Introduction to Deep Learning

# Assignment no. 1

Due Data: 27-04-25

Instructions:  
1. This assignment should be completed by hand and use cam scanner for pdf conversion. Please ensure your handwriting is neat and legible.   
2. Show all your calculations step by step. Snaps of codes and outputs should be provided over appropriate places

3. Submit your completed assignment by the specified deadline.

## Question 1: Artificial Neural Network (ANN)

Part 1: A. Conceptual (4 Marks)

1. Why is bias important in a neural network, and how is it initialized?  
2. What is the role of the learning rate in gradient descent?  
3. Compare Sigmoid and ReLU activation functions. Mention one advantage and one disadvantage of each.  
4. What does the loss function represent, and why is it necessary?

Part 2:

A simple feedforward neural network consists of:  
- Input layer: 2 neurons  
- Hidden layer: 2 neurons

- Activation function f(x) = 1 / (1 + e^(-x)) (sigmoid activation)  
- Output layer: 1 neuron with the same activation function.  
  
The initial weights and biases are as follows:  
- Weights between the input layer and the hidden layer:  
 W\_1 = [[0.1, 0.3], [0.2, 0.4]]  
- Weights between the hidden layer and the output layer:  
 W\_2 = [[0.5], [0.6]]  
- Bias for the hidden layer: b\_hidden = [0.1, 0.2]  
- Bias for the output layer: b\_output = 0.3  
  
The input to the network is:  
X = [1, 0]  
The target output is Y\_true = 0.8.  
  
Tasks:  
1. Perform a forward pass to calculate the predicted output Y\_pred.  
2. Compute the error using Mean Squared Error (MSE):  
 Error = (1/2) \* (Y\_true - Y\_pred)^2.  
3. Backpropagate the error to update the weights W\_1 and W\_2 using the gradient descent rule:  
 W <- W - η \* ∂Error/∂W,  
 where the learning rate η = 0.1.

# Question 2: Convolutional Neural Networks (10 Marks)

1. A. Conceptual (4 Marks)

1. What is the purpose of the Convolution Layer in CNN?  
2. Explain the difference between Stride and Padding in convolution.  
3. What is Flattening, and why is it used before the fully connected layer?  
4. Why is Softmax used in the final layer of a classification CNN?

1. B. Coding (6 Marks)

Build a basic CNN model to classify images from the CIFAR-10 dataset using TensorFlow:  
- Include the following layers:  
 - One Conv2D layer with ReLU  
 - MaxPooling2D  
 - Flatten  
 - One Dense layer with Softmax  
- Train the model for 3 epochs  
- Show model summary and final accuracy  
Add inline comments explaining each step (e.g., feature maps, pooling, flattening, etc.).