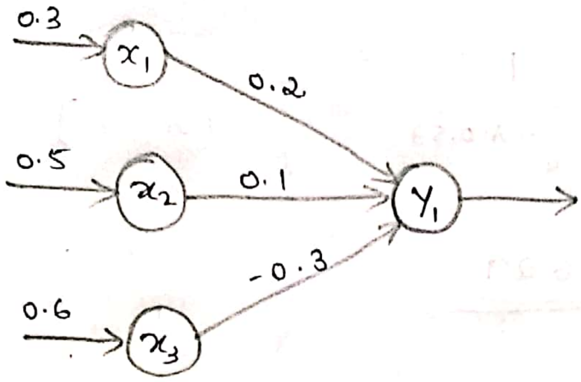
MODULE - 1

Q1. For the network shown in the fig. Calculate the net i/p for the o/p.



$x_1 = 0.3$ $\quad w_1 = 0.2$

$x_2 = 0.5$ $\quad w_2 = 0.1$

$x_3 = 0.6$ $\quad w_3 = -0.3$

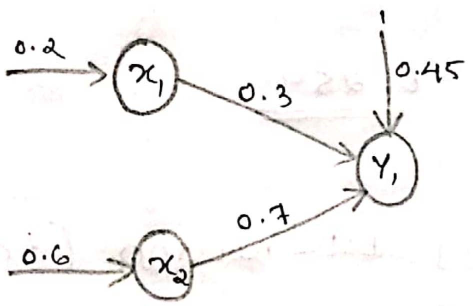
$$Y_{in} = x_1 w_1 + x_2 w_2 + x_3 w_3$$

$$= 0.3 \times 0.2 + 0.5 \times 0.1 + 0.6 \times -0.3$$

$$= 0.06 + 0.05 - 0.18$$

$$= \underline{\underline{-0.07}}$$

Q2. Calculate the net i/p for the network shown in the fig with bias included in network.



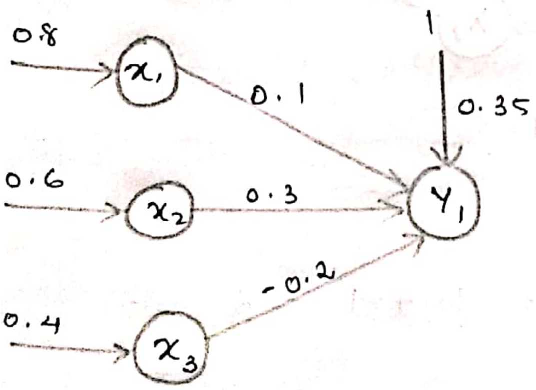
$$Y_{in} = x_1 w_1 + x_2 w_2 + b_j$$

$$= 0.2 \times 0.3 + 0.6 \times 0.7 + 0.45$$

$$= 0.06 + 0.42 + 0.45$$

$$= \underline{\underline{0.93}}$$

Q3. Obtain the o/p of neuron Y, for the network shown in the figure using binary sigmoidal & bipolar sigmoidal activation fn.



$$Y_{in} = x_1 w_1 + x_2 w_2 + x_3 w_3 + b_j$$

$$= 0.8 \times 0.1 + 0.6 \times 0.3 + 0.4 \times -0.2 + 0.35$$

$$= 0.08 + 0.18 - 0.08 + 0.35$$

$$= \underline{\underline{0.53}}$$

$y_{out} = f(y_{in})$

binary,

$$f(x) = \frac{1}{1+e^{-\lambda x}}$$

$$f(y_{in}) = \frac{1}{1+e^{-\lambda y_{in}}} = \frac{1}{1+e^{-\lambda \cdot 0.53}} \quad (\lambda = 1)$$

$$= \frac{1}{1+e^{-0.53}} = \underline{\underline{0.629}}$$

bipolar,

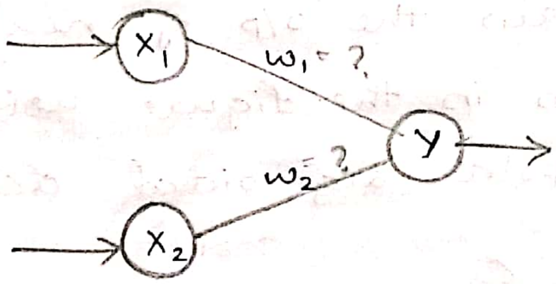
$$f(x) = \frac{2}{1+e^{-\lambda x}} - 1$$

