Performance Comparison of ANN and CNN

Introduction:

Artificial Neural Networks (ANNs) and Convolutional Neural Networks (CNNs) are popular deep learning models used for image recognition tasks. While ANN handles data in a flat vector form, CNNs are designed to capture spatial hierarchies from images. This project aims to compare their performances on the MNIST dataset.

Problem Statement:

The goal is to evaluate how ANN and CNN differ in accuracy, training time, and ability to generalize when classifying handwritten digits (0–9) from the MNIST dataset.

Input: 28×28 grayscale images of digits
Output: Predicted class (digit 0–9)

Goal:

The Goal is to understand how the choice of neural network architecture affects performance in image classification tasks, and to highlight why CNNs outperform traditional ANNs in visual data.

Literature Survey:

- LeCun et al. (1998): Introduced the LeNet architecture for digit recognition, which became the foundation of modern CNNs.
- Krizhevsky et al. (2012): Proposed AlexNet, which showed the power of CNNs in large-scale image recognition

Methodology:

- Data Collection: MNIST dataset
- Data Preprocessing: Normalize images, reshape for ANN and CNN.
- Model Building:
    - ANN: Input → Dense layers → Output
    - CNN: Conv → Pooling → Dense → Output
- Training: Use same train/test split, optimizer, and epochs.
- Evaluation: Compare accuracy, loss, and training time.

Evaluation Methods:

- Accuracy
- Precision, Recall, F1-score
- Training Time
- Loss curves comparison

Error Analysis:

Quantitative:
- Confusion matrix to identify misclassified digits.
- Calculation of misclassification rate.

Qualitative:
- Visualization of sample misclassified images.
- Observing cases where ANN vs CNN failed.