Mc Culloch Pitts Neuron

MCP model:

↳ directed weight paths
↳ neuron may/may not fire.
↳ weights may be excitatory or inhibitory.
↳ all excitatory wts into a particular neuron have same wts.
↳ fixed threshold.

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

$$\theta > nw - p$$

O/p will fire if it receives 'k' or more excitatory i/p's but no inhibitory
i/p's

$$kw \geq \theta > (k-1)w.$$

AND Table using MCP

(3)

x_1	x_2	y
1	1	1
1	0	0
0	1	0
0	0	0

Assume $w_1 = w_2 = 1$

$y_{in1} = 1\times1 + 1\times1 = 2$

$y_{in2} = 1\times1 + 0\times1 = 1$

$y_{in3} = 0\times1 + 1\times1 = 1$

$y_{in4} = 0\times1 + 0\times1 = 0$

$\boxed{\theta = 2}$

$$y = f(y_{in}) = \begin{cases} 1 & \text{if } y_{in} \geq 2 \\ 0 & y_{in} < 2. \end{cases}$$

ANDNOT Table

x_1	x_2	y
0	0	0
0	1	0
1	0	1
1	1	0

$w_1 = 1$

$w_2 = -1$

$\boxed{\theta = 1}$

$y_{in1} = 0\times1 + 0\times(-1) = 0$

$y_{in2} = 0\times1 + 1\times-1 = -1$

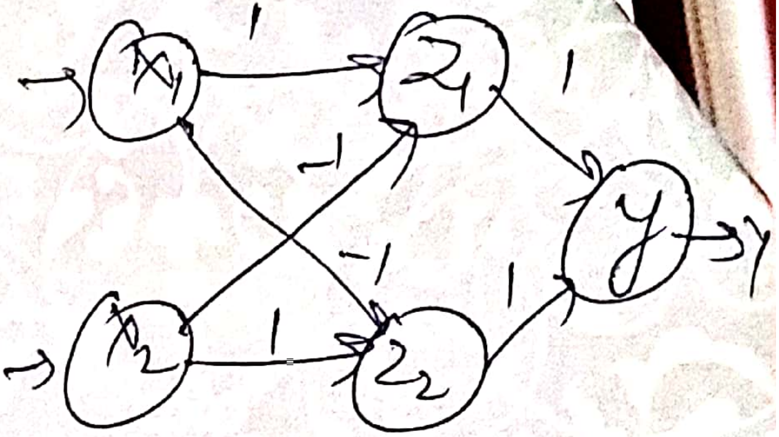
$y_{in3} = 1\times1 + 0\times-1 = 1$

$y_{in4} = 1\times1 + 1\times-1 = 0$

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

XOR Gate using MCP

x_1	x_2	y
0	0	0
0	1	1
1	0	1
1	1	0



$z_1 = x_1 \overline{x_2}$

$z_2 = \overline{x_1} x_2$

$y = z_1 \text{ OR } z_2$

x_1	x_2	z_1
0	0	0
0	1	0
1	0	1 (AND NOT)
1	1	0

x_1	x_2	z_2
0	0	0
0	1	1
1	0	0
1	1	0

z_1	z_2	y
0	0	0
0	1	1
1	0	1
0	0	0

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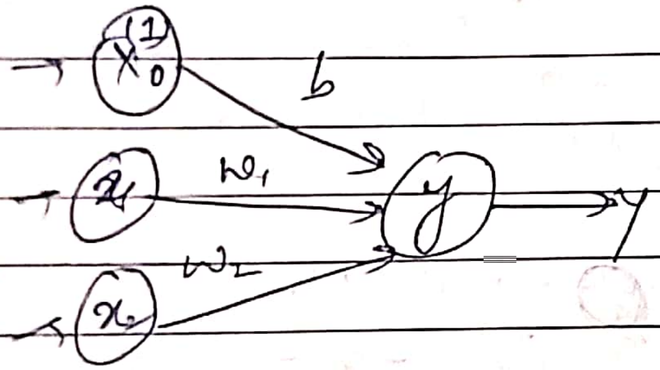
Linear Separability

$$y_{in} = b + \sum_{i=1}^{n} x_i w_i$$

Decision Boundary at region $y_{in} > 0$ & $y_{in} < 0$

$$b + \sum_{i=1}^{n} x_i w_i = 0$$



$$y_{in} = b + x_1 w_1 + x_2 w_2$$

$$b + x_1 w_1 + x_2 w_2 = 0$$

$$x_2 w_2 = -b - x_1 w_1$$

$$\boxed{x_2 = \frac{-b}{w_2} - \frac{x_1 w_1}{w_2}}$$

Compare

$y = mx + c$

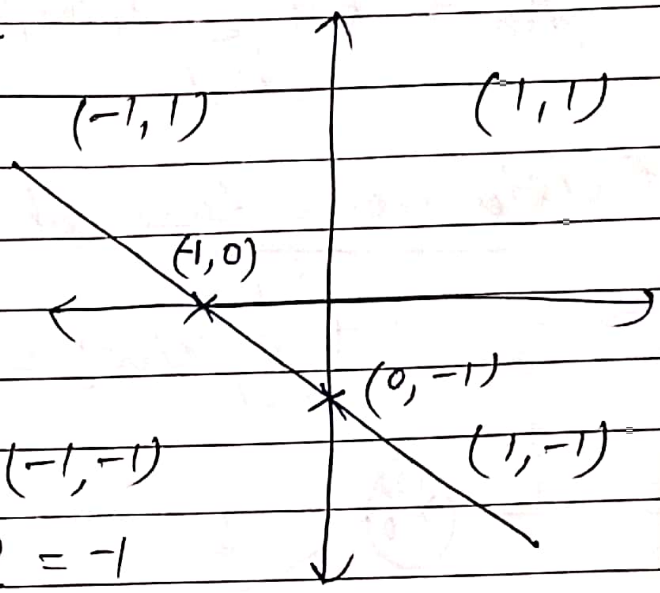
$c = -b/w_2$

$m = -w_1/w_2$

calculate values for b, w_1 & w_2

e concept of linear separability
to obtain response for OR func'n.
(bipolar i/ps & targets).

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



$(x_1, y_1) = (-1, 0)$
(x_2, y_2) $(0, -1)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1-0}{0+1} = -1$$

$y_1 = mx_1 + c \quad \therefore \; 0 = (-1)(-1) + c \quad \therefore \; c = -1$

$y = mx + c \quad \therefore \; \boxed{y = -x - 1} \qquad x_2 = -x_1 - 1$

$$x_2 = -\frac{x_1 w_1}{w_2} - \frac{b}{w_2}$$

$\therefore \; \boxed{w_1 = w_2 = b = 1}$

x_1	x_2	b	y_{in}
1	1	1	3
1	-1	1	1
-1	1	1	1
-1	-1	1	-1

$$y = \begin{cases} 1 & y_{in} \geq 1 \\ -1 & y_{in} < 1 \end{cases}$$

$y_1 = 1 \; ; \; y_3 = 1$
$y_2 = 1 \; ; \; y_4 = -1$

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