Neural Networks

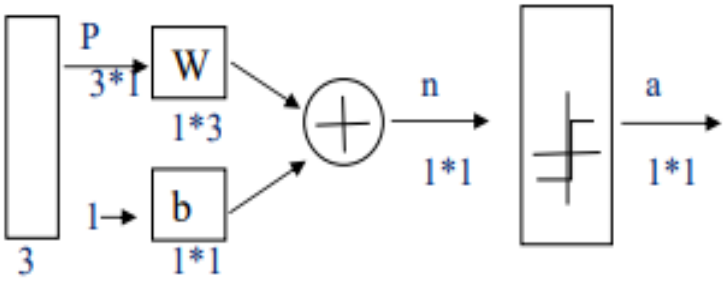
Sheet -1

1- Q1

Solve 1:

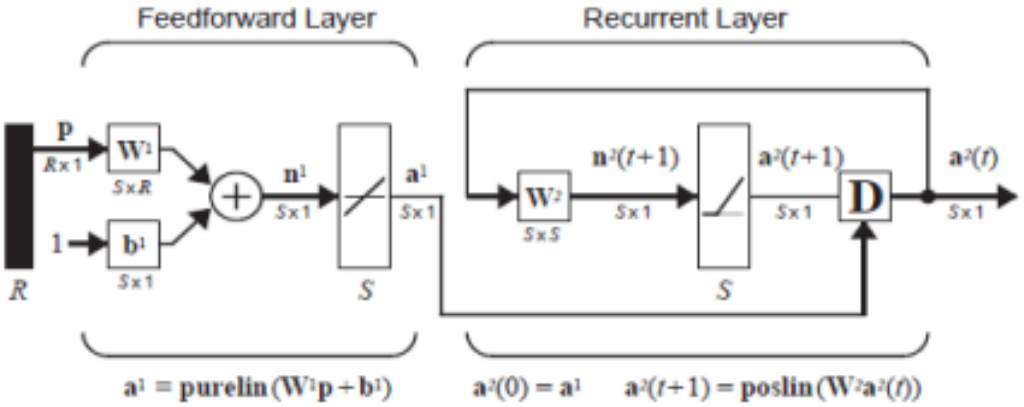
i- The design of perceptron

Input



Let`s assume weight matrix W = [0 -1 1] and b = 0
And the target of banana and pineapple t1 = -1 , t2 = 1
And the transfer function is **Symmetric Hard Limit.**

