

**Homework # 3(due 03/14/2002)**

**1.** Initialize a feed forward network, with 2 inputs, 2 neurons at first layer (implementing logsig) and 1 neuron at output layer (implementing purelin). The training algorithm will be trained. This network will be trained to implement AND logic. Initialize the weight matrix and bias to zero.

a. Set the learning rate to a small value. Train your network with various number of epochs. Observe the error between the output and target. Then estimate a minimum optimum number of epochs such that error converges to a small value (10 pts)

b. Using your estimate in a, set the number of epochs. Start training your network from the initial conditions and by changing the learning rate; observe the error between the output and target. Plot the relationship between learning rate & error for fixed number of epochs. (20 pts)

c. Fix your error to  $1e-5$ ; start training your network from initial zero conditions. This time observe the number of epochs needed to achieve desired error rate by changing the learning rate. Plot the relationship between learning rate & number of epochs for fixed error rate. (20 pts)

**2.** Consider a Hopfield network with two neurons. Target vector of the Hopfield network is  $[0.5 \ 0.5; -0.5 \ -0.5]$ . Design your hopfield network with these stable points. Then observe the response of the network to various random input vectors in the range  $[-1 \ 1]$ . (Generate a random input, simulate the hopfield network with this input, observe the output) Then take this output as an input to the network and simulate again. Repeat this process until network stabilizes at the target points). Plot a state space diagram; show the stable target points and the trajectories of outputs of your network for different inputs. (Take a look at the state space diagram at p.324 of the manual) (50 pts)