Problem Set – Neural Networks

I. Draw a neural network that represents the function f(x1; x2; x3) defined below. You can only use two types of units: linear units and sign units. Recall that the linear unit takes as input weights and attribute values and outputs $w_0 + \sum_i w_i x_i$, while the sign unit outputs +1 if $w_0 + \sum_i w_i x_i$, > 0 and -1 otherwise.

x1	x2	x3	f(x1,x2,x3)
0	0	0	10
0	0	1	-5
0	1	0	-5
0	1	1	10
1	0	0	-5
1	0	1	10
1	1	0	10
1	1	1	10

You have to write down the precise numeric weights (e.g., -1, -0:5, +1, etc.) as well as the precise units used at each hidden and output node.

II. Consider a two-layer feedforward ANN with two inputs a and b, one hidden unit c, and one output unit d. This network has five weights (w_{ca}, w_{cb}, w_{c0}, w_{dc}, w_{d0}), where w_{x0} represents the threshold weight for unit x. Initialize these weights to the values (.1,.1,.1,.1,.1), then give their values after each of the first two training iterations of the Backpropagation algorithm. Assume learning rate Ƞ =.3, momentum α = 0.9, incremental weight updates, and the following training examples:

a	b	d
1	0	1
0	1	0

III. Revise the BACKPROPAGATION algorithm in Table 4.2 in Tom Mitchell book so that it operates on units using the squashing function $tanh$ in place of the sigmoid function. That is, assume the output of a single unit is $o = tanh(\vec{w} * \vec{x})$). Give the weight update rule for output layer weights and hidden layer weights. Hint: $tanh'(x) = 1 - tanh^2(x)$.