ARTIFICIAL NEURAL NETWORK

Unit-2: Perceptron

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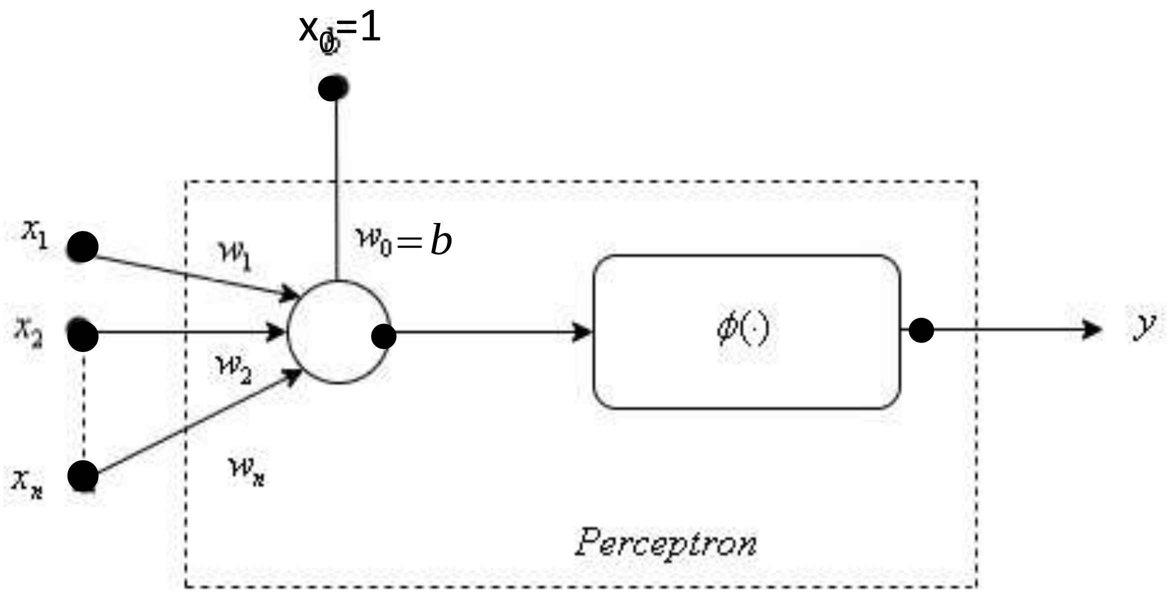
Perceptron

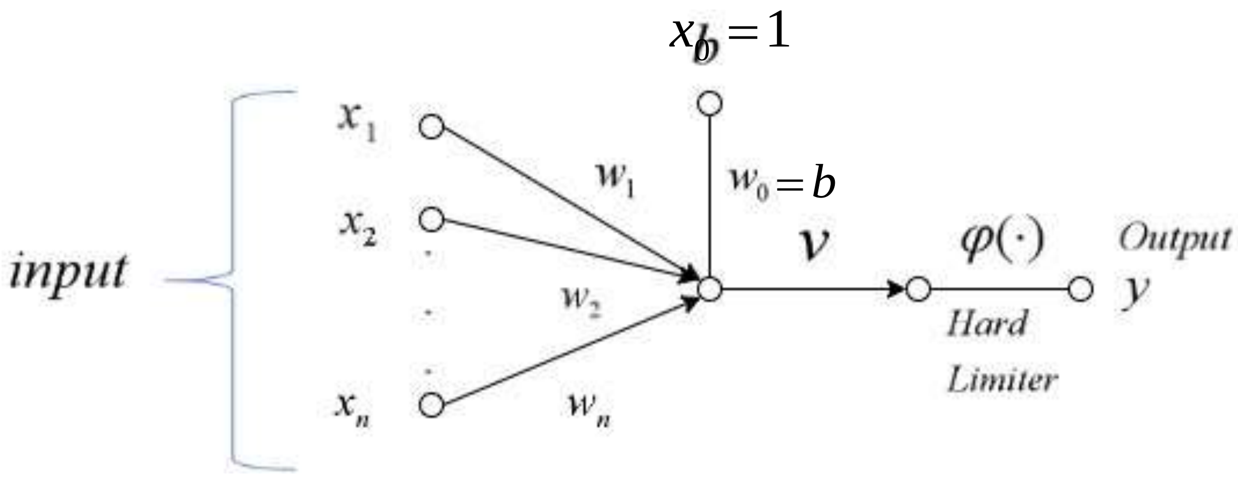
- **Perceptron:** It is a non-linear neuron model.
- The graphical representation of the perceptron is shown below:



