Advait Pai

677368201

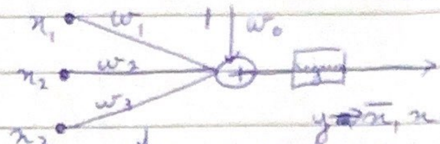
Assignment - 1

- Creating first layer of $\bar{x}_1 x_2 x_3$ & $x_1 \bar{x}_2$

Q.1

x_1	x_2	x_3	$(\bar{x}_1 x_2 x_3)$ Output 1	Signum Input
-1	-1	-1	-1	< 0 - I
-1	-1	1	-1	< 0 - II
-1	1	-1	-1	< 0 - III
-1	1	1	1	> 0 - IV
1	-1	-1	-1	< 0 - V
1	-1	1	-1	< 0 - VI
1	1	-1	-1	< 0 - VII
1	1	1	-1	< 0 - VIII

∴ To build a ~~cell~~ perceptron as shown below



$y = \bar{x}_1 x_2 x_3$

where $y = \text{signum}(w_0 + x_1 w_1 + x_2 w_2 + x_3 w_3)$

We need to find the weights w_0; w_1; w_2; w_3 such that output $= \bar{x}_1 x_2 x_3$

∴ The generalized equation for the perceptron output is $\boxed{y = \text{signum}(w_0 + w_1 x_1 + w_2 x_2 + w_3 x_3)}$, which must satisfy the conditions of < 0 or > 0 as shown in the table.

We assume $\boxed{w_0 = -2;\ w_1 = -1;\ w_2 = +1;\ w_3 = +1}$

- For $x_1 = -1$; $x_2 = -1$; $x_3 = -1$

  $y = (-2).(+1) + (-1).(-1) + (+1).(-1) + (1)(-1)$

  $= -2 + 1 - 1 - 1 = -3$

  I → Satisfied

- For $x_1 = -1$; $x_2 = -1$; $x_3 = +1$

  $y = -1$ II → Satisfied

- For $x_1 = -1$; $x_2 = 1$; $x_3 = -1$

  $y = -1$ III → Satisfied

- For $x_1 = -1$; $x_2 = 1$; $x_3 = 1$

  $y = +1$ IV → Satisfied

For $x_1 = 1$; $x_2 = -1$; $x_3 = -1$

$y = -5$ V → Satisfied

For $x_1 = 1$; $x_2 = -1$; $x_3 = +1$

$y = -3$ VI → Satisfied

For $x_1 = 1$; $x_2 = 1$; $x_3 = -1$

$y = -3$ VII → Satisfied

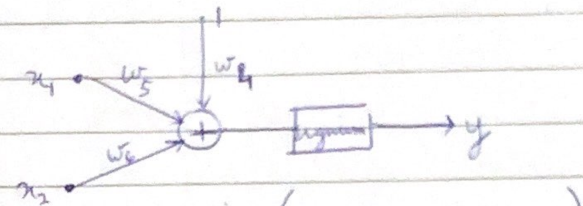
For $x_1 = 1$; $x_2 = 1$; $x_3 = 1$

$y = -1$ VIII → Satisfied

∴ All conditions satisfied the weights are ACCURATE

- Now $x_1 \overline{x_2}$:

x_1	x_2	$x\overline{x_2}$	Output
-1	-1	-1	< 0 - I
-1	1	-1	< 0 - II
1	-1	1	> 0 - III
1	1	-1	< 0 - IV



$y = \text{signum}(w_4 + w_5 x_1 + w_6 x_2)$

& $y \longrightarrow x_1\overline{x_2}$

$\therefore$ Now we assume $w_4 = -1$; $w_5 = 1$; $w_6 = -1$

- For $x_1 = -1$; $x_2 = -1$
  $y = -1$ (I) $\rightarrow$ satisfied

  For $x_1 = 1$; $x_2 = -1$
  $y = 1$ (III) $\rightarrow$ satisfied

- For $x_1 = -1$; $x_2 = 1$
  $y = -3$ (II) $\rightarrow$ satisfied

  For $x_1 = 1$; $x_2 = 1$
  $y = -1$ (IV) $\rightarrow$ satisfied

$\therefore$ All conditions satisfied, weights are accurate

- Now we need to build the second layer having inputs: u & v where $u = \overline{x_1} x_2 x_3$
  $v = x_1 \overline{x_2}$

Output: $u + v$

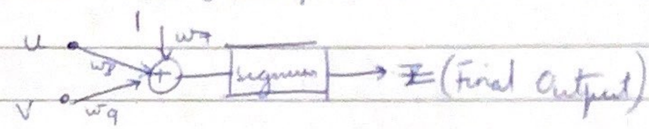
P.T.O

- For $u + v$ (Simple OR gate)

u	v	$u+v$	Output
-1	-1	-1	< 0 - I
-1	1	1	> 0 - II
1	-1	1	> 0 - III
1	1	1	> 0 - IV

