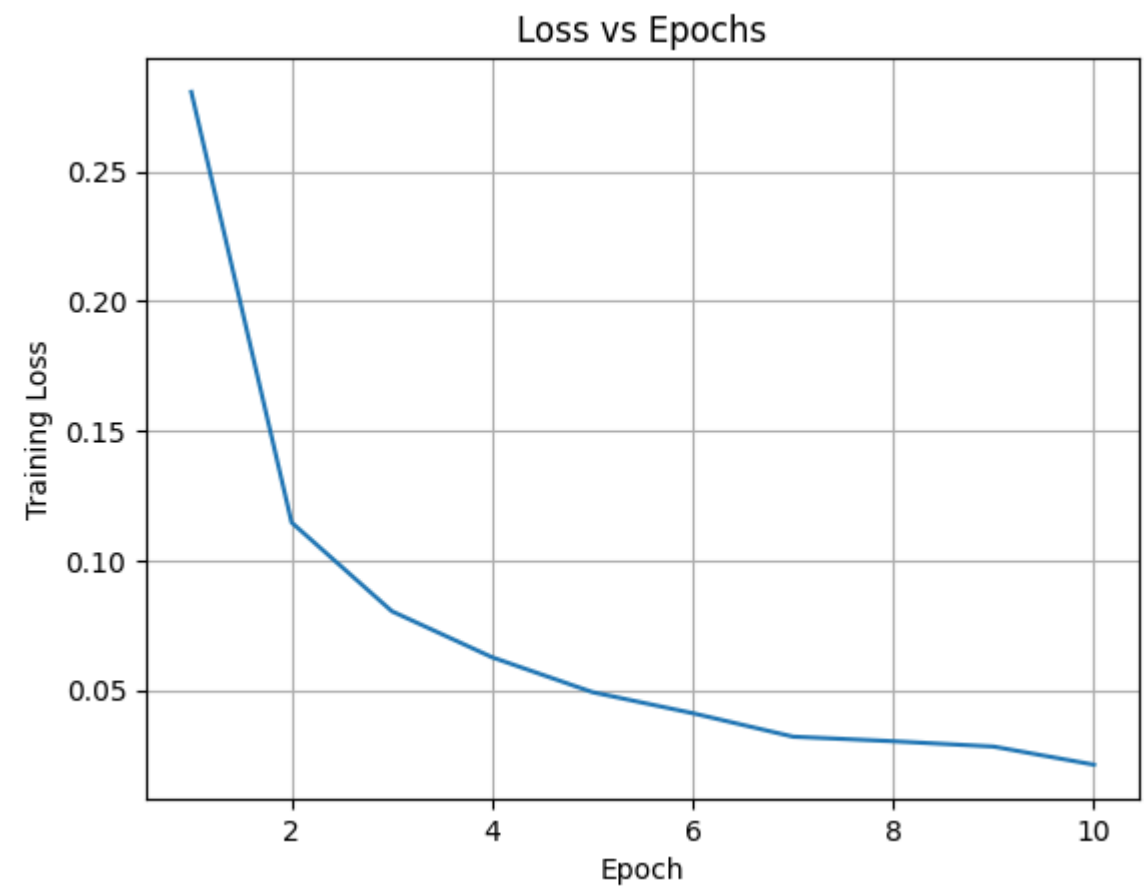
This plot shows the steady decline in training loss, validating effective learning.

◆ **Confusion Matrix**