**Week 2 – Implementation of Neural Networks**

Objective:

The primary goal of this lab is to provide students with a hands-on introduction to artificial neural networks (ANNs), the fundamental building blocks of deep learning. By the end of this lab, students should be familiar with basic neural network architectures, understand the components of a neural network, and be able to implement a simple neural network from scratch.

Tasks:

1. Introduction to Neural Networks:
   * Brief theoretical overview of artificial neural networks.
   * Explanation of key terms: neurons, layers, weights, biases, activation functions.
2. Building a Simple Neural Network from Scratch:
   * Implement a basic neural network with a single hidden layer using NumPy.
   * Define the input layer, hidden layer, and output layer.
   * Initialize random weights and biases.
   * Implement the forward pass using a sigmoid activation function.
   * Calculate the loss using a simple mean squared error.
3. Training the Neural Network:
   * Generate a synthetic dataset for a binary classification problem.
   * Split the dataset into training and testing sets.
   * Implement the backpropagation algorithm to update weights and biases during training.
   * Iterate through epochs and observe how the loss decreases.
4. Evaluation:
   * Use the trained neural network to make predictions on the test dataset.
   * Evaluate the performance using metrics such as accuracy.
   * Visualize the decision boundary learned by the neural network.
5. Experimentation:
   * Encourage students to experiment with different architectures (number of hidden layers, neurons per layer).
   * Explore the impact of changing hyperparameters (learning rate, activation functions).