ii- The design of hamming

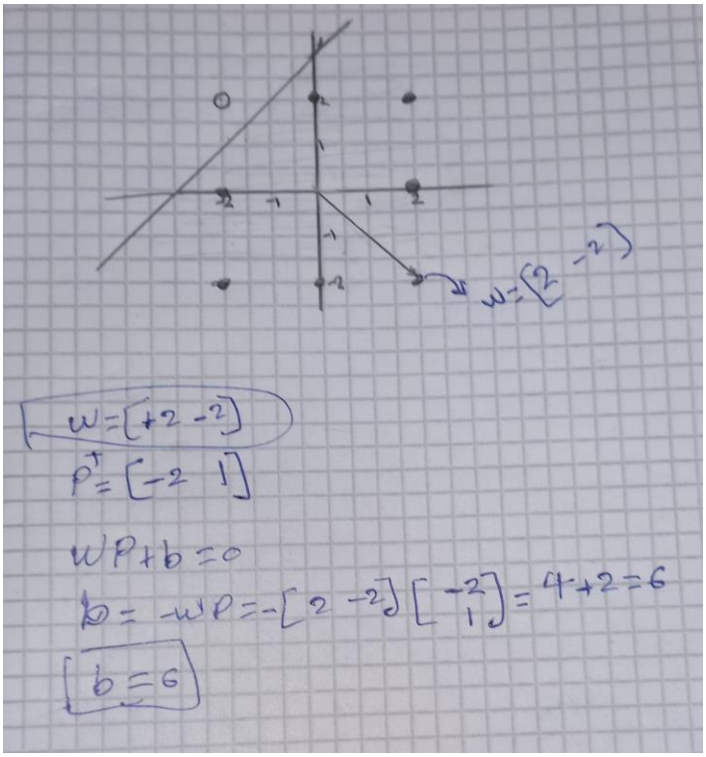


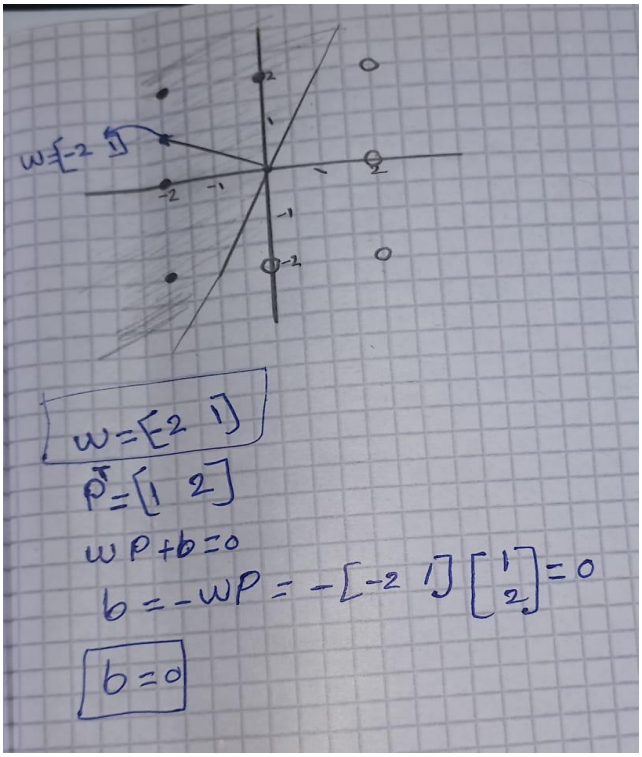
First layer has 2 neurons and 3 input so w will be 2*3 and b 2*1
S = 2 and R = 3 in the diagram.

In first layer: $W^1 = \begin{bmatrix} -1 & 1 & -1 \\ -1 & -1 & 1 \end{bmatrix}$ $b^T = [\,R\ R\,] = [\,3\ \ 3\,]$

Second layer: $W^2 = \begin{bmatrix} 1 & -\varepsilon \\ -\varepsilon & 1 \end{bmatrix} = \begin{bmatrix} 1 & -0.5 \\ -0.5 & 1 \end{bmatrix}$

2- Q2





3- Q3 Mention different transfer function that can be used in Neural Network

1- Hard limit
2- symmetrical hard limit
3- linear
4- saturating linear
5- symmetrical saturating linear
6- log-sigmoid
7- hyperbolic tangent sigmoid
8- positive linear
9- competitive

4- Q4

[4] i- $w = \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}$, $b = \begin{bmatrix} -2 \\ 0 \end{bmatrix}$

∴ R = 2, S = 2

∴ num of Classes = $2^2 = 4$ classes

ii- $wP + b$, Suppose $P = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

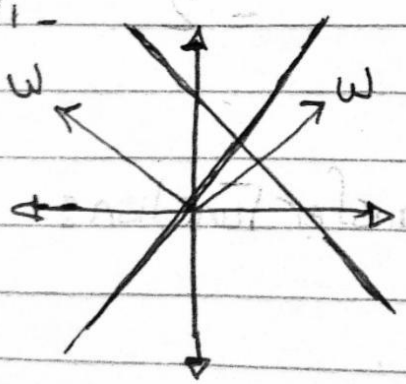
$\begin{bmatrix} 0 \\ -2 \end{bmatrix} + \begin{bmatrix} -2 \\ 0 \end{bmatrix} = \begin{bmatrix} -2 \\ -2 \end{bmatrix}$

use Symmetric transfer Function

$a < 0 = -1$, $a \geq 0 = 1$

∴ $a = \begin{bmatrix} -1 \\ -1 \end{bmatrix}$

iii-



5- Q5

5-

$P_1 = \begin{bmatrix} 2 \\ 2 \end{bmatrix}$, $t_1 = 0$ $\quad$ $P_2 = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$, $t_2 = 1$

$P_3 = \begin{bmatrix} -2 \\ 2 \end{bmatrix}$, $t_3 = 0$ $\quad$ $P_4 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$, $t_4 = 1$

- use $w(0) = [0 \quad 0]$, $b(0) = 0$
- use transfer function is HardLimit

$n \geq 0 \rightarrow a = 1$
$n < 0 \rightarrow a = 0$

$w(new) = w(old) + eP^T$
$b(new) = b(old) + e$
$e = t - a$

$a_1 = hardlim(wP_1 + b) = hardlim([0\ 0]\begin{bmatrix} 2 \\ 2 \end{bmatrix} + 0)$
$a_1 = hardLim(0) = 1 \neq t_1$
$w(1) = w(0) + (t-a)\,P_1^T$
$w(1) = [0\ 0] + (-1)[2\ 2] = [-2\ -2]$
$b(1) = b(0) + (t-a) = 0 + (-1) = -1$

