XOR GATE USING MADALINE.

1

→ Madaline network is used to implement XOR function with bipolar inputs and targets.

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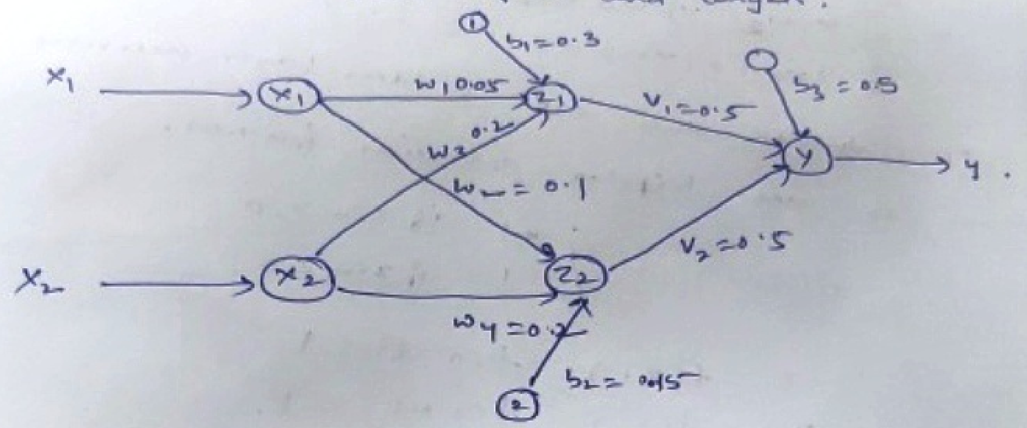

→ The weights between input and hidden layers are adjustable.

→ The weights between hidden and output layer is fixed they are not adjustable.

If the target and obtained are same then no problem. Otherwise we need to adjust the weights at input hidden layer.

x_1	x_2	t
1	1	−1
1	−1	1
−1	1	1
−1	−1	−1

Assume the learning rate as 0.5

For first input $x_1=1$, $x_2=1$ and target = −1

Calculate the input to hidden layer. (2)

$z_1 = x_1 w_1 + x_2 w_3 + b_1$

$= 1 \times 0.5 + 1 \times 0.2 + 0.3 = 0.55$

$z_2 = x_1 w_2 + x_2 w_4 + b_2$

$= 1 \times 0.1 + 1 \times 0.2 + 0.15 = 0.45$

To calculate the o/p hidden layer neurons, we have to use bipolar activation function.

$$f(z_{in}) = \begin{cases} +1 & \text{if } z_{in} \geq 0 \\ -1 & \text{if } z_{in} < 0. \end{cases}$$

$\therefore z_1 = f(z_1) = f(0.55) = 1$

$z_2 = f(z_2) = f(0.45) = 1.$

$y_{in} = z_1 v_1 + z_2 v_2 + b_3$

$= 1 \times 0.5 + 1 \times 0.5 + 0.5 = \underline{1.5}$

$f(y_{in}) = f(1.5) = 1$

Updating the weights and bias on both hidden units, we obtain.

$w_i(new) = w_i(old) + \alpha(t - o)x_i$

$b(new) = b(old) + \alpha(t - o).$

$\therefore w_1(new) = w_1(old) + \alpha(t - o)x_i$

$= 0.5 + 0.5(-1 - 0.55) \times 1 = -0.725$

$w_2(new) = w_2(old) + \alpha(t - o)x_2$

$= 0.5 + 0.5(-1 - 0.45) \times 1 = -0.625$

$b_1(new) = b_1(old) + \alpha(t - o) = 0.3 + 0.5(-1 - 0.55)$

$= -0.475$

(3)

w_3 new $= w_3$ new $+ \alpha(t - o)x_2$

$= 0.2 + 0.5(-1 - 0.55) = -0.575$

w_4 new $= w_4$ new $+ \alpha(t - o)x_2$

$= 0.2 + 0.5(-1 - 0.45) \times 1 = -0.525$

$b_2(\text{new}) = b_2(\text{old}) + \alpha(t - o)$

$= 0.15 + 0.5(-1 - 0.45) = -0.575$.

After 3 Epoch we will then get the Correct o/p.

$$\boxed{\begin{array}{l} w_1 = 1.32,\ w_2 = -1.34,\ w_3 = -1.29,\ w_4 = 1.29. \\ b_1 = -1.07 \qquad b_2 = -1.08 \end{array}}$$