Artificial Neural Network

Perceptron

- The signal flow graph of the perceptron is shown below:



Perceptron

- The summing node of the neuron model computes the linear combination of the inputs applied to its synspses and also incorporates an externally applies bias
- The resulting sum is applied to a hard limiter
- Accordingly neuron produces output

- From the model, the induced local field/hard limit input is

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

- The hardlimit function is defined as follows

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

Perceptron

- When do we use this perceptron ?
- Let us consider, we have 2 sets which is represented as in 2D- Plane as shown in the below figure

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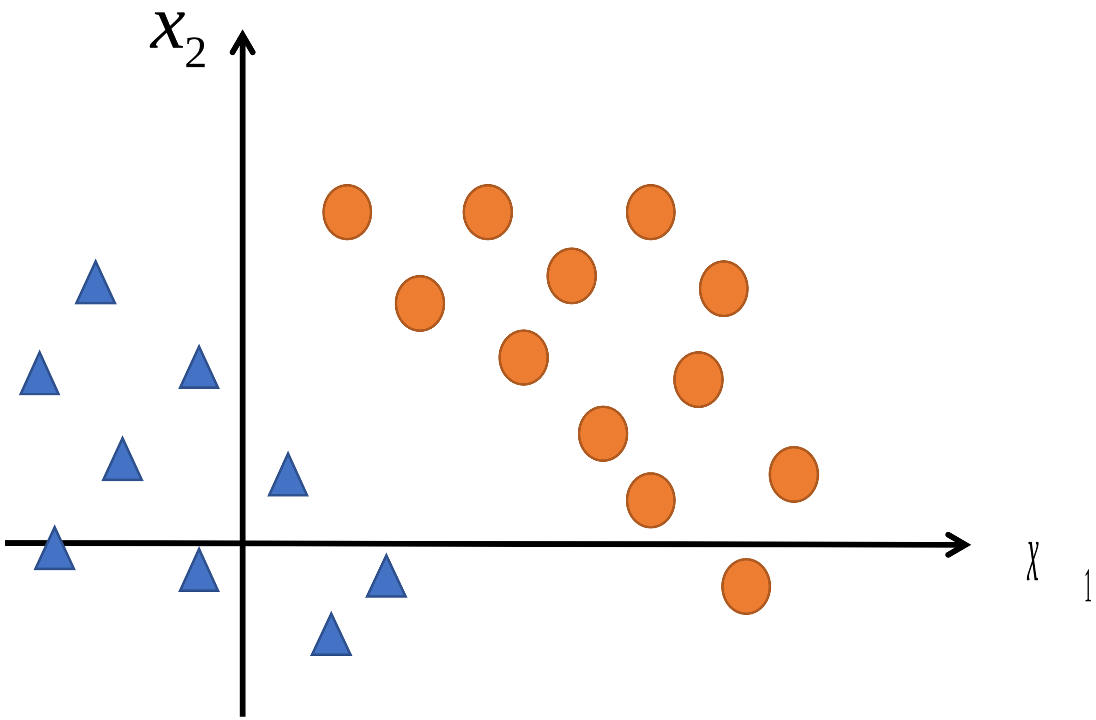