$$Y_{out} = f(Y_{in}) = \frac{2}{1+e^{-\lambda y_{in}}} - 1$$

$$= \frac{2}{1+e^{-\lambda 0.53}} - 1 = \underline{\underline{0.259}}$$

Q4. Implement AND fn using MP neuron (take binary data)

x_1	x_2	y
1	1	1
1	0	0
0	1	0
0	0	0



- Assume $w_1 = 1$ & $w_2 = 1$,

  Let $x_1 = 1$ & $x_2 = 1$

  $Y_{in} = x_1 w_1 + x_2 w_2 = 1 + 1 = 2$

  Let $x_1 = 1$ & $x_2 = 0$

  $Y_{in} = 1 + 0 = 1$

$[x_1 = 0 , x_2 = 1]$ $Y_{in} = 0 + 1 = \underline{1}$

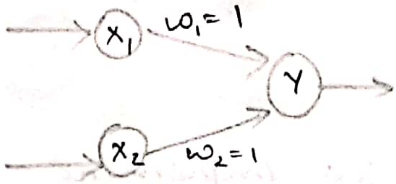
$[x_1 = 0 , x_2 = 0]$ $Y_{in} = 0 + 0 = 0$

Ass $f(y_{in}) = \begin{cases} 1, & y_{in} \geq \theta \\ 0, & y_{in} < \theta \end{cases}$

$\therefore \theta = 2$

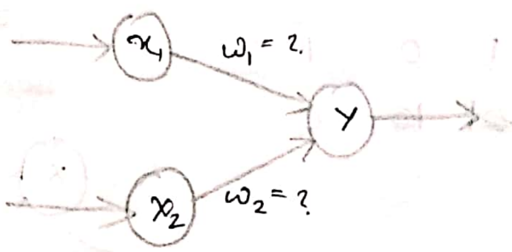
So, weights $w_1 = 1$ & $w_2 = 1$

$\therefore y = f(y_{in}) = \begin{cases} 1, & y_{in} \geq 2 \\ 0, & y_{in} < 2 \end{cases}$



Q5. Implement AND-NOT function using MP neuron use binary data $[x_1 \bar{x}_2]$

x_1	x_2	$\bar{x}_2$	Y $x_1 \bar{x}_2$
0	0	1	0
0	1	0	0
1	0	1	1
1	1	0	0



Assume $w_1 = 1$ & $w_2 = 1$, $\quad y_{in} = x_1 w_1 + x_2 w_2$

$x_1 = 0, x_2 = 0, y_{in} = 0 + 0 = 0$

$x_1 = 0, x_2 = 1, y_{in} = 0 + 1 = 1$

$x_1 = 1, x_2 = 0, y_{in} = 1 + 0 = 1$

$x_1 = 1, x_2 = 1, y_{in} = 1 + 1 = 2$

Assume, $w_1 = 1$, $w_2 = -1$

$[0, 0]$, $y_{in} = 0 + 0 = 0$

$[0, 1]$, $y_{in} = 0 - 1 = -1$

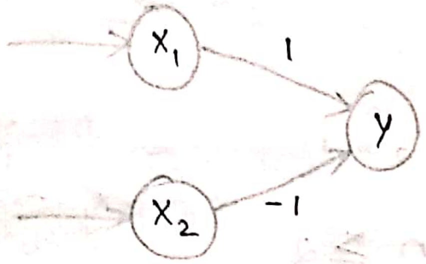
$[1, 0]$ $y_{in} = 1 + 0 = 1$

$[1, 1]$ $y_{in} = 1 - 1 = 0$

$\therefore \theta = 1.$

ie. $y = f(y_{in}) = \begin{cases} 1, & \text{if } y_{in} \geq 1 \\ 0, & \text{if } y_{in} < 1 \end{cases}$

So, weights, $w_1 = 1$ & $w_2 = -1$.



Q6. Implement XOR fn using MP neuron. Take binary data.