$a_2 = hardlim(w(1)P_2 + b(1)) = hardlim([-2\ -2]\begin{bmatrix} 1 \\ -2 \end{bmatrix} - 1) = hardlim(1) = 1 = t_2$
$a_3 = hard\,lim(w(1)P_3 + b(1)) = hardlim([-2\ -2]\begin{bmatrix} -2 \\ 2 \end{bmatrix} - 1) = hardlim(-1) = 0 = t_3$
$a_4 = hardlim(w(1)P_4 + b(1)) = hardlim([-2\ -2]\begin{bmatrix} -1 \\ 1 \end{bmatrix} - 1) = hardlim(-1) = 0 \neq t_4$
$w(2) = w(1) + (t-a)\,P_4^T$
$w(2) = [-2\ -2] + (1)[-1\ \ 1] = [-3\ \ -1]$
$b(2) = b(1) + (t-a) = -1 + 1 = 0$

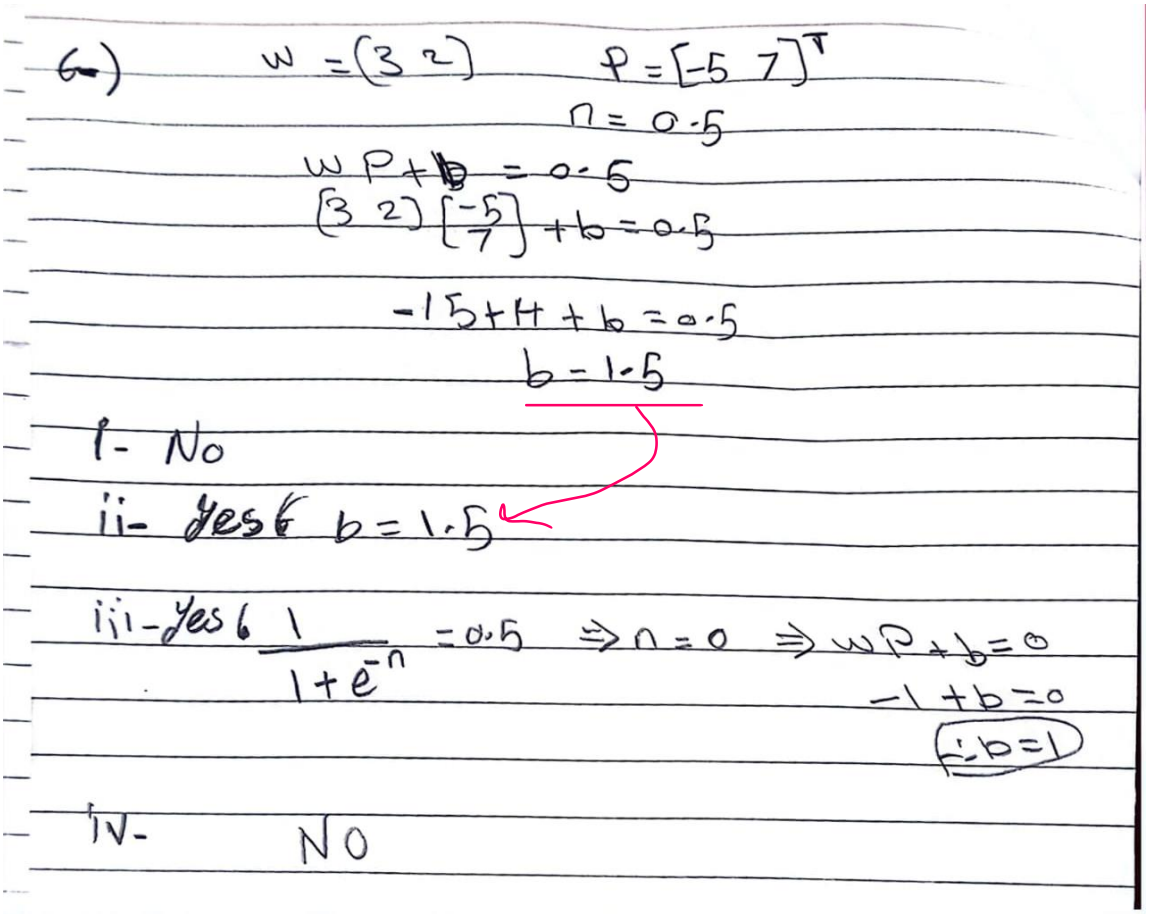
$a_1 = hardlim(w(2)P_1 + b(2)) = hardlim([-3\ -1]\begin{bmatrix} 2 \\ 2 \end{bmatrix} + 0) = hardlim(-8) = 0 = t_1$
$a_2 = hardlim(w(2)P_2 + b(2)) = hardlim([-3\ -1]\begin{bmatrix} 1 \\ -2 \end{bmatrix} + 0) = hardlim(-1) = 0 \neq t_2$
$w(3) = w(2) + (t-a)\,P_2^T$
$w(3) = [-3\ -1] + (1)[1\ \ -2] = [-2\ \ -3]$
$b(3) = b(2) + (t-a) = 0 + 1 = 1$