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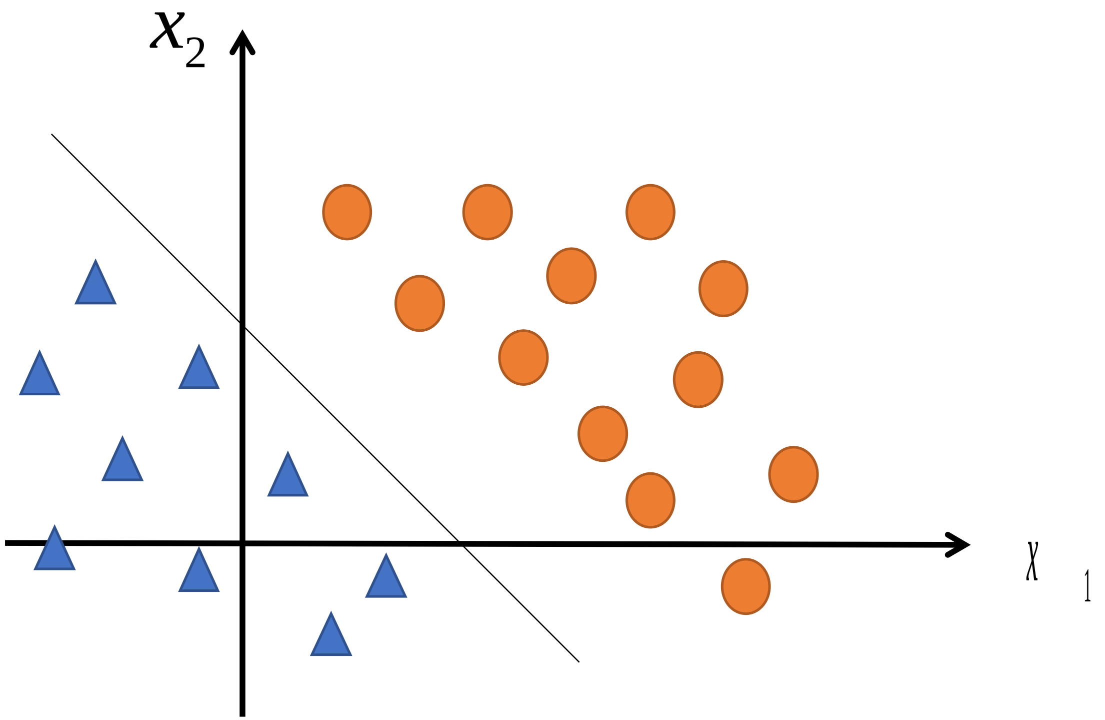

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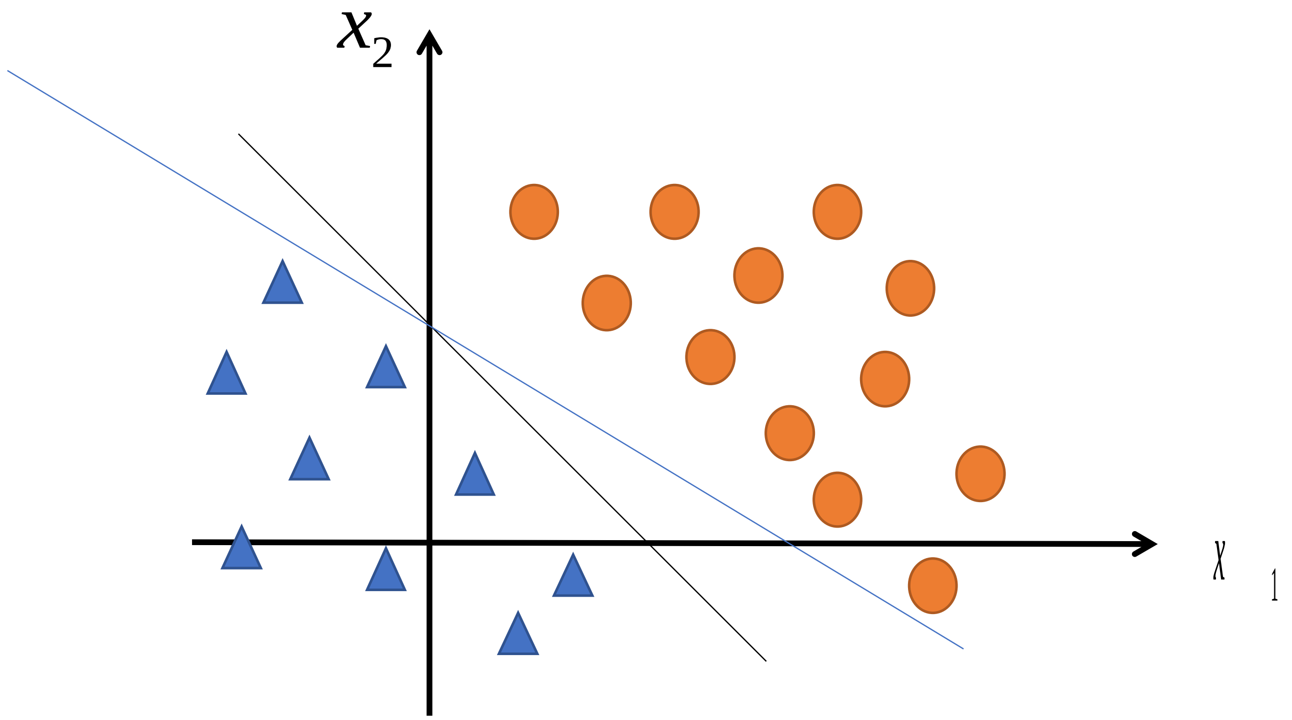

