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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT303-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

III YEAR/ V SEMESTER

1

UNIT 4 – NEURONS AND NEURAL NETWORKS

4.4 Perceptron learning Algorithm

Perceptron learning Algorithm
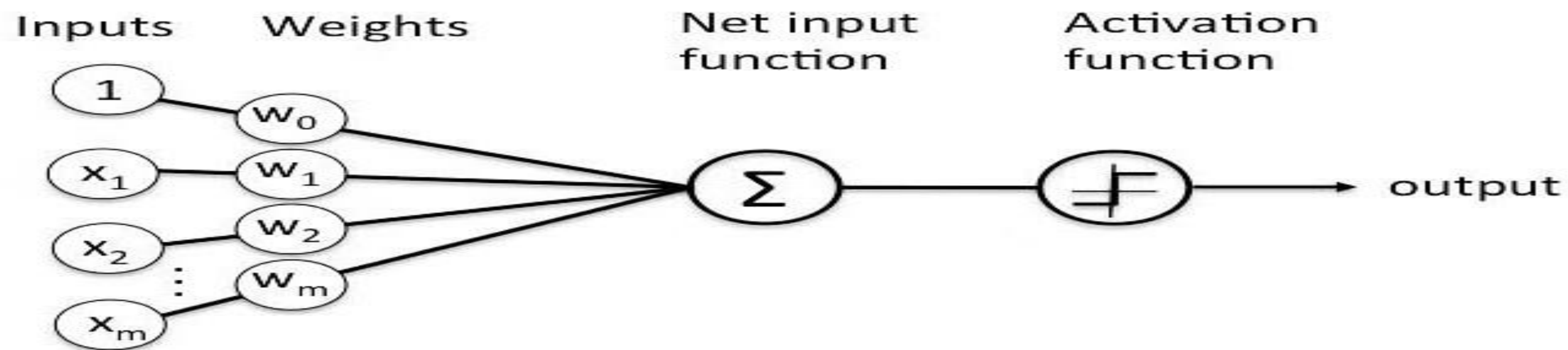
Perceptron

introduced by Frank Rosenblatt in 1957.

Perceptron is a type of artificial neural network, which is a fundamental concept in machine learning.

Perceptron learning rule based on the original MCP neuron.

an algorithm for supervised learning of binary classifiers.

enables neurons to learn and processes elements in the training set one at a time.

Perceptron learning Algorithm

Basic Components of Perceptron

Input Layer: The input layer consists of one or more input neurons, which receive input signals from the external world or from other layers of the neural network.

Weights: Each input neuron is associated with a weight, which represents the strength of the connection between the input neuron and the output neuron.

Bias: A bias term is added to the input layer to provide the perceptron with additional flexibility in modeling complex patterns in the input data.

Activation Function: The activation function determines the output of the perceptron based on the weighted sum of the inputs and the bias term. Common activation functions used in perceptrons include the step function, sigmoid function, and ReLU function.

Output: The output of the perceptron is a single binary value, either 0 or 1, which indicates the class or category to which the input data belongs.

Training Algorithm: The perceptron is typically trained using a supervised learning algorithm such as the perceptron learning algorithm or backpropagation. During training, the weights and biases of the perceptron are adjusted to minimize the error between the predicted output and the true output for a given set of training examples.

Overall, the perceptron is a simple yet powerful algorithm that can be used to perform binary classification tasks and has paved the way for more complex neural networks used in deep learning today.

Perceptron learning Algorithm

Types of Perceptron:

Single layer: learn only linearly separable patterns.

Multilayer:

learn about two or more layers having a greater processing power.

The Perceptron algorithm learns the weights for the input signals in order to draw a linear decision boundary.

Note:

Supervised Learning is a type of Machine Learning used to learn models from labeled training data. It enables output prediction for future or unseen data. Let us focus on the Perceptron Learning Rule in the next section.

Perceptron learning Algorithm

Perceptron in Machine Learning

beginning step of learning coding and Deep Learning technologies, which consists of

input values,

scores,

thresholds, and weights implementing logic gates.

nurturing step of an Artificial Neural Link.

In **19h century,** **Mr. Frank Rosenblatt** invented the Perceptron to perform specific high-level calculations to detect input data capabilities or business intelligence. However, now it is used for various other purposes.

Perceptron learning Algorithm

What is the Perceptron Model in Machine Learning