Design a Hebb net to implement logical AND function

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

→ Initially the weights and bias are set to 0

$\therefore w_1 = w_2 = b = 0$

First input $[x_1\ x_2\ b] = [1\ 1\ 1]$

target = 1 i.e. $y = 1$

set the initial weights as old weights and apply hebb rule.

$w(new) = w(old) + \Delta w$

$\Delta w = xy$

$\therefore \Delta w_1 = x_1 y = 1 * 1 = 1$

$\Delta w_2 = x_2 y = 1 * 1 = 1$

$\Delta b = y = 1$

$w_1(new) = w_1(old) + \Delta w_1$

$= 0 + 1 = 1$

$w_2(new) = w_2(old) + \Delta w_2$

$= 0 + 1 = 1$

$b(new) = b(old) + \Delta b$

$= 0 + 1 = 1$

New weight and bias vector = [1 1 1]

Second input $[x_1 \; x_2 \; b] = [1 \; -1 \; *]$

$b = y = -1$

$\therefore \Delta w_1 = x_1 y = +1 * (-1) = -1$

$\Delta w_2 = x_2 y = (-1) * (-1) = 1$

$\Delta b = y = -1$

$\therefore w_1(new) = w_1(old) + \Delta w_1$

$= 1 + (-1) = 0$

$w_2(new) = w_2(old) + \Delta w_2$

$= 1 + 1 = 2$

$b(new) = b(old) + \Delta b$

$= 1 - 1 = 0$

∴ new weight and bias vector = [0 2 0]

Third input $[x_1\ x_2\ b] = [-1\ \ 1\ \ -1]$

$= [-1\ \ 1\ \ -1]$

~~$\Delta w_1 = w_1(old) + \Delta$~~

~~$w_1(new) = w_1(old) + \Delta w_1$~~

~~$= 0+1$~~

$\Delta w_1 = x_1 y = (-1) * (-1) = 1$

$\Delta w_2 = x_2 y = (1) * (-1) = -1$

$\Delta b = y = -1$

$\therefore w_1(new) = w_1(old) + \Delta w_1$

$= 0 + 1 = 1$

$w_2(new) = w_1(old) + \Delta w_2$

$= 2 + (-1) = 1$

$b(new) = b(old) + \Delta b$

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

∴ New weight and bias vector = [1 1 −1]

Fourth input $[x_1\ x_2\ b] = [-1\ \ -1\ \ -1]$

$\Delta w_1 = x_1 y = (-1) * (-1) = 1$

$\Delta w_2 = x_2 y = (-1) * (-1) = 1$

$\Delta b = y = -1$

$\therefore w_1(new) = w_1(old) + \Delta w_1$

$= 1 + 1 = 2$

$w_2(new) = w_2(old) + \Delta w_2$

$= 1 + 1 = 2$

$b(new) = b(old) + \Delta b$

$= -1 - 1 = -2$

$\therefore$ Final weight and bias vectors: $[2 \quad 2 \quad -2]$

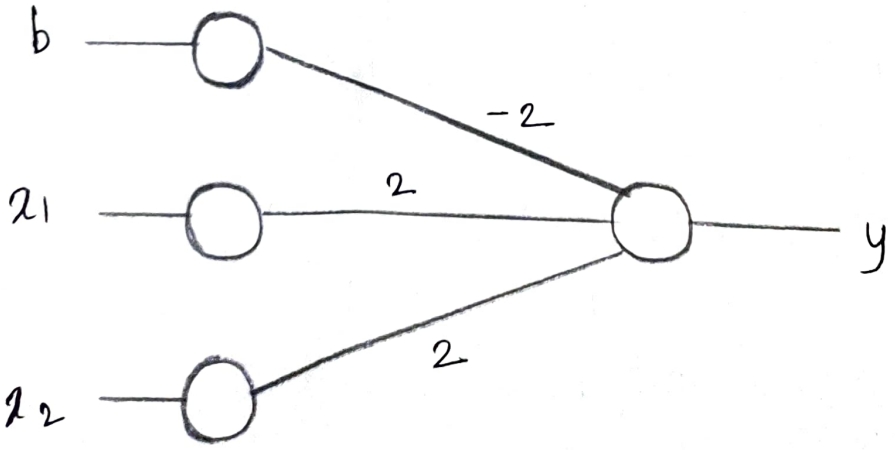

fig. Hebb Network for AND function

Network Test:

For $x_1 = 1$ $x_2 = 1$ $b = 1$

$y = 2 + 2 - 2 = 2$ (positive value)

For $x_1 = 1$ $x_2 = -1$ $b = 1$

$y = 2 - 2 - 2 = -2$ (-ve value)

For $x_1 = -1$ $x_2 = 1$ $b = 1$

$y = -2 + 2 - 2 = -2$ (-ve value)

For $x_1 = -1$ $x_2 = -1$ $b = 1$

$y = -2 - 2 - 2 = -6$ (-ve value)

The final answers (+, -, -, -) aligns with final value of AND logic i.e. (1, -1, -1, -1).