**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.