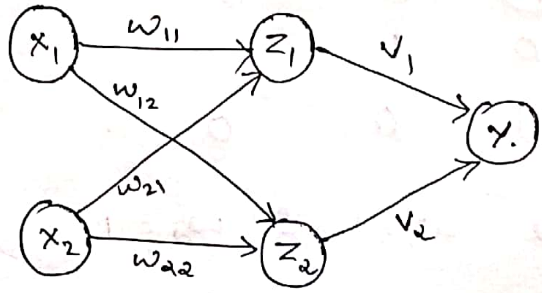
x_1	x_2	y
0	0	0
0	1	1
1	0	1
1	1	0

$y = x_1 \overline{x_2} + \overline{x_1} x_2$

i) $z_1 = x_1 \cdot \overline{x_2}$

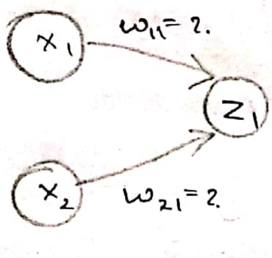
ii) $z_2 = \overline{x_1} \, x_2$

iii) $y = z_1 + z_2$



Decompose it into 3 :-

i)



x_1	x_2	z_1
0	0	0
0	1	0
1	0	1
1	1	0

Assume $w_{11} = w_{21} = 1$,

$[0, 0]$, $z_{in} = 0$ $\quad [x_1 w_{11} + x_2 w_{21}]$

$[0, 1]$ $\quad z_{in} = 0 + 1 = 1$

$[1, 0]$ $\quad z_{in} = 1$

[1,1] , $Z_{1in} = 1 + 1 = 2$

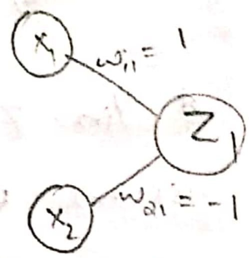
Assume $w_{11} = 1$, $w_{21} = -1$,

[0,0] , $Z_{1in} = 0$

[0,1] , $Z_{1in} = 0 - 1 = -1$

[1,0] $Z_{1in} = 1 - 0 = 1$

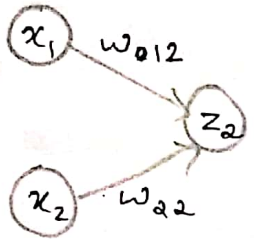
[1,1] $Z_{1in} = 1 - 1 = 0$



$\therefore \theta = 1$ $w_{11} = 1$, $w_{21} = -1$

$$Z_1 = f(Z_{1in}) = \begin{cases} 1, & Z_{1in} \geq 1 \\ 0, & Z_{1in} < 1 \end{cases}$$

2 ii)



x_1	x_2	Z_2
0	0	0
0	1	1
1	0	0
1	1	0

Assume $w_{12} = w_{22} = 1$

[0,0] , $Z_{2in} = 0$

[0,1] $Z_{2in} = 0 + 1 = 1$

[1,0] $Z_{2in} = 1 + 0 = 1$

[1,1] $Z_{2in} = 1 + 1 = 2$

Assume $w_{12} = 1$ & $w_{22} = -1$

[0,0] , $Z_{2in} = 0$

[0,1] $Z_{2in} = 0 + {}^{-}1 = {}^{-}1$

[1,0] $Z_{2in} = 1 + 0 = 1$

[1,1] $Z_{2in} = 1 - 1 = 0$

Assume $w_{12} = -1$ & $w_{22} = 1$

[0,0] , $Z_{2in} = 0 + 0 = 0$

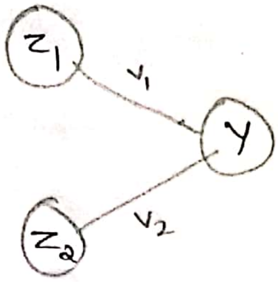
[0,1] , $Z_{2in} = 0 + 1 = 1$

[1,0] , $Z_{2in} = -1 + 0 = -1$

[1,1] ; $Z_{2in} = -1 + 1 = 0$

$\therefore \theta = 1$ & $w_{12} = -1$, $w_{22} = 1$

iii)



