Machine Learning

Neural Network

1. Given a multiple layer network as shown below

$W_{12}=0$ 2 $W_{24}=-1$

y_2

x   1   4 y_4

y_3

$W_{13}=0$ 3 $W_{34}=1$
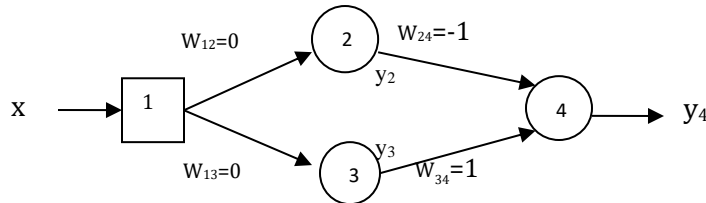
   1) If the input x=2; what are the outputs of neuron 2, 3, and 4, i.e y_2 y_3 and y_4?
      (We use sigmoid function sigm(x)=1/(1+e^{-x}) as the activation function of neurons.)

   y2=sigm(x*w12)=sigm(2*0)=1/2
   y3=sigm(x*w13)=sigm(2*0)=1/2
   y4=sigm(y2*w24+y3*w34)=sigm(-1/2+1/2)=1/2

   2) If the desired output for input x=2 is y_{4d}=1, update w_{12}, w_{13}, w_{24} and w_{34} according to the
      updating rule of neural network. (The learning rate $\alpha = 0.1$)? Please list the details of your
      calculation.

   e=yd-y4=1-1/2=1/2 delta4=y4*(1-y4)*e=0.5*(1-0.5)*0.5=0.125
   w24$_{new}$=w24+α*delta4*y2=-1+0.1*0.125*0.5=-0.99375
   w34$_{new}$=w34+α*delta4*y3=1+0.1*0.125*0.5=1.00625
   delta2=y2*(1-y2)*w24*delta4=0.5*(1-0.5)*(-1)*0.125=-0.03125
   delta3=y3*(1-y3)*w34*delta4=0.5*(1-0.5)*1*0.125=0.03125
   w12$_{new}$=w12+α*delta2*x =0+0.1*(-0.03125)*2=-0.00625
   w13$_{new}$=w34+α*delta3*x=0+0.1*0.03125*2=0.00625

2. In Kohonen network, we have three neurons A, B, C. Currently, the link weights to A are [1, 3], the
   link weights to B are [2, 3], and link weights to C are [4, 5].
   1) Then given a data [4.5, 2.4], which neuron should be fired?

Because d(W_B,X)<d(W_C,X)<d(W_A,X) (Please show the calculation of Euclidian distances)
B is the winner and will be fired

   2) For the neuron that will be fired, what will be its new weights, if the learning rate $\alpha = 0.1$
$W_{B\ new}$=W_B+ α(X-W_B)=[2,3]+0.1([4.5, 2.4]-[2,3])=[2.25,2.94]