Lab 6.1: MNIST Autoencoder

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# Objective

To build a simple autoencoder model using TensorFlow that encodes input images from the MNIST dataset to a lower-dimensional representation and then decodes them back to the original images.

# Description

Autoencoders are a type of neural network used to learn efficient representations of data, typically for dimensionality reduction or feature learning. In this experiment, we are using a *shallow network* with a single hidden layer in the encoder and decoder to encode and decode MNIST images. The shallow network provides a straightforward approach to understanding the basic functioning of autoencoders.

# Model

**Steps to Build a Simple Autoencoder**

1. **Define the Model Architecture:**
   * Input layer with 784 units (flattened 28x28 images).
   * Encoder layer: Dense layer with 32 units and ReLU activation.
   * Decoder layer: Dense layer with 784 units and sigmoid activation.
2. **Compile the Model:**
   * Use the Adam optimizer.
   * Set the loss function as binary crossentropy to compare pixel values.
3. **Train the Model:**
   * Load and preprocess the MNIST dataset.
   * Normalize pixel values and flatten images.
   * Train the model for 50 epochs.
4. **Evaluate the Model:**
   * Use test images to visualize and compare original images with reconstructed images.
   * Plot encoded and decoded images for visual comparison.

# Training Results

The autoencoder was trained using 60,000 images from the MNIST dataset over 50 epochs. The shallow network effectively minimized reconstruction loss, demonstrating its ability to learn a lower-dimensional representation of the input images.

# Visualization

* The input, encoded, and decoded images were displayed using Matplotlib to visualize the model’s performance.
* Random samples of 10 images from the test dataset were encoded and then reconstructed, demonstrating the ability of the shallow autoencoder to learn and recreate the original images.

# GitHub Link

https://github.com/dyuthiramesh/Deep\_Learning\_Elective/blob/main/Sem5/Lab\_6\_1/Lab\_Encoder\_1\_Linear\_DISTRI.ipynb