CS 678 Machine Learning
Programming Assignment #4 Part B
(Graded – mandatory)

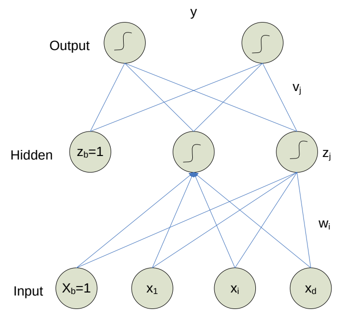
Backpropagation for Neural Network Learning

Specification

The idea is to write a program that implements a multi-layer neural network and demonstrates iterative learning.

Background

A multi-layer perceptron (i.e. neural network) includes an additional *hidden* layer between the input and output layers. In conjunction with logistic activation (σ) it can approximate non-linear functions:



As a form of Supervised Learning, the training process consists of repeatedly presenting labeled examples to the system and iteratively adjusting parameters (weights) until the desired outcome is obtained:

$$\text{WeightUpdate} = \text{LearningRate} \cdot (\text{TargetOutput} - \text{ActualOutput}) \cdot \text{Input}$$

In a multilayer network, there is no target value for perceptrons in the hidden layer; hence their error cannot be directly calculated. Therefore, error is propagated backwards from the output layer (see the full algorithm as given in the Tutorial).

Assignment

Implement a multi-layer perceptron using the neural architecture described in the Backpropagation Tutorial. Step through the complete processing of a single instance:

- Feedforward the inputs
- Backpropagate error
- Learn (update weights)

Requirements

- Your program should display diagnostic output (as stepped through in the Tutorial) that clearly shows the process of learning.
- Submit a written report (single PDF):
  - Include complete documentation, source code and program output.