ARTIFICIAL NEURAL NETWORK

Unit-2: Perceptron

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- Single layer perceptron:

Consider 2 input AND Logic Gate

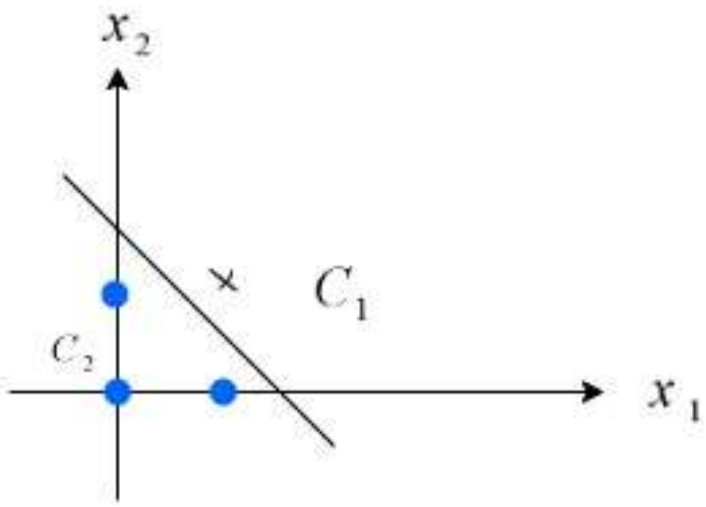
x	y	z
0	0	0
1	0	0
0	1	0
1	1	1

C_2

C_1

Single Layer Peceptron

- Lets design the 2 input AND gate using single layer perceptron using Rosennblatt's Algorithm



Rosenblatt's algorithm:

Let W(1) be any initial choice of the weight vector and X(k) be any sequence in $C_1 \cup C_2$

At the kth stage, Let W(k) be the weight vector

If X(k) is correctly classified, then no changes, i.e no updation of wieghts

Otherwise, updation in weights as follows

$$W(k+1) = W(k) + \begin{cases} -\eta X(k) & W^T(k)X(k) \geq 0 \,\&\, X(k) \in C_2 \\ \eta X(k) & W^T(k)X(k) < 0 \,\&\, X(k) \in C_1 \end{cases}$$

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Rosenblatt's algorithm:

Let W(1)=[0.1 1 1.1]',

X(1)=[1 0 0]

Learning rate=0.1

Iteration 1: n=1

$$v = W^T(1)X(1)$$

$$v = 0.1$$

$$\Rightarrow X(1) \in C_1$$

But X(1) belongs to C_2

Therefore, update the weights as follows:

$$W(2) = W(1) - \eta X(1)$$

$$W(2) = \begin{pmatrix} 0.1 \\ 1 \\ 1.1 \end{pmatrix} - (0.1)\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 0 \\ 1 \\ 1.1 \end{pmatrix}$$

Rosenblatt's algorithm:

Iteration 2: n=2

$$v = W^T(2)X(2)$$

$$v = 1.1$$

$$\Rightarrow X(1) \in C_1$$

But X(2) belongs to C_2

Therefore, update the weights as follows:

$$W(3) = W(2) - \eta X(2)$$

$$W(3) = \begin{pmatrix} 0 \\ 1 \\ 1.1 \end{pmatrix} - (0.1)\begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} -0.1 \\ 1 \\ 1 \end{pmatrix}$$

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Rosenblatt's algorithm:

Iteration 3: n=3

$$v = W^T(3)X(3)$$

$$v = 0.9$$

$$\Rightarrow X(3) \in C_1$$

But X(3) belongs to C_2

Therefore, update the weights as follows:

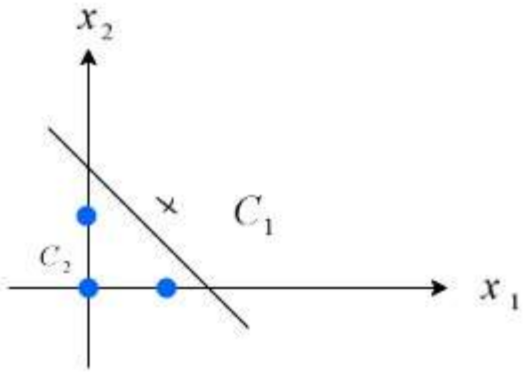
$$W(4) = W(3) - \eta X(3)$$

$$W(4) = \begin{pmatrix} -0.1 \\ 1 \\ 1 \end{pmatrix} - (0.1)\begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix} = \begin{pmatrix} -0.2 \\ 0.9 \\ 1 \end{pmatrix}$$

This procedure will continue till perceptron learns all the patterns

- Let the Choice of W=[-0.75 0.25 0.5]'

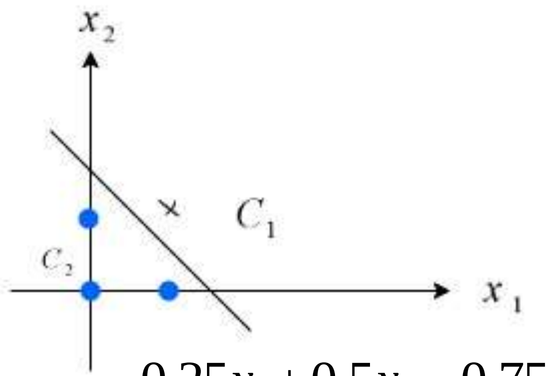
x_0	x_1	x_2	v	$\varphi(v)$	y
1	0	0	-0.75	0	0
1	0	1	-0.25	0	0
1	1	0	-0.5	0	0
1	1	1	0	1	1



$$\varphi(v) = \begin{cases} 1 & v \geq 0 \\ 0 & v < 0 \end{cases}$$

- Let the Choice of W=[-0.75 0.25 0.5]'

x_0	x_1	x_2	v	$\varphi(v)$	y
1	0	0	-0.75	0	0
1	0	1	-0.25	0	0
1	1	0	-0.5	0	0
1	1	1	0	1	1



$$0.25x_1 + 0.5x_2 - 0.75 = 0$$

THANK YOU

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