Deep Learning

Digital Assignment - I

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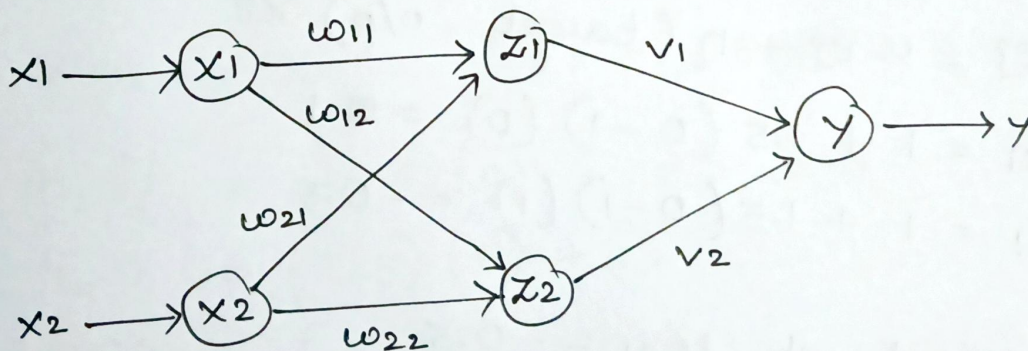
1) Implement XOR function using perceptron

Truth Table

X1	X2	Y
0	0	0
0	1	1
1	0	1
1	1	0

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

$$y = z_1 + z_2$$

$$f(y_{in}) = \begin{cases} 1 & \text{eb} \quad y_{in} \geq \theta \\ 0 & \text{eb} \quad y_{in} < \theta \end{cases}$$

$z_1 = x_1 \overline{x_2}$

Assume :   weights $\omega_{11} = \omega_{21} = 1$

   Threshold $= 1$

   Learning rate $(\eta) = 1.5$

$(x_1, x_2) \rightarrow (0, 0)$ o/p $= 0$

x_1	x_2	$\overline{x_2}$	z_1
0	0	1	0
0	1	0	0
1	0	1	1
1	1	0	0

$z_1 = \omega_{ij} * x_i$

$\quad = 1(0) + 1(0) = 0$

$(x_1, x_2) \rightarrow (0, 1)$ o/p $= 0$

$z_1 = 1(0) + 1(1) = 1$

new weights

$\omega_{ij} = \omega_{ij} + \eta \, (\text{target} - \text{o/p}) \, x_i$

$\omega_{11} = 1 + 1.5 \, (0-1) \, (0) = 1$

$\omega_{21} = 1 + 1.5 \, (0-1) \, (1) = -0.5$

So, $\omega_{11} = 1$ & $\omega_{21} = -0.5$

   Threshold $= 1$

   $\eta = 1.5$

(x_1, x_2)

$(0,0) = 1(0) + (-0.5)(0) = 0$

$(0,1) = 1(0) + (-0.5)(1) = -0.5 \simeq 0$

$(1,0) = 1(1) + (-0.5)(0) = 1$

$(1,1) = 1(1) + (-0.5)(1) = 0.5 \simeq 0$

$z_2 = \overline{x_1} x_2$

x_1	$\overline{x_1}$	x_2	z_2
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0

$\omega_{12} = -0.5$, $\omega_{22} = 1$, $\theta = 1$, $\eta = 1.5$

$(0,0) = (-0.5)(0) + 1 * 0 = 0$

$(0,1) = (-0.5)(0) + (1)(1) = 1$

$(1,0) = (-0.5)(1) + (1)(0) = -0.5 \simeq 0$

$(1,1) = (-0.5)(1) + (1)(1) = 0.5 \simeq 0$

$y = z_1 \text{ OR } z_2$

$y_{en} = z_1 v_1 + z_2 v_2$

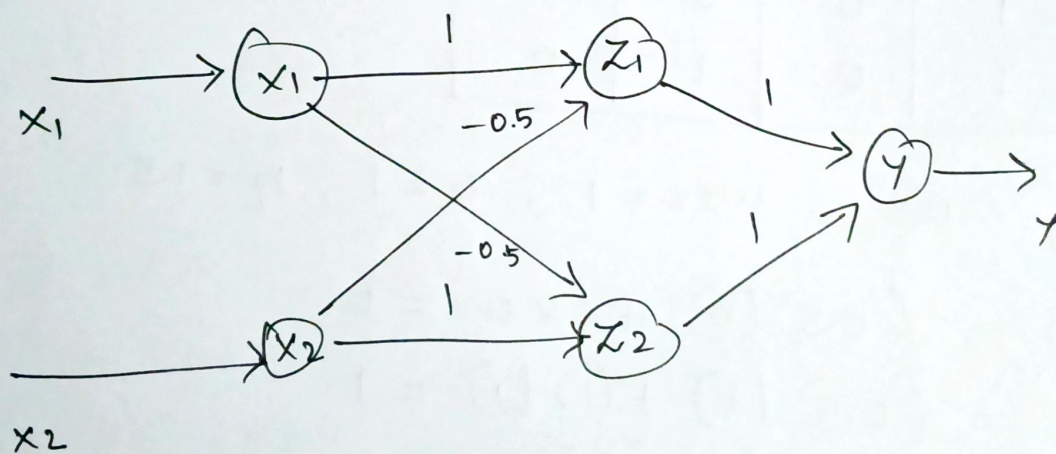| x_1	x_2	z_1	z_2	y
0	0	0	0	0
0	1	0	1	1
1	0	1	0	1
1	1	0	0	0

$v_1 + v_2 = 1$

$\theta = 1 \qquad \eta = 1.5$

$(0,0) \longrightarrow y_{en} = 0$

$(0,1) \longrightarrow y_{en} = 1$

$(1,0) \longrightarrow y_{en} = 1$

$(\cancel{0,0}) \longrightarrow y_{en} = 0$

2.

X → hours worked

Y → no. of toys fabricated

X	Y	$x - \bar{x}$	$y - \bar{y}$	$(x - \bar{x}) * (y - \bar{y})$
1	10	−4.5	−14.1	63.45
2	22	−3.5	−2.1	7.35
3	15	−2.5	−9.1	22.75
4	20	−1.5	−4.1	6.15
5	31	−0.5	6.9	−3.45
6	45	0.5	20.9	10.45
7	18	1.5	−6.1	−9.15
8	17	2.5	−7.1	−17.75
9	23	3.5	−1.1	−3.85
10	40	4.5	15.9	71.55

$\bar{x} = 5.5$

$\bar{y} = 24.1$

$\sum(x - \bar{x})^2 = 82.5$

$\sum(x - \bar{x}) * (y - \bar{y}) = 147.5$

$$y = mx + c$$

$$m = \frac{\sum(x - \bar{x}) * (y - \bar{y})}{\sum(x - \bar{x})^2}$$

$$m = \frac{147.5}{82.5}$$

$$\boxed{m = 1.7878}$$

$$\bar{y} = m\bar{x} + c$$

$$c = \bar{y} - m\bar{x}$$

$$= 24.1 - (1.7878)(5.5)$$

$$= 24.1 - 9.834$$

$$= 14.266$$

If $x = 2.5$ hrs then toys manufactured (y) is

$$y = (1.7878)(2.5) + 14.266$$

$$y = 4.4695 + 14.266$$

$$y = 18.7355$$

If $x = 15$ hrs then toys manufactured (y) is

$$y = (1.7878)(15) + 14.266$$

$$= 26.817 + 14.266$$

$$= 41.083$$