$a_3 = hardlim(w(3)P_3 + b(3)) = hardlim([-2\ -3]\begin{bmatrix} -2 \\ 2 \end{bmatrix} + 1) = hardlim(-1) = 0 = t_3$
$a_4 = hardlim(w(3)P_4 + b(3)) = harlim([-2\ -3]\begin{bmatrix} -1 \\ 1 \end{bmatrix} + 1) = hardlim(0) = 1 = t_4$
$a_1 = hardlim(w(3)P_1 + b(3)) = hardlim([-2\ -3]\begin{bmatrix} 2 \\ 2 \end{bmatrix} + 1) = hardlim(-9) = 0 = t_1$
$a_2 = hardlim(w(3)P_2 + b(3)) = hardlim([-2\ -3]\begin{bmatrix} 1 \\ -2 \end{bmatrix} + 1) = hardlim(5) = 1 = t_2$

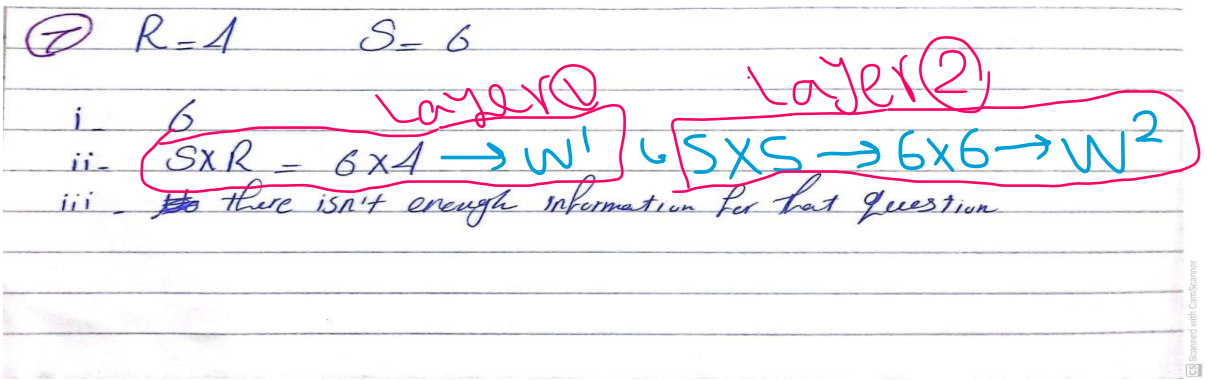
then $W = [-2\ -3]$ & $b = 1$

مع تحياتي بالتوفيق #

6- Q6


6-) w = (3 2) p = [-5 7]^T
n = 0.5
wp + b = 0.5
[3 2] [-5 7] + b = 0.5
-15 + 14 + b = 0.5
b = 1.5
i- No
ii- yes & b = 1.5
iii- yes & 1/(1+e^-n) = 0.5 ⇒ n = 0 ⇒ wp + b = 0
-1 + b = 0
∴ b = 1
iv- NO

7- Q7


7) R = 1 S = 6
i- 6
ii- SxR = 6x1 → W^1 & SxS → 6x6 → W^2
iii- there isn't enough information for that question
Layer(1)
Layer(2)

Answer the following MCQs questions

8- What are dendrites?
a) fibers of nerves
b) nuclear projections
c) other name for nucleus
d) none of the mentioned

9- What is shape of dendrites like
a) oval
b) round
c) tree
d) rectangular

10- What is purpose of Axon?
a) receptors
b) transmitter
c) transmission
d) none of the mentioned

11- The cell body of neuron can be analogous to what mathematical operation?
a) summing
b) differentiator
c) integrator
d) none of the mentioned

12- In a three layer network, number of classes is determined by?
a) number of units in second layer
b) number of units in third layer
c) number of units in second and third layer
d) none of the mentioned

13- Which is the most direct application of neural networks?
a) vector quantization
b) pattern mapping
c) pattern classification
d) control applications

14- In a three layer network, number of classes is determined by?
a) number of units in second layer
b) number of units in third layer
c) number of units in second and third layer
d) none of the mentioned

15- For what purpose, hamming network is suitable?

a) classification

b) association

c) pattern storage

d) none of the mentioned

16- Prototype is consisting of

a) $\begin{matrix} shape \\ [texture] \\ size \end{matrix}$ b) $\begin{matrix} shape \\ [texture] \\ weight \end{matrix}$ c) $\begin{matrix} shape \\ [texture] \\ color \end{matrix}$