x_1	x_2	Z_1	Z_2	Y
0	0	0	0	0
0	1	0	1	1
1	0	1	0	1
1	1	0	0	0

$Y_{in} = Z_1 V_1 + Z_2 V_2$

Assume $V_1 = V_2 = 1$,

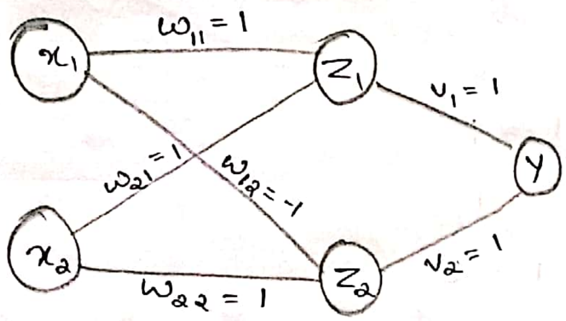
$[0,0]$ $Y_{in} = 0$

$[0,1]$ $Y_{in} = 0 + 1 = 1$

$[1,0]$ $Y_{in} = 1 + 0 = 1$

$[0,0]$ $Y_{in} = 0$

$\theta = 1$, $\therefore V_1 = 1$ & $V_2 = 1$



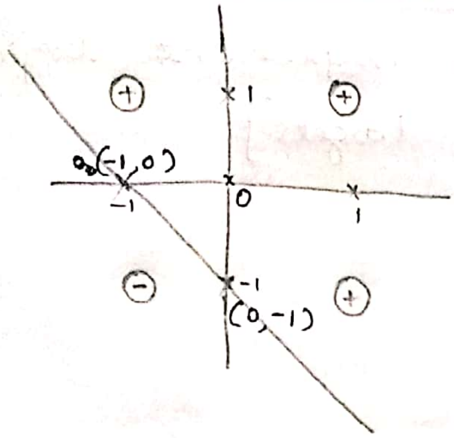
$$Y = f(y_{in}) = \begin{cases} 1, & y_{in} \geq 1 \\ 0, & y_{in} < 1 \end{cases}$$

22/8/19

Q7. Using the linear separability concept, obtain the response for OR fn. Take bipolar i/p as target.

Ans :-

x_1	x_2	y
-1	-1	-1
-1	1	1
1	-1	1
1	1	1



eq. of line :- $y = mx + C$

$$m = \frac{y_2 - y_1}{x_2 - x_1} \qquad (x_1, y_1) = (-1, 0) \quad (x_2, y_2) = (0, -1)$$

$$= \frac{-1 - 0}{0 - -1}$$

$$= \frac{-1}{1} = \underline{\underline{-1}}$$

$(x, y) = (-1, 0)$

$y = mx + c$

$0 = -1 \times -1 + c$

$c = 0 - 1 = \cancel{\ } \ \underline{\underline{-1}}$

$\therefore$ Eq. of line, $\underline{\underline{y = -x - 1}}$

$$x_2 = -x_1 - 1 \quad \text{——— (1)}$$

General eq. of line :-

$$x_2 = \frac{-b}{w_2} - \frac{w_1}{w_2} \cdot x_1 \quad \text{——— (2)}$$

compare (1) & (2),

$$\frac{b}{w_2} = 1 \quad \& \quad \frac{w_1}{w_2} = 1 = \frac{1}{1}$$

$$b = w_2 \quad \& \quad w_1 = w_2$$

$$\therefore w_1 = w_2 = b = 1$$

$$y_{in} = b + x_1 w_1 + x_2 w_2$$

x_1	x_2	y	y_{in}
-1	-1	-1	$1 + -1 - 1 = -1$
-1	1	1	$1 - 1 + 1 = 1$
1	-1	1	$1 + 1 - 1 = 1$
1	1	1	$1 + 1 + 1 = 3$

$\therefore y_{in} \geq 1$ ie. $\theta = \underline{\underline{1}}$

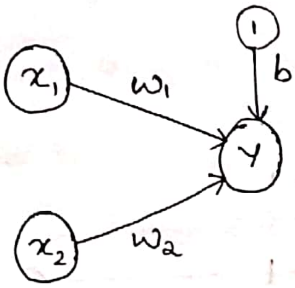
$$y = f(y_{in}) = \begin{cases} 1, & \text{if } y_{in} \geq 1 \\ -1, & \text{if } y_{in} < 1 \end{cases}$$

26/8/19

Q8. Design a hebb ~~network~~ to implement logical AND fn [use bipolar i/ps & targets]

x_1	x_2	y
1	1	1
1	-1	-1
-1	1	-1
-1	-1	-1

Step 1:-



$w_1 = 0$

$w_2 = 0$

$b = 0$

Step 2:- $x_1 = 1$, $x_2 = 1$

Step 3:- $y = 1$

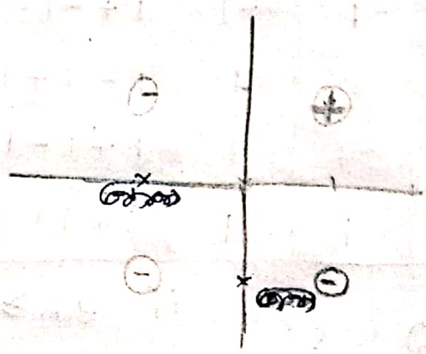
Step 4:- $\Delta w_i = x_i y$ & $\Delta b = y$

