MINISTRY OF HIGHER EDUCATION & SCIENTIFIC RESEARCH
AL IRAQIA UNIVERSITY
COLLEGE OF ENGINEERING
COMPUTER ENGINEERING DEPARTMENT
FINAL EXAM 2016-2017
FIRSTATTEMPT- SEMESTER I
STAGE: Four
SUBJECT: Soft Computing
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NOTE : ANSWER FOUR QUESTION

Time: 3 hours

Q1: A multiple-input neuron has a weight matrix=[1.2 -1.2 -1] and a bias b=[-0.1], do the following: **[15 marks]**

1- Plot an abbreviated notation for neuron showing numeric values.

2- Calculate the net input net if input is p=[-1.0 -3.1 -0.1] .

3- For the result in (2) ,find the network output a for each of the transfer function.

A-hardlim . B- logsig.

Q2: Calculate the thresholds and weight for Hopfield Network that is to learn the following three input vector:

X1=[-1 -1 1] X2=[1 -1 -1] X3= [-1 1 1] **[15 marks]**

Q3: Determine the neural network weight matrices using perceptron rule after applying **<u>first iteration</u>** on the prototype vector: **[15 marks]**

$$\left\{\mathbf{p}_1 = \begin{bmatrix}2\\2\end{bmatrix}, t_1 = 0\right\} \left\{\mathbf{p}_2 = \begin{bmatrix}1\\-2\end{bmatrix}, t_2 = 1\right\} \left\{\mathbf{p}_3 = \begin{bmatrix}-2\\2\end{bmatrix}, t_3 = 0\right\} \left\{\mathbf{p}_4 = \begin{bmatrix}-1\\1\end{bmatrix}, t_4 = 1\right\}$$

And

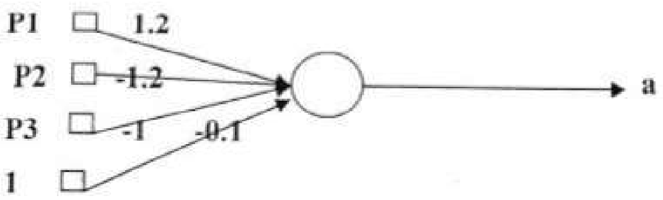
$$\mathbf{W}(0) = \begin{bmatrix}0 & 0\end{bmatrix} \qquad b(0) = 0$$

Q4:A kohonen self-organization map(SOM) to be cluster two vectores **Vocter1**=(1 1 0) and **Vocter2**=(0 0 0) . the maximum numder of cluster to be formed is m=2 with learning rate $\propto$=0.6 and the initial waite matrex are: **[15 marks]**

كلية الهندسة
قسم هندسة الحاسوب

Q1:

1:



2:

Net = W *p(vectors Transpose) +b

$$\text{Net}=[1.2\ -1.2\ \ -1] * \begin{bmatrix} 1.0 \\ -3.1 \\ -0.1 \end{bmatrix} + [-0.1] = 2.52$$

3:

A: a= hardlim(2.52)=1 Net>0	B: a= 1 / (1+ exp –(Net) = 0.9255

Q2:

1-

The vectors

(-1 -1 1)   (1 -1 -1)   (-1 1 1)

The matrix

$$\begin{matrix} -1 & -1 & 1 \\ 1 & -1 & -1 \\ -1 & 1 & 1 \end{matrix}$$

The transpose of matrix

$$\begin{matrix} -1 & 1 & -1 \\ -1 & -1 & 1 \\ 1 & -1 & 1 \end{matrix} * \begin{matrix} 1 \\ 1 \\ 1 \end{matrix} = \begin{matrix} -1 \\ -1 \\ 1 \end{matrix} = W0$$

$$Tj = -W0 = \begin{matrix} 1\ (T1) \\ 1\ (T2) \\ -1\ (T3) \end{matrix}$$

2- The weight matrix

The vectors

(-1 -1 1)   (1 -1 -1)   (-1 1 1)

$w_{1,1} = 0$

$w_{1,2} = (-1) \times (-1) + 1 \times (-1) + (-1) \times 1 = \quad -1$

$w_{1,3} = (-1) \times 1 + 1 \times (-1) + (-1) \times 1 = \quad -3$

$w_{2,2} = 0$

$w_{2,1} = w_{1,2}$

$w_{2,3} = (-1) \times 1 + (-1) \times (-1) + 1 \times 1 = \quad 1$

$w_{3,3} = 0$

$w_{3,1} = w_{1,3}$

$w_{3,2} = w_{2,3}$

Q3:

$$\left\{\mathbf{p}_1 = \begin{bmatrix}2\\2\end{bmatrix}, t_1 = 0\right\} \left\{\mathbf{p}_2 = \begin{bmatrix}1\\-2\end{bmatrix}, t_2 = 1\right\} \left\{\mathbf{p}_3 = \begin{bmatrix}-2\\2\end{bmatrix}, t_3 = 0\right\} \left\{\mathbf{p}_4 = \begin{bmatrix}-1\\1\end{bmatrix}, t_4 = 1\right\}$$

