SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF MCA

19CAT703 – MACHINE LEARNING

II YEAR III SEM

UNIT II - LINEAR MODELS

**TOPIC 13 – Perceptrons-Multilayer neural networks**

Perceptron

1. **Frank Rosenblatt** (1928 – 1971) was an American psychologist notable in the field of Artificial Intelligence.

2. In **1957** he started something really big. He "invented" a **Perceptron** program, on an IBM 704 computer at Cornell Aeronautical Laboratory.

3. Scientists had discovered that brain cells (**Neurons**) receive input from our senses by electrical signals.

4. The Neurons, then again, use electrical signals to store information, and to make decisions based on previous input.

5. Frank had the idea that **Perceptrons** could simulate brain principles, with the ability to learn and make decisions.

Perceptron

1. The original **Perceptron** was designed to take a number of **binary** inputs, and produce one **binary** output (0 or 1).

2. The idea was to use different **weights** to represent the importance of each **input**, and that the sum of the values should be greater than a **threshold** value before making a decision like **true** or **false** (0 or 1).

$$x_1 \cdot w_1$$
$$x_2 \cdot w_2$$
$$x_3 \cdot w_3$$
$$x_4 \cdot w_4$$
$$x_5 \cdot w_5$$
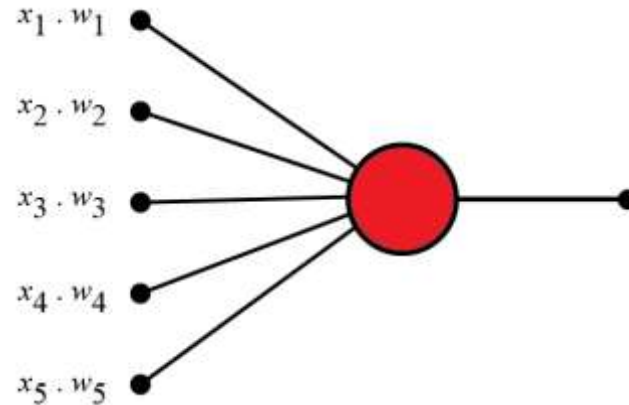
Perceptron Example

1. Imagine a perceptron (in your brain).

2. The perceptron tries to decide if you should go to a concert.

3. Is the artist good? Is the weather good?

4. What weights should these facts have?

Criteria	Input	Weight
Artists is Good	$x1 = 0$ or 1	$w1 = 0.7$
Weather is Good	$x2 = 0$ or 1	$w2 = 0.6$
Friend will Come	$x3 = 0$ or 1	$w3 = 0.5$
Food is Served	$x4 = 0$ or 1	$w4 = 0.3$
Alcohol is Served	$x5 = 0$ or 1	$w5 = 0.4$

