Perceptron

AND/OR Gate

Binary

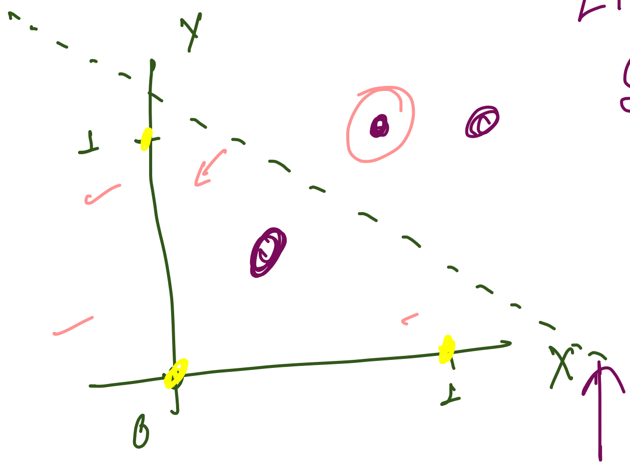
AND

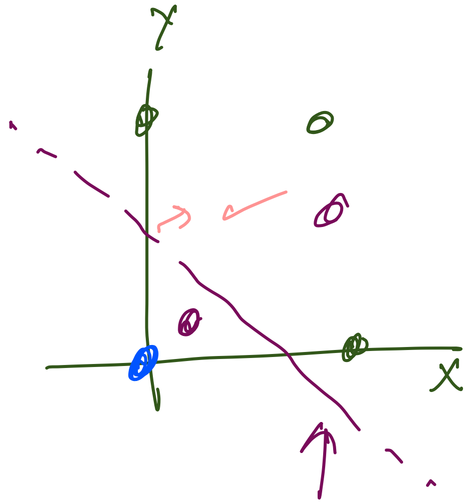
x_1	x_2	Y
0	0	0
0	1	0
1	0	0
1	1	1

OR

x_1	x_2	Y
0	0	0
0	1	1
1	0	1
1	1	1

Linearly Seperable



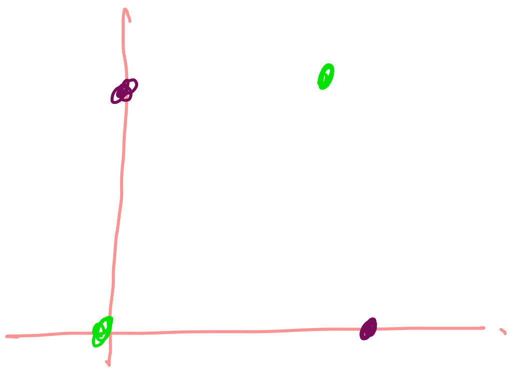


DS Decision Surface

D

XOR

x_1	x_2	Y
0	0	0
0	1	1
1	0	1
1	1	0

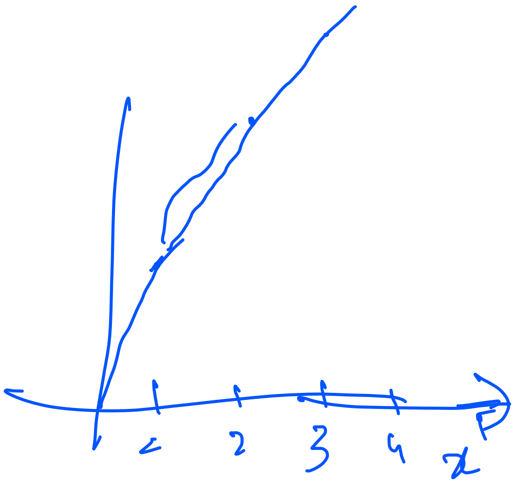


?

No

Can we have a linear decision surface ?