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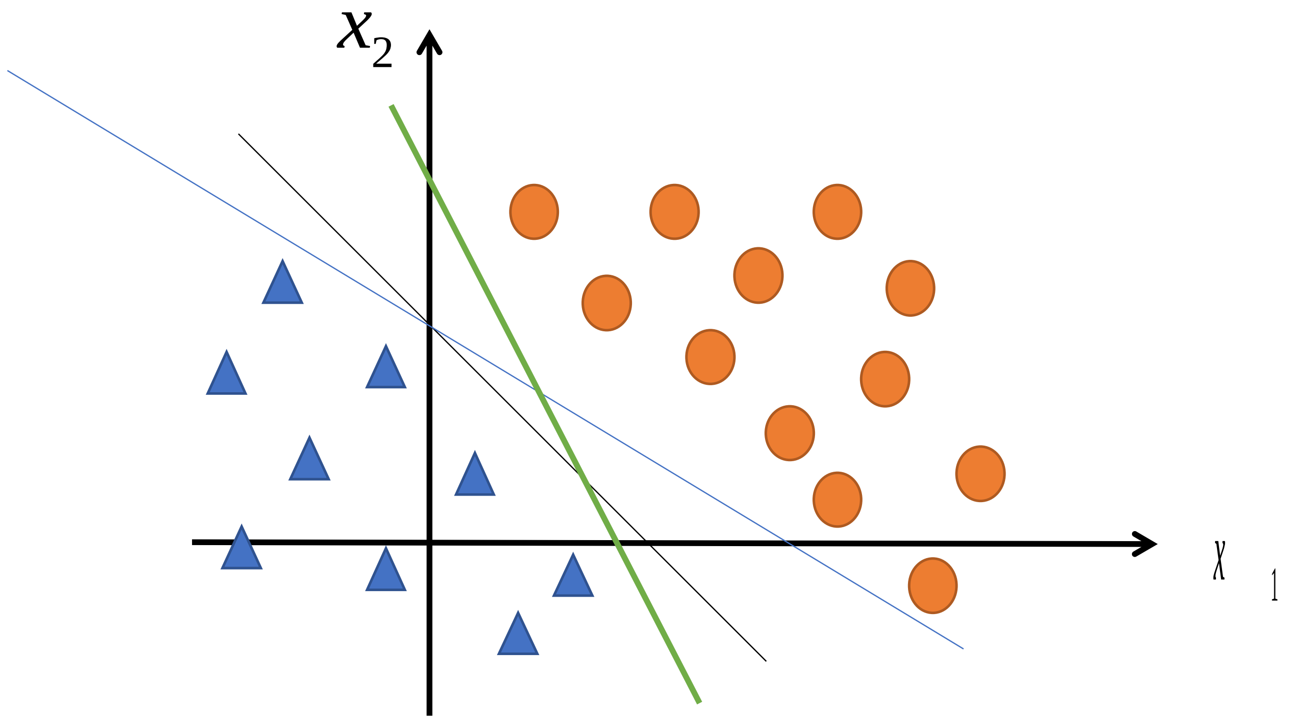