The Perceptron Algorithm

1. Set a threshold value
2. Multiply all inputs with its weights
3. Sum all the results
4. Activate the output

1.Set a threshold value: Threshold = 1.5

2. Multiply all inputs with its weights:

$x1 * w1 = 1 * 0.7 = 0.7$

$x2 * w2 = 0 * 0.6 = 0$

$x3 * w3 = 1 * 0.5 = 0.5$

$x4 * w4 = 0 * 0.3 = 0$

$x5 * w5 = 1 * 0.4 = 0.4$

3. Sum all the results: $0.7 + 0 + 0.5 + 0 + 0.4 = 1.6$ (The Weighted Sum)

4. Activate the Output: Return true if the sum > 1.5 ("Yes I will go to the Concert")

```
const threshold = 1.5;
const inputs = [1, 0, 1, 0, 1];
const weights = [0.7, 0.6, 0.5, 0.3, 0.4];

let sum = 0;
for (let i = 0; i < inputs.length; i++) {
  sum += inputs[i] * weights[i];
}

const activate = (sum > 1.5);
```
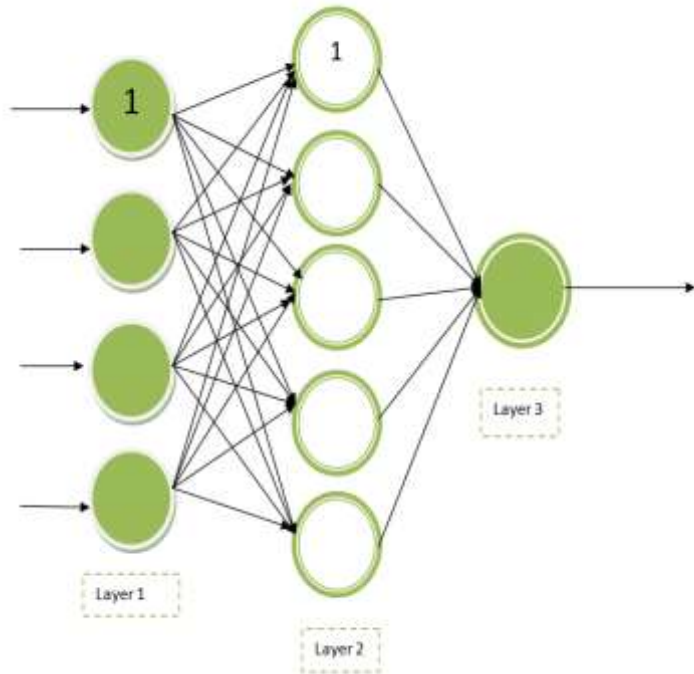
MULTILAYER NEURAL NETWORKS

To be accurate a fully connected Multi-Layered Neural Network is known as Multi-Layer Perceptron.

A Multi-Layered Neural Network consists of multiple layers of artificial neurons or nodes.

Unlike Single-Layer Neural networks, in recent times most networks have Multi-Layered Neural Network.

MULTILAYER NEURAL NETWORKS

Explanation: Here the nodes marked as "1" are known as **bias units**.

The leftmost layer or Layer 1 is the **input layer**

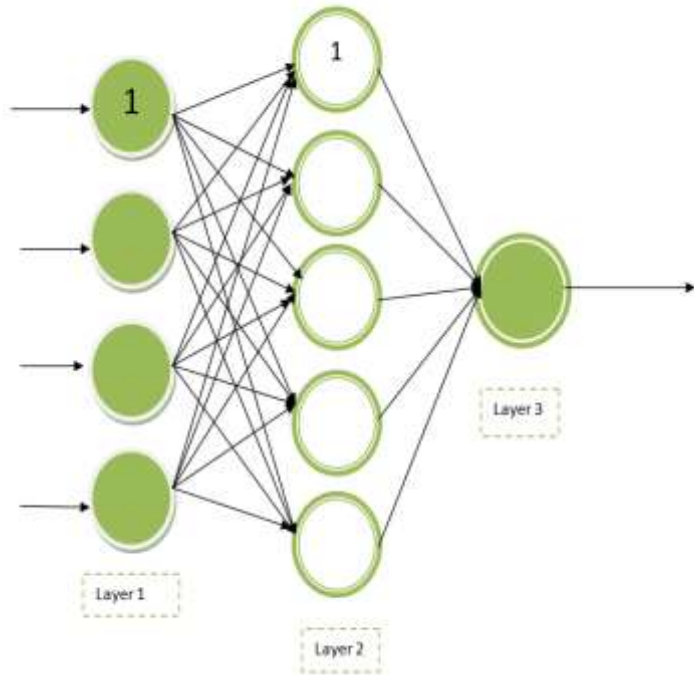The middle layer or Layer 2 is the **hidden layer**

The rightmost layer or Layer 3 is the **output layer**.