$y = 2x$ $\quad$ $y = 6x$



x	-1	2	3	5
y	-2	4	6	10

x	1	2	3	4	5
y	6	12	18	24	30

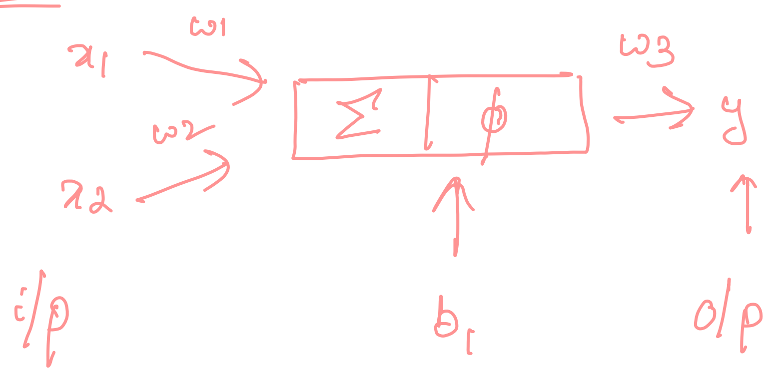
As we increase the value of x, the value of y expands linearly.

$y = 6x + C$

Linear or nonlinearly?

Plot the graph.

Single Perceptron



Σ = weighted average

$\phi \rightarrow$ Transfer function (TF)

$$w_3 \leftarrow \phi(x_1 w_1 + x_2 w_2 + b)$$

If TF was not there & $b = 0$ then

$$w_3 \leftarrow x_1 w_1 + x_2 w_2$$

let $w_2 = 0$

$$\boxed{w_3 \leftarrow x_1 w_1}$$

To intro non-linearity $\rightarrow$ transfer function has been used

also bias.

$$AI \rightarrow ML \rightarrow NN \rightarrow DL$$

AI - Artifical Intellegence

ML $\rightarrow$ Machine Learning

NN $\rightarrow$ Neural N/w

DL $\rightarrow$ Deep learning.

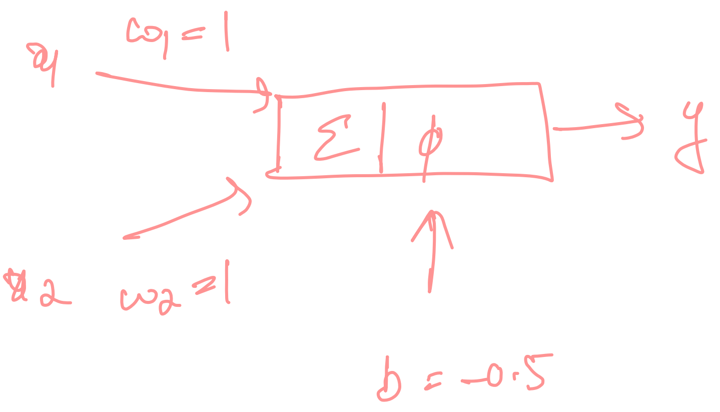
$$P = x_1 w_1 + x_2 w_2 + b$$

$$\phi(P) = \begin{cases} 0 & \Sigma x w + b \geq 0 \\ 1 & \text{otherwise} \end{cases}$$

XNOR

Non-linearity

Perceptron OR



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

$$\phi \quad y = \begin{cases} 0 & w \cdot x + b \leq 0 \\ 1 & \text{otherwise} \end{cases}$$