Use the initial weights and bias:

$$\mathbf{W}(0) = \begin{bmatrix}0 & 0\end{bmatrix} \qquad b(0) = 0 .$$

We start by calculating the perceptron's output a for the first input vector $\mathbf{p}_1$, using the initial weights and bias.

$$a = hardlim(\mathbf{W}(0)\mathbf{p}_1 + b(0))$$

$$= hardlim\left(\begin{bmatrix}0 & 0\end{bmatrix}\begin{bmatrix}2\\2\end{bmatrix} + 0\right) = hardlim(0) = 1$$

The output a does not equal the target value t_1, so we use the perceptron rule to find new weights and biases based on the error.

$$e = t_1 - a = 0 - 1 = -1$$
$$\mathbf{W}(1) = \mathbf{W}(0) + e\mathbf{p}_1^T = \begin{bmatrix}0 & 0\end{bmatrix} + (-1)\begin{bmatrix}2 & 2\end{bmatrix} = \begin{bmatrix}-2 & -2\end{bmatrix}$$
$$b(1) = b(0) + e = 0 + (-1) = -1$$

We now apply the second input vector $\mathbf{p}_2$, using the updated weights and bias.

$$a = hardlim(\mathbf{W}(1)\mathbf{p}_2 + b(1))$$

$$= hardlim\left(\begin{bmatrix}-2 & -2\end{bmatrix}\begin{bmatrix}1\\-2\end{bmatrix} - 1\right) = hardlim(1) = 1$$

This time the output a is equal to the target t_2. Application of the perceptron rule will not result in any changes.

$$\mathbf{W}(2) = \mathbf{W}(1)$$
$$b(2) = b(1)$$

We now apply the third input vector.

$$a = hardlim(\mathbf{W}(2)\mathbf{p}_3 + b(2))$$

$$= hardlim\left(\begin{bmatrix}-2 & -2\end{bmatrix}\begin{bmatrix}-2 \\ 2\end{bmatrix} - 1\right) = hardlim(-1) = 0$$

The output in response to input vector $\mathbf{p}_3$ is equal to the target t_3, so there will be no changes.

$$\mathbf{W}(3) = \mathbf{W}(2)$$
$$b(3) = b(2)$$

We now move on to the last input vector $\mathbf{p}_4$.

$$a = hardlim(\mathbf{W}(3)\mathbf{p}_4 + b(3))$$

$$= hardlim\left(\begin{bmatrix}-2 & -2\end{bmatrix}\begin{bmatrix}-1 \\ 1\end{bmatrix} - 1\right) = hardlim(-1) = 0$$

This time the output a does not equal the appropriate target t_4. The perceptron rule will result in a new set of values for $\mathbf{W}$ and b.

$$e = t_4 - a = 1 - 0 = 1$$
$$\mathbf{W}(4) = \mathbf{W}(3) + e\mathbf{p}_4^T = \begin{bmatrix}-2 & -2\end{bmatrix} + (1)\begin{bmatrix}-1 & 1\end{bmatrix} = \begin{bmatrix}-3 & -1\end{bmatrix}$$
$$b(4) = b(3) + e = -1 + 1 = 0$$

After making one pass through all of the two inputs ,get the value : w=[-3 -1] ,and b=0.

Q4:

1- for the first vector

$$\begin{array}{ccc} x_1 & x_2 & x_3 \\ (1 & 1 & 0\ ) \end{array}$$

$$D(1) = (1-0.2)^2 + (1-0.6)^2 + (0-0.5)^2 = 1.05$$

$$D(2) = (1-0.8)^2 + (1-0.4)^2 + (0-0.7)^2 = 0.89 \text{ (Minimum)}$$

$\therefore$ J = 2 (The input vector) is closest to output node 2)

$\therefore$ The weight on the winning unit is update:-

$$W_{21}(new) = W_{12}(old) + 0.6(x_1 - W_{12}(old))$$
$$= 0.8 + 0.6(1 - 0.8) = 0.92$$

$$W_{22}(new) = 0.4 + 0.6(1 - 0.4)$$
$$= 0.4 + 0.36 = 0.76$$

Step 1: for each I/p training vector target o/p

Pair, S : t do steps 2- 4.

Step 2 : Set activations for I/P units:

$x_i = s_i$ ($i = 1$ to n)

Step 3 : set activation for O/P unit :

$y=t$

Step 4 : Adjust the weights for

$w_i (new) = w_i(old) + x_i y$ ($i = 1$ to n)

Adjust the bias:

$b(new) = b(old) + y$