It can say that the above diagram has **3 input units** (leaving the bias unit), **1 output unit, and 4 hidden units(1 bias unit is not included).**
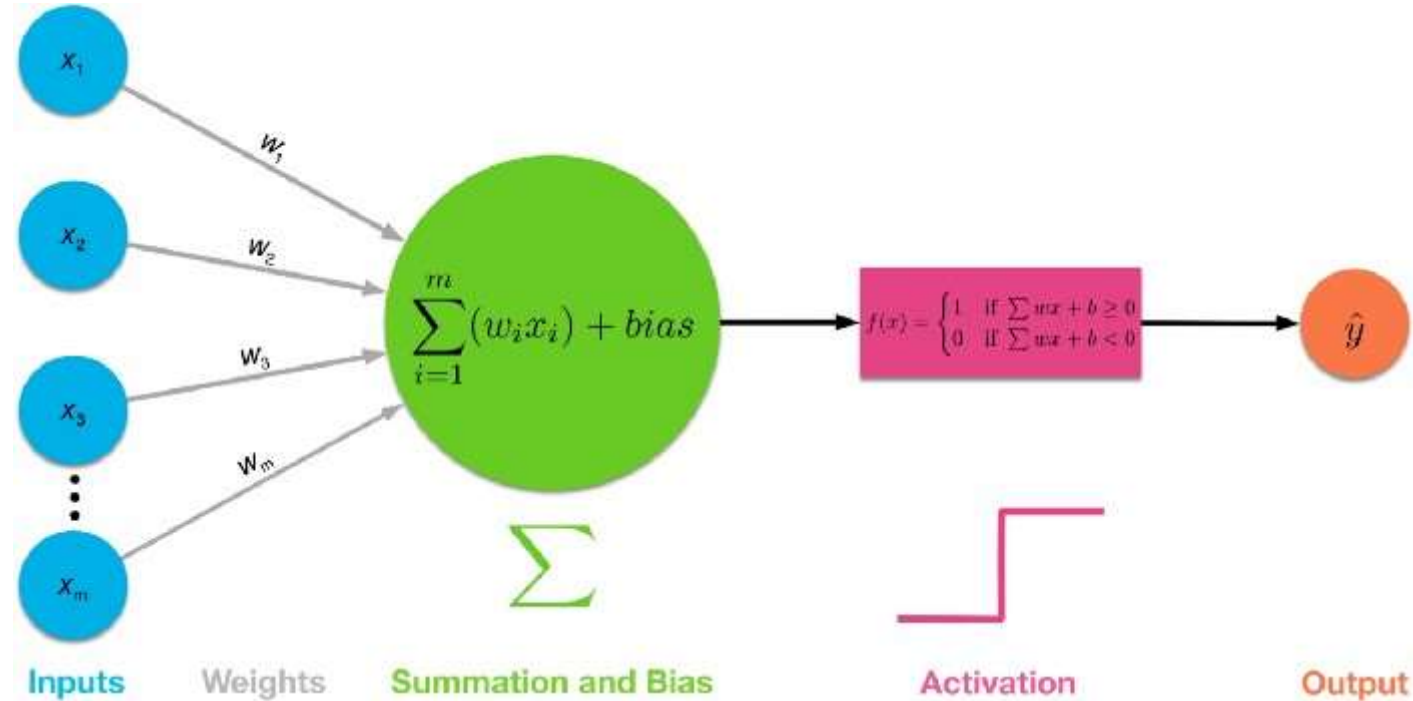
MULTILAYER NEURAL NETWORKS

1. A Multi-layered Neural Network is a typical example of the Feed Forward Neural Network.

2. The number of neurons and the number of layers consists of the hyperparameters of Neural Networks which need tuning.

3. In order to find ideal values for the hyperparameters, one must use some cross-validation techniques. Using the Back-Propagation technique, weight adjustment training is carried out.

$$\sum_{i=1}^{m}(w_i x_i) + bias$$

$$f(x) = \begin{cases} 1 & \text{if } \sum wx + b \geq 0 \\ 0 & \text{if } \sum wx + b < 0 \end{cases}$$

$\hat{y}$

Inputs **Weights** **Summation and Bias** **Activation** **Output**

Reference

1. https://w3schools.com
2. https://www.analyticsvidhya.com/
3. https://www.geeksforgeeks.org/