* CO544 - Machine Learning and Data Mining

* Tutorial 01 (Perceptron)

1. $x_1 + x_2 - 1.5$; $(w_0 = -1.5, w_1 = 1, w_2 = 1)$

Perceptron Algorithm says that

$$y = 1 \text{ if } \sum_{i=0}^{2} w_i * x_i \geq 0$$

$$= 0 \text{ if } \sum_{i=0}^{2} w_i * x_i < 0$$

Here $w_0 = -1.5$

$$\text{if } \sum_{i=1}^{2} w_i x_i + w_0 \geq 0 \Rightarrow \text{output} = 1$$

$$\text{if } \sum_{i=1}^{2} w_i x_i + w_0 < 0 \Rightarrow \text{output} = 0$$

for 1st row of AND logic table

$w_1 x_1 + w_2 x_2 + w_0$

$= 1.0 + 1.0 - 1.5 = -1.5 \leq 0$

So out = 0

for 2nd row of AND logic table

$w_1 x_1 + w_2 x_2 + w_0$

$= 1.0 + 1.1 - 1.5 = -0.5 \leq 0$

So out = 0

for 3rd row of AND logic table

$w_1 x_1 + w_2 x_2 + w_0$

$= 1.1 + 1.0 - 1.5 = -0.5 \leq 0$

So out = 0

for 4th row of AND logic table

$w_1 x_1 + w_2 x_2 + w_0$

$= 1.1 + 1.1 + (-1.5) = 0.5 \geq 0$

So out = 1

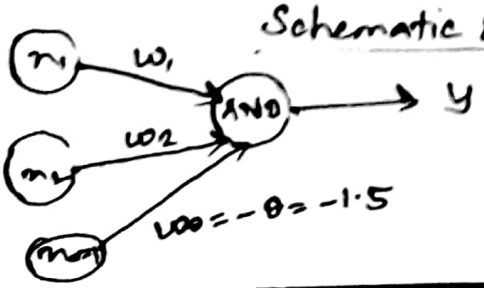
A	B	out
0	0	0
0	1	0
1	0	0
1	1	1

AND logic table

So, this perceptron model satisfies the AND logic so, it can be used to achieve an AND gate.

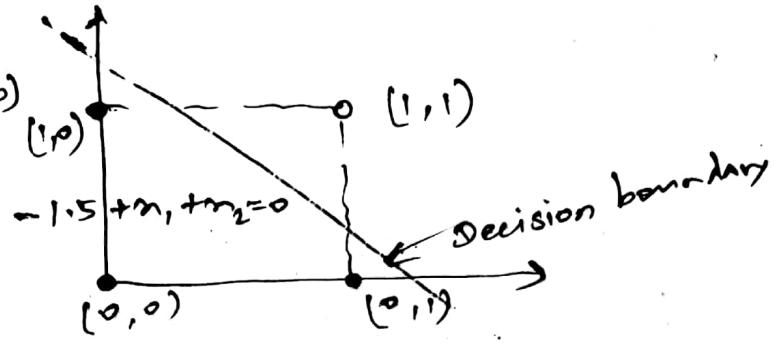
Schematic Diagram

(a)



1.

(b)



2.

$$y = \begin{cases} 1 & V \geq 3 \\ 0 & V < 3 \end{cases}$$; where V - output of the sigma function.

$$w_0 + \sum_{i=1}^{3} w_i x_i = w_0 + w_1 x_1 + w_2 x_2 + w_3 x_3$$

x_1	x_2	x_3	out
1	3	2	0
2	2	4	1
3	1	5	1
2	4	1	0
3	3	3	1

1st row $\Rightarrow$ $0.4 + 1\cdot(0.1) + (0.4)\cdot 3 + (0.5)\cdot 2$

$= 0.4 + 0.1 + 1.2 + 1$

$= 2.7 < 3 \Rightarrow$ out $= 0$

2nd row $\Rightarrow$ $0.4 + 2(0.1) + 3(0.4) + (0.5)\cdot 4$

$= 0.4 + 0.2 + 0.8 + 2$

$= 3.4 \geq 3 \Rightarrow$ out $= 1$

3rd row $\Rightarrow$ $0.4 + (0.1)\cdot 3 + (0.4)\cdot 1 + (0.5)\cdot 5$

$= 0.4 + 0.3 + 0.4 + 2.5$

$= 3.6 \geq 3 \Rightarrow$ out $= 1$

4th row $\Rightarrow$ $0.4 + (0.1)\cdot 2 + (0.4)\cdot 4 + (0.5)\cdot 1$

$= 0.4 + 0.2 + 1.6 + 0.5$

$= 2.7 < 3 \Rightarrow$ out $= 0$

5th row $\Rightarrow$ $0.4 + (0.1)\cdot 3 + (0.4)\cdot 3 + (0.5)\cdot 3$

$= 0.4 + 0.3 + 1.2 + 1.5$

$= 3.4 \geq 3 \Rightarrow$ out $= 1$

3.

x_1	x_2	d
0	0	0
0	1	1
1	0	1
1	1	1

OR gate

$$y = \begin{cases} 1 & v \geq 0.5 \\ 0 & v < 0.5 \end{cases}$$

threshold value $v = 0.5$, $\eta = 0.1$

Using Stochastic Gradient Decent (SGD) method for optimisation

initial weight parameter values $\Rightarrow w_1 = 0, w_2 = 0, w_0 = 0$.

$$e(n) = d(n) - y(n)$$

$$w_i(n+1) = w_i(n) + \eta * e(n) * x_i(n);$$

$i = 0, n = 0 \Rightarrow w_0(1) = w_0(0) + 0.1 * e(0) * x_0(0)$

$$w_0(1) = 0$$

$i = 1, n = 1 \Rightarrow w_1(2) = w_1(1) + 0.1 * e(1) * x_1(1)$

$$w_1(2) = 0 + 0.1 * 0 * 0 = 0$$

$i = 2, n = 2 \Rightarrow w_2(3) = w_2(2) + 0.1 * e(2) * x_2(2)$

$$w_2(3) = w_2(2) + 0.1 * 1 * 1 = 0.1$$

$i = 2, n = 3 \Rightarrow w_2(4) = w_2(3) + 0.1 * e(3) * x_2(3)$

$$w_2(4) = w_2(3) = 0.1$$

$i = 1, n = 2 \Rightarrow$ like similarly we can find

$$w_0(2) = w_1(2) = w_3(2) = 0$$

$$w_0(3) = w_2(3) = 0.1$$

$$w_1(3) = 0$$

$$w_0(4) = 0.2$$

$$w_1(4) = w_2(4) = 0.1$$

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