1st case

$x_1 = 0 \qquad x_2 = 0$

$$P = \underbrace{x_1 w_1 + x_2 w_2}_{0} + b$$

$$= -0.5 \leq 0$$

$$= 0 \checkmark$$

2nd

$x_1 = 0 \qquad x_2 = 1$

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

$$= 1 \times 1 - 0.5$$

$$= 0.5 > 0$$

$$= 1$$

3rd

$x_1 = 1 \qquad x_2 = 0$

$$P = 1 \times 1 + -0.5$$

$$= 0.5 > 0$$

$$= 1$$

4th

$x_1 = 1 \qquad x_2 = 1$

$$P = 1 \times 1 + 1 \times 1 - 0.5$$

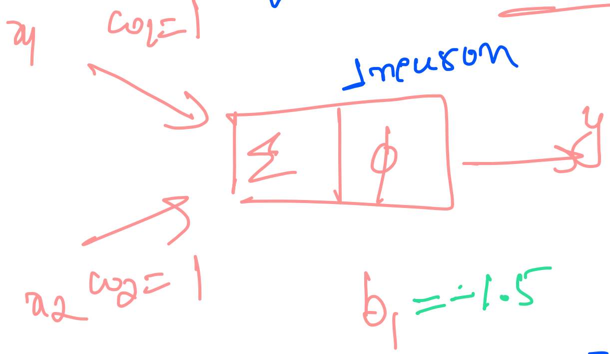
$$= 1.5 > 0$$

$$= 1$$

$$\boxed{w_1 = w_1} + \underbrace{\Delta w_1}_{\text{zero}}$$

$$w_1 = \eta \underbrace{(y - \hat{y})}_{\text{zero}} x_1$$

Perceptron AND



$b_1 = -1.5$

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

$$\phi = \begin{cases} 0 & w \cdot x + b \le 0 \\ 1 & \text{otherwise} \end{cases}$$