- Therefore, if any 2 sets can be separated by line then it is referred as Linearly Separable sets otherwise it will be non-linear Separable Sets

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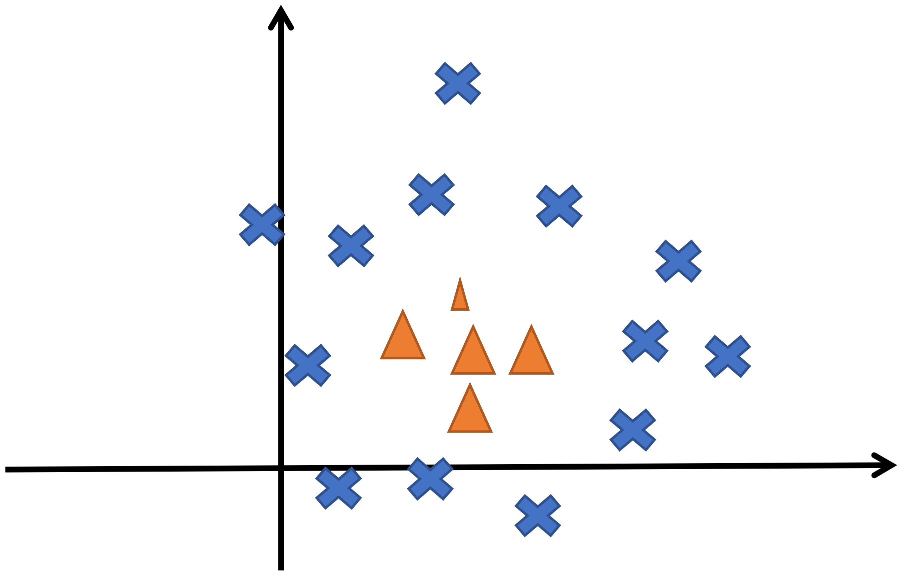
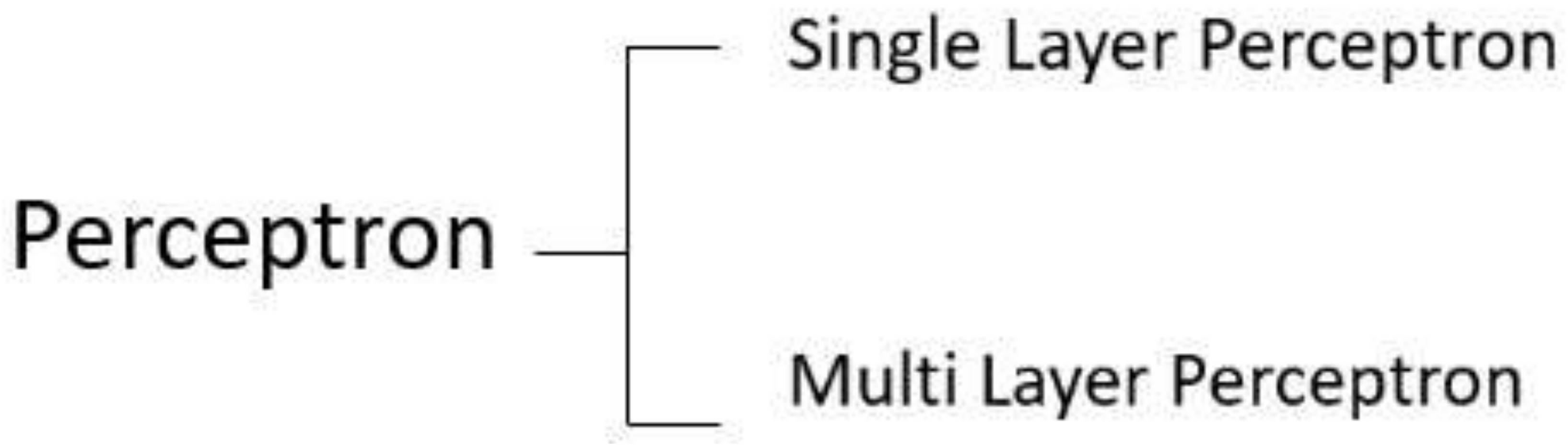