For the OR gate we can use the weights

$w_7 = w_8 = w_9 = 1$



- For $u=-1;\ v=-1$

  $z = -1$ I $\rightarrow$ Satisfied

  For $u=1;\ v=-1$

  $z = 1$ III $\rightarrow$ Satisfied

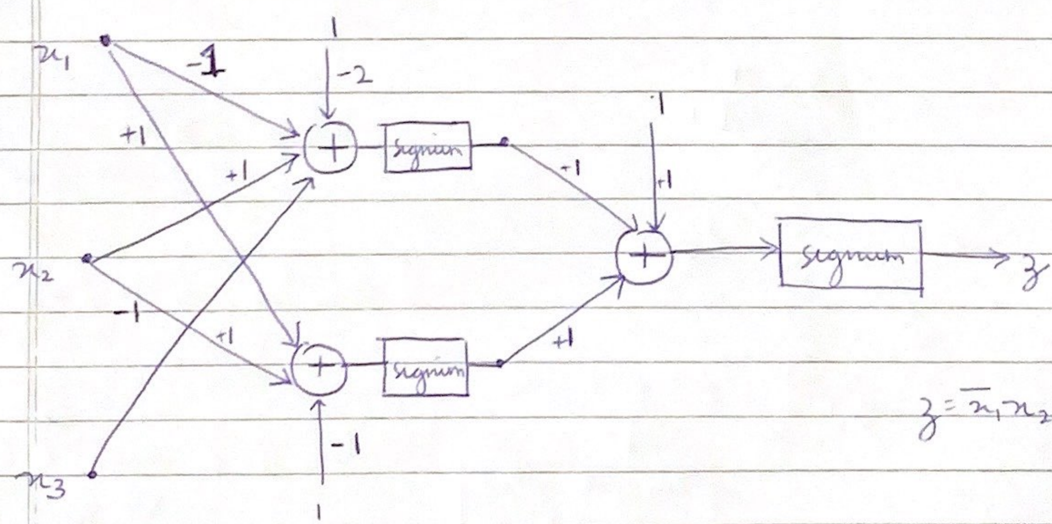
- For $u=-1;\ v=1$

  $z = 1$ II $\rightarrow$ Satisfied

  For $u=1;\ v=1$

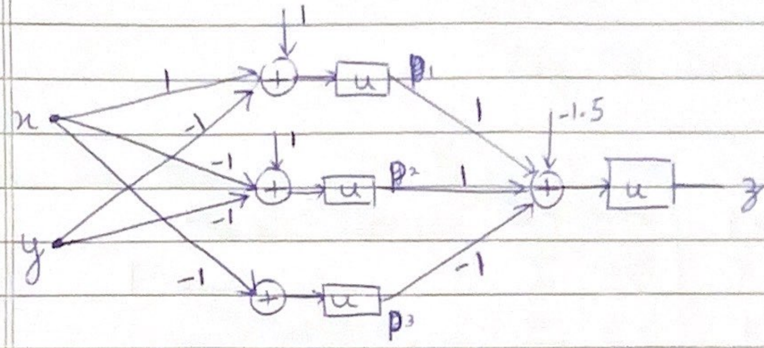
  $z = 3$ IV $\rightarrow$ Satisfied

* Final Network



$z = \bar{x}_1 x_2 x_3 + x_1 \bar{x}_2$

Q2.



$p_1 = u(1+x-y)$; $p_2 = u(1-x-y)$; $p_3 = u(-x)$ — (1)

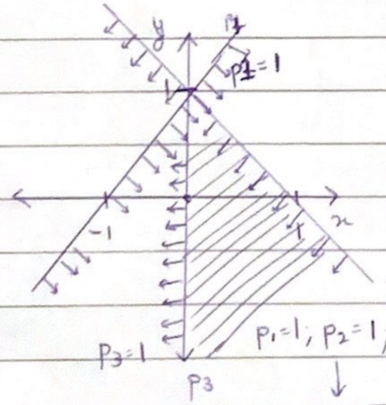
$z = u(-1.5 + p_1 + p_2 - p_3)$ — (2)

Now we find all such x & y where $-1.5 + p_1 + p_2 - p_3 = z = 1$

x	y	p_1	p_2	p_3	z
0	0	1	1	1	0
0	1	1	1	1	0
1	0	1	1	0	1
1	1	1	0	0	0

(We get p_1, p_2, p_3 by substituting x & y in (1))

← This is the condition we need to draw the graph for.



$p_1 = 1$; $p_2 = 1$; $p_3 = 0$
↓
$\boxed{\text{This gives output } z = 1}$

∴ Line for $p_1 \Rightarrow 1 + x - y = 0$
∴ $1 - x = y \rightarrow$ Points $(0,1)$, $(-1,0)$

Line for $p_2 \Rightarrow 1 - x - y = 0$
$1 - x = y \rightarrow$ Points $(0,1)$, $(1,0)$

Line for $p_3 \rightarrow -x = 0$ (Y axis)
∴ We need output of 0 for this line