Hebb's Learning [Hebbian] UNSUPERVISED LEARNING

1) Set all weights to zero, $w_i = 0$ for $i = 1$ to n, and bias to zero.

2) For each input vector and target repeat follows steps 3–4.

3) Set activations for input units with the input vector $x_i = s_i$ for $i = 1$ to n.

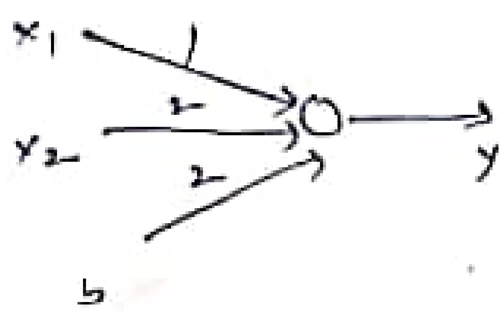
4) update the weights and bias by applying Hebb rule $i = 1$ to n

Activation function $\Delta w = x_i \cdot y$, where $i = 1$ to n.

OR GATE

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

$W_{new} = W_{old} + x_i y$.



Initially all the weights & bias = 0.

1st iteration

$W_{new} = [0 \quad 0 \quad 0] + [-1 \quad -1 \quad 1] \cdot (-1)$

$= [0 \quad 0 \quad 0] + [1 \quad 1 \quad -1] = [1 \quad 1 \quad -1]$

2nd iteration

weight $= [1 \quad 1 \quad -1] + [1 \quad -1 \quad 1]$

$= [1 \quad 1 \quad -1] + [1 \quad -1 \quad 1]$

$= [1 \quad 0 \quad 0]$

3rd iteration $= [1 \quad 0 \quad 0] + [-1 \quad 1 \quad 1](1)$

$= [1 \quad 0 \quad 0] + [-1 \quad 1 \quad 1]$

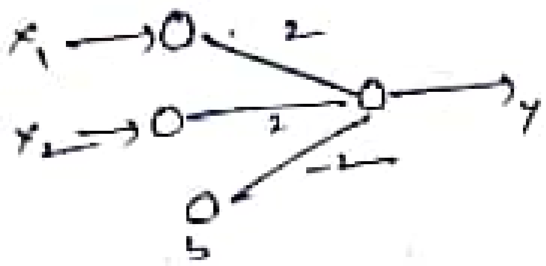
$= [0 \quad 1 \quad 1]$

4th iteration $= [0 \quad 1 \quad 1] + [1 \quad 1 \quad 1](1)$

$= [1 \quad 2 \quad 2]$.

AND GATE

-1	-1	1	-1
1	-1	1	-1
-1	1	1	-1
1	1	1	1



1st iteration

$$W_{new} = [0 \quad 0 \quad 0] + [-1 \; -1 \; 1](-1)$$
$$= [1 \quad 1 \quad -1]$$

2nd iteration

$$W_{new} = [1 \quad 1 \; -1] + [1 \; -1 \quad 1](-1)$$
$$= [1 \quad 1 \; -1] + [-1 \quad 1 \; -1]$$
$$= [0 \quad 2 \; -2]$$

3rd iteration

$$W_{new} = [0 \quad 2 \; -2] + [-1 \quad 1 \quad 1](-1)$$
$$= [0 \quad 2 \; -2] + [1 \; -1 \; -1]$$
$$= [1 \quad 1 \; -3]$$

4th iteration

$$= [1 \quad 1 \; -3] + [1 \quad 1 \quad 1](1)$$
$$= [1 \quad 1 \; -3] + [1, \; 1 \quad 1]$$
$$= [2 \quad 2 \; -2]$$

+1	-1	+1
	+1	
-1	-1	-1

+1	+1	-1
+1		-1
+1	-1	-1

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	b	y
1	1	1	1	-1	1	-1	1	1	1	1	1
0	1	1	1	1	-1	1	1	1	1	1	-1

$w_1 = w_2 = w_3 = w_4 = w_5 = w_6 = w_7 = w_8 = w_9 = b = 0.$

$w_1 = w_{old} + x_i \cdot y = 0 + 1 \cdot 1 = 1$

$w_2 = 0 + 1 \cdot 1 = 1$ $\quad w_3 = 0 + 1 \cdot 1 = 1$ $\quad w_4 = 0 + -1 \cdot 1 = -1$

$w_5 = 0 + 1 \cdot 1 = 1$, $\quad w_6 = 0 + -1 \cdot 1 = -1$ $\quad w_7 = 0 + 1 \cdot 1 = 1$

$w_8 = 0 + 1 \cdot 1 = 1$ $\quad w_9 = 0 + 1 \cdot 1 = 1$ $\quad b = 0 + 1 \cdot 1 = 1$

$w_1 = 1 + 1 \times -1 = 0$ $\quad w_2 = 1 + 1 \times -1 = 0$ $\quad w_3 = 0 + 1 \cdot -1 = 0$

$w_4 = -1 + 1 \times -1 = \underline{\underline{-2}}$ $\quad w_5 = 1 + 1 \times 1 = \underline{\underline{2}}$ $\quad w_6 = -1 + 1(-1) = \underline{\underline{-2}}$

$w_7 = 1 + 1 - 1 = 0$ $\quad w_8 = 1 + 1 \times -1 = 0$ $\quad w_9 = 1 + 1 \times -1 = 0$

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