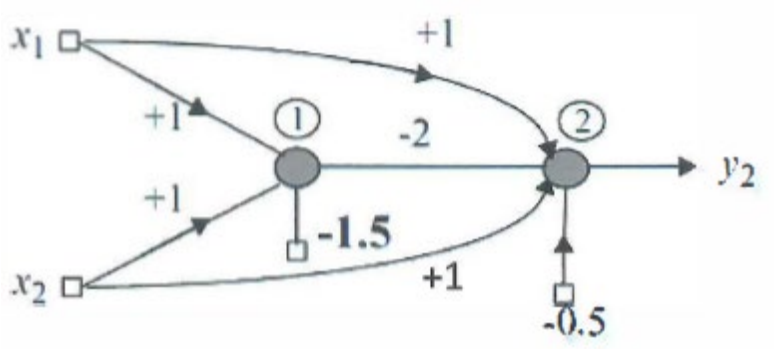
SysEng 5212/EE5370 Homework 5

1. (10 pints) Compute the induced local field (v) and the neuron output (y) for both neurons in the network given



Assume a hard limit activation function for both neurons. Show that this network solves the XOR problem.

2. (40 Points) Build a backpropogation neural network architecture employing a sigmoidal

(i) $f(x) = \exp(-x)$ where $1 \leq x \leq 10$

(ii) $f(x, y) = \sin(\pi x)\cos(\pi y)$ where $x \in (-2,2)$ and $y \in (-2,2)$

nonlinearity to achieve one-to-one mapping of above two functions.

3. (50 points) Write a Matlab program to create and train a multilayer perceptron using backpropogation algorithm with momentum. Use your network to classify the Iris dataset (iris3class.mat) provided with this homework. Divide your data into a training set and testing set in a 2:1 ratio. Perform the following experiments with your network:

a. Experiment with the following values of the learning rate (η) and momentum parameter (α) and comment on your results. Determine the values of η and α that yield the best classification accuracy.

$$\eta \in \{0.001, 0.01, 0.1, 0.25, 0.5\}$$
$$\alpha \in \{0, 0.1, 0.5, 0.8, 0.99\}$$

b. Use the Levenberg-Marquardt variant of backpropagation to train your network and compare its performance with classical backpropagation.

c. Use the Nguyen-Widrow technique for weight initialization and compare the network's performance to that using random weight initialization.

d. Use 3-fold cross validation to test and train your network. Comment on the network's performance.

You may use the Matlab Neural Network Toolbox to create and train your network.