$w = w_{new} = w_{i\,old} + \Delta w_i$ $w_i(old) = 0$ · $b_{new} = b_{old} + y$

x_1	x_2	y	Δw_1 $x_1 y$	Δw_2 $x_2 y$	Δb y	w_1 0	w_2 0	b 0
1	1	1	1	1	1	0+1 = 1	0+1 = 1	0+1 = 1
1	-1	-1	-1	1	-1	0	2	0
-1	1	-1	1	-1	-1	1	1	-1
-1	-1	-1	1	1	-1	2	2	-2

$$x_2 = \frac{-b}{w_2} - \frac{w_1}{w_2} \cdot x_1$$

There are 4 pairs.



Scanned by CamScanner

i) $w_1 = 1$, $w_2 = 1$, $b = 1$

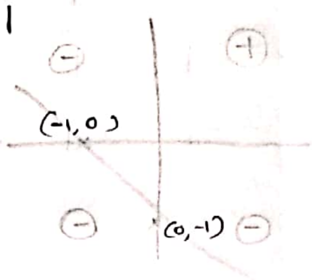
$$x_2 = \frac{-1}{1} - \frac{1}{1}x_1$$

$$x_2 = -1 - x_1$$

when $x_1 = 0$, $x_2 = -1$

when $x_2 = 0$, $0 = -1 - x_1 \implies x_1 = -1$

$\therefore$ $(0,-1)$ & $(-1,0)$

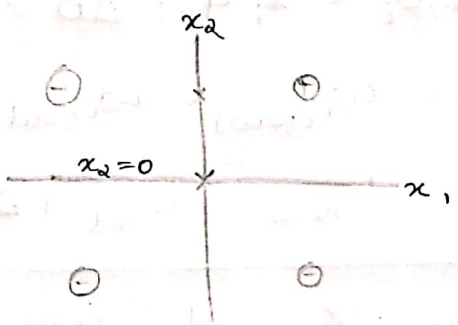


It does not separate $-$ve & $+$ve responses. So, it is not the final weights.

ii) $w_1 = 0$, $w_2 = 2$, $b = 0$

$$x_2 = -\frac{0}{2} - \frac{0}{2}.x_1$$

$$x_2 = 0$$



iii) $w_1 = 1$, $w_2 = 1$, $b = -1$

$$x_2 = \frac{-1}{1} - \frac{1}{1}.x_1$$

$$x_2 = +1 - x_1$$

when $x_1 = 0$, $x_2 = 1$

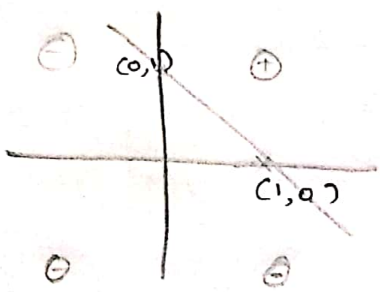
$x_2 = 0$, $x_1 = 1$

$(0,1)$ $(1,0)$

iv) $w_1 = 2$, $w_2 = 2$, $b = -2$.

$$x_2 = -\frac{-2}{2} - \frac{2}{2}x_1$$

$$x_2 = 1 - x_1$$

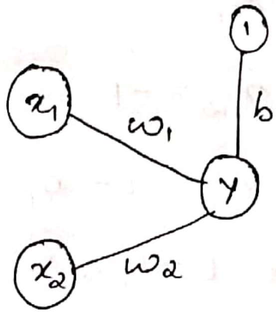


$\therefore$ $w_1 = 1$, $w_2 = 1$, $b = -1$ or

$w_1 = 2$, $w_2 = 2$, $b = -2$.

Q9. Design a hebb net to implement OR fn.
[use bipolar i/ps & target]

x_1	x_2	y
1	1	1
1	-1	1
-1	1	1
-1	-1	-1



$w_1 = 0$, $w_2 = 0$, $b = 0$

$x_1 = 1$, $x_2 = 1$ & $y = 1$.

$\Delta w_i = x_i y$.; $\Delta b = y$

$w = w_{i(new)} = w_{i(old)} + \Delta w_i$

$b_{new} = b_{old} + \Delta b$

x_1	x_2	y	Δw_1 $x_1 y$	Δw_2 $x_2 y$	Δb y	w_1 0	w_2 0	b 0
1	1	1	1	1	1	1	1	1
1	-1	1	1	-1	1	2	0	2
-1	1	1	-1	1	1	1	1	3
-1	-1	-1	1	1	-1	2	2	2