1st case $\quad x_1 = 0 \quad x_2 = 0$

$\phi(P) = \phi(x_1 w_1 + x_2 w_2 + b_1)$

$= \phi(-1.5) \le 0$

$= 0$

2nd $\quad x_1 = 0 \quad x_2 = 1$

$\phi(P) = \phi(x_1 w_1 + x_2 w_2 + b_1)$

$= \phi(0 \times 1 + 1 \times 1 + (-1.5))$

$= \phi(-0.5) \le 0$

$= 0$

3rd case $\quad x_1 = 1 \quad x_2 = 0$

$\phi(P) = \phi(x_1 w_1 + x_2 w_2 + b_1)$

$= \phi(-0.5) \le 0$

$= 0$

4th $\quad x_1 = 1 \quad x_2 = 1$

$\phi(P) = \phi(1 + 1 - 1.5)$

$= \phi(0.5) \ge 0$

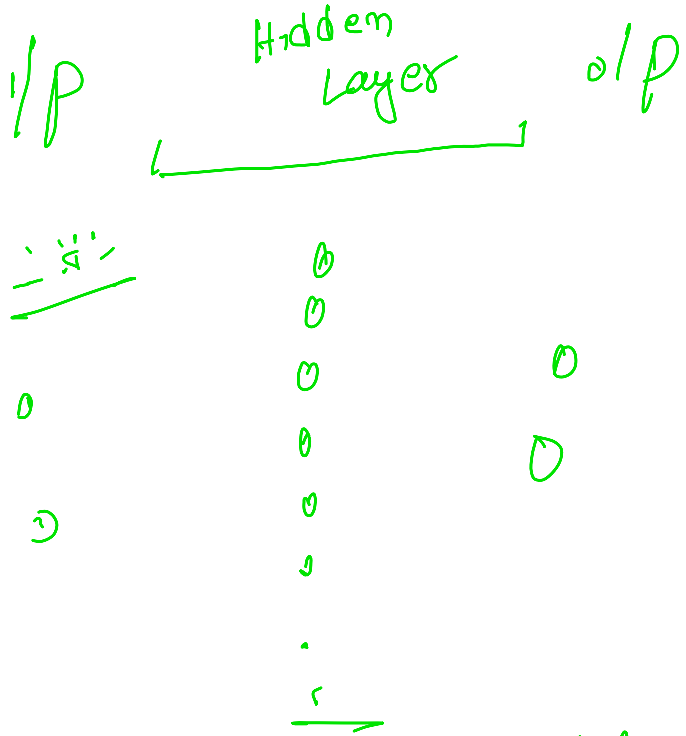
$= 1$

XOR

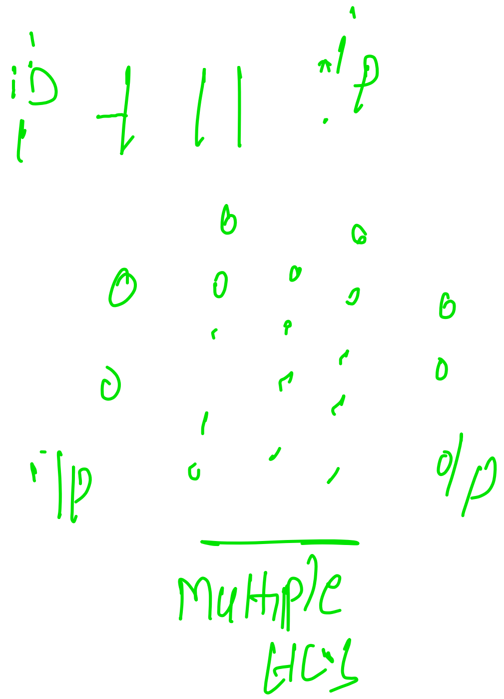
1 single neuron is enough ?

1 Hidden Layer

more than 1 HL



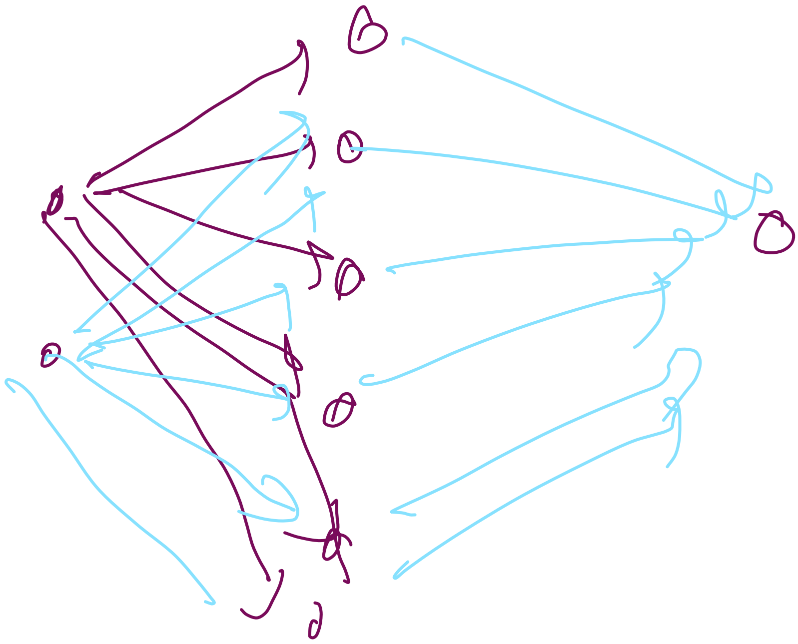
1HL with multiple neuron



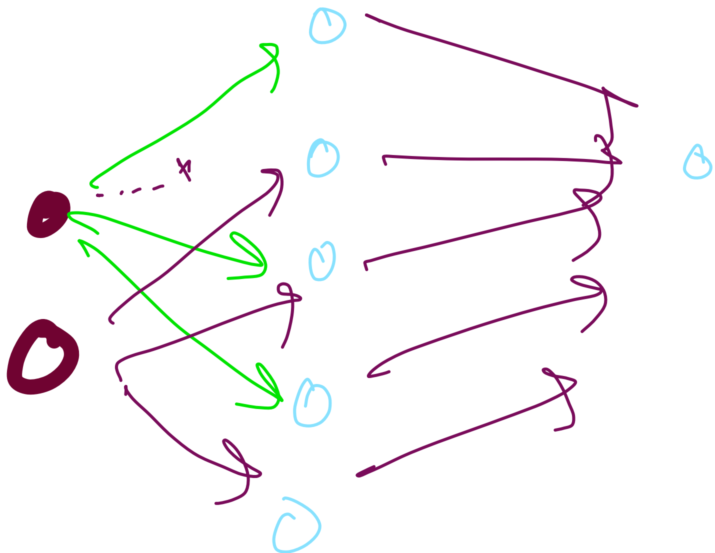
Fully Connected (FC)

- all neurons are connected to all other neurons

MLP → Multi Layer Perceptron



FL



Not FC