REVIEW EXERCISE 09

Question 1. A perceptron has two input units, a unipolar step function, weights $w_1 = 0.2$ and $w_2 = -0.5$, and a threshold $\theta = 0.2$ (note that, θ can be considered as a weight for an extra input which is always set to -1).

a. The actual output for the input pattern $\boldsymbol{x} = [1, 1]^T$ is ....

b. The perceptron is now trained using the learning rule $\Delta\boldsymbol{w} = \eta(d - y)\boldsymbol{x}$, where $\boldsymbol{x}$ is the input vector, η is the learning rate, $\boldsymbol{w}$ is the weight vector, d is the desired output, and y is the actual output. What are the new values of the weights and threshold after one step of training with the input vector $\boldsymbol{x} = [0, 1]^T$ and desired output 1, with $\eta = 0.2$?

y	w_1	w_2	θ

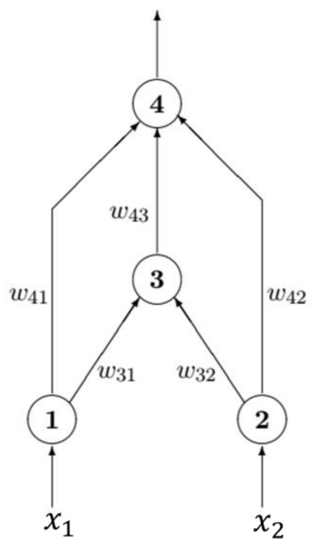
c. Show the equation of the decision line for the perceptron **before** training

....

d. Show the equation of the decision line for the perceptron **after** training with the input vector in b.

....

Question 2. In the network shown aside, all the units have binary inputs (0 or 1), unipolar step functions and binary outputs (0 or 1). The weights for this network are $w_{31} = 1, w_{32} = 1, w_{41} = 1, w_{42} = 1$ and $w_{43} = -2$. The threshold of the hidden unit (3) is 1.5 and the threshold of the output unit (4) is 0.5. The threshold of both input units (1 and 2) is 0.5, so the output of these units is the same as the input.



Compute the output at every neuron for all pairs of input values.

x_1	x_2	Neurons			
		1	2	3	4
0	0				
0	1				
1	0				
1	1				

Which Boolean functions can be computed by this network? ....

Question 3. A single-layer network of perceptrons has 3 input units and 3 output units. No threshold or bias is considered.

The network has .... weights.

Question 4. A multi-layer feedforward network has 5 input units, a first hidden layer with 4 units, a second hidden layer with 3 units, and 2 output units. No threshold or bias is considered.

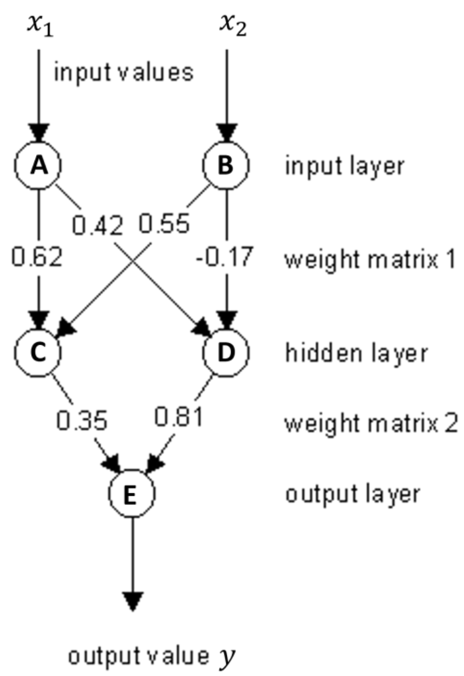
If no threshold (or bias) is used the network has .... weights.

If threshold (bias) is used, the network has .... weights.

Question 5. Suppose you have the following three-layered multi-layer neural networks. No threshold is considered. The pattern to be learned is $\boldsymbol{x} = [0, 1]^T$ with desired output $y_d = 0$. The learning rate is 0.25.

The weight vectors are

$$w_1 = \begin{bmatrix} 0.62 \\ 0.55 \end{bmatrix} \quad w_2 = \begin{bmatrix} 0.42 \\ -0.17 \end{bmatrix} \quad w_3 = \begin{bmatrix} 0.35 \\ 0.81 \end{bmatrix}$$



a. Compute the output at every neuron when the pattern is propagated through the net.

A	B	C	D	E

b. Adjust the weights when the backpropagation takes place.

w_{11}	w_{12}	w_{21}	w_{22}	w_{31}	w_{32}

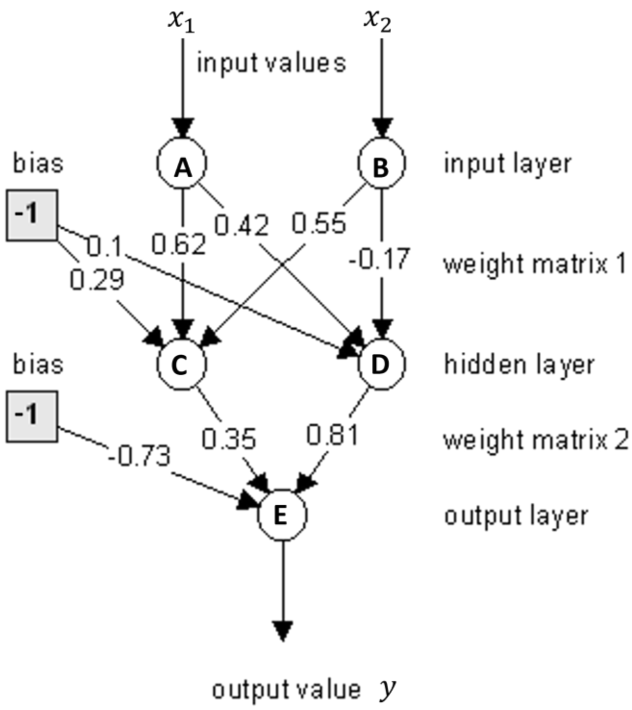
Question 6. Suppose you have the following three-layered multi-layer neural networks. No threshold is considered. The pattern to be learned is $\boldsymbol{x} = [0,1]^T$ with desired output $y_d = 0$. The learning rate is 0.25.

The weight vectors are

$$w_1 = \begin{bmatrix} 0.62 \\ 0.55 \end{bmatrix} \quad w_2 = \begin{bmatrix} 0.42 \\ -0.17 \end{bmatrix} \quad w_3 = \begin{bmatrix} 0.35 \\ 0.81 \end{bmatrix}$$

The biases are

$$b_0 = 0.29 \quad b_1 = 0.1 \quad b_3 = -0.73$$



a. Compute the output at every neuron when the pattern is propagated through the net.

A	B	C	D	E

b. Adjust the weights when the backpropagation takes place.

w_{11}	w_{12}	w_{21}	w_{22}	w_{31}	w_{32}