# Assignment No:1

Practical Exercise: Implementing Feedforward Neural Networks using Keras and TensorFlow

## 1) Problem Statement

Implement a Feedforward Neural Network using Python, Keras, and TensorFlow to classify handwritten digits from the MNIST dataset. The model should include input, hidden, and output layers, and it should be trained using backpropagation.

## 2) Libraries Used

Python:  
1. **TensorFlow/Keras**: For building and training the neural network.  
2. **NumPy**: For array manipulation.  
3. **Matplotlib**: For visualizing sample images and results.

## 3) Theory

Feedforward Neural Networks (FNN) are a type of artificial neural network where the connections between the nodes do not form cycles. Information moves in one direction from the input nodes, through the hidden layers, and to the output nodes.  
  
The MNIST dataset consists of 28x28 grayscale images of handwritten digits (0-9). Each image is flattened into a 784-dimensional vector and passed through a series of layers in the FNN. The model is trained using a supervised learning technique called backpropagation, which adjusts the weights in the network to minimize prediction error.

## 4) Methods

1. **Data Preprocessing**:  
 - The MNIST dataset is loaded and normalized. The pixel values are scaled between 0 and 1, and the 28x28 images are flattened into 784-dimensional vectors.  
2. **Model Architecture**:  
 - The model is a Sequential feedforward neural network with:  
 - Input layer of 784 units (one for each pixel).  
 - One or more hidden layers with ReLU activation.  
 - Output layer with 10 units and softmax activation to classify digits (0-9).  
3. **Training**:  
 - The model is trained using the Adam optimizer and categorical crossentropy loss function.  
 - The model is evaluated on the test set after training to check its accuracy.

## 5) Advantages and Disadvantages

- **Advantages**:  
 - FNNs are simple and effective for tasks like image classification.  
 - TensorFlow/Keras provides high-level APIs that make building neural networks easy.  
   
- **Disadvantages**:  
 - FNNs struggle with more complex tasks that require spatial hierarchies (e.g., image recognition tasks where Convolutional Neural Networks (CNNs) perform better).  
 - Feedforward networks lack memory and cannot handle sequential data (e.g., time-series).

**6) Diagram**

## Understanding Feedforward Neural Networks | LearnOpenCV

## Implementing a CNN in TensorFlow & Keras

## 7) Conclusion

Feedforward Neural Networks provide a strong foundation for solving image classification problems. While simple feedforward models can effectively classify handwritten digits, more complex tasks require advanced architectures like Convolutional Neural Networks (CNNs) or Recurrent Neural Networks (RNNs). Keras and TensorFlow simplify the development and deployment of such models.