Artificial Neural Network

Perceptron



- Goal of the Single Layer Perceptron
  - Classify externally applied input into 2 classes
  - if v is greater than or equal to 0, then input X belongs to C_1 otherwise, input X belongs to C_2.

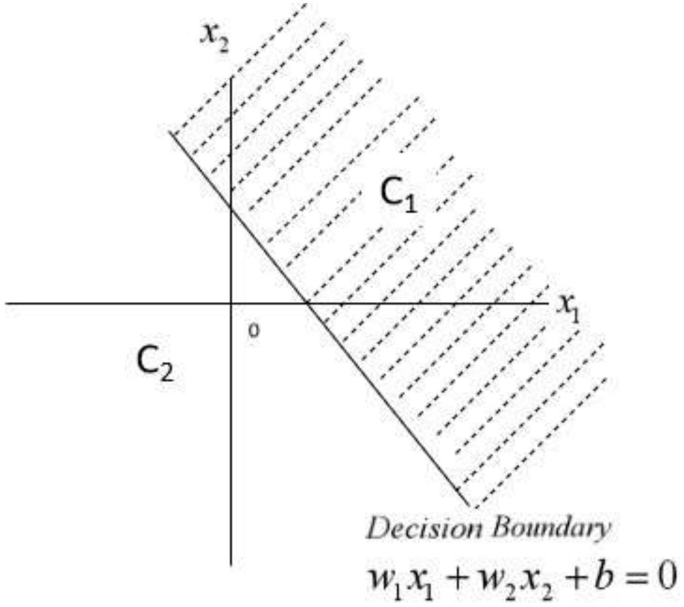


fig 1: Illustration of the hyperplane

Single-Layer Perceptron

- Training the Single-Layer Perceptron:
- Rosenblatt's Algorithm/Perceptron Learning Rule:
  - It is a Supervised Learning.
  - This algorithm, learn the pattern/classes in finite number of steps.
  - It can be applied only for the linearly-separable classes

- Single layer perceptron:

Consider 2 input AND Logic Gate

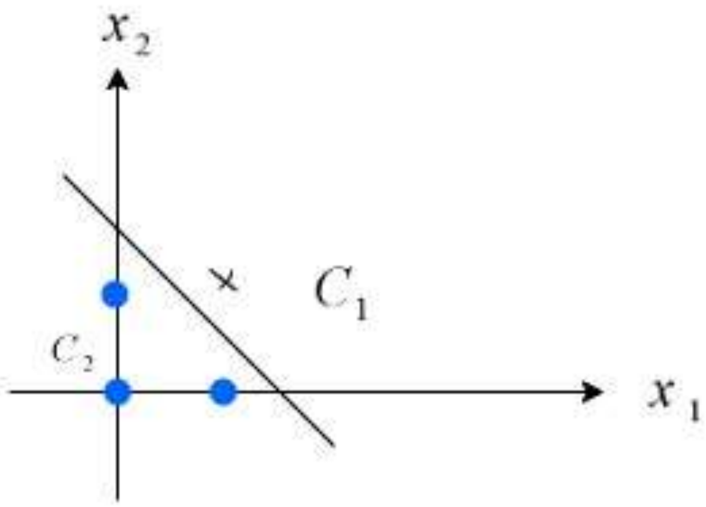
x	y	z
0	0	0
1	0	0
0	1	0
1	1	1

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

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

Reference

- S. Haykin, (2003), “Neural Networks: A Comprehensive Foundation”, 2nd edition, Prentice Hall of India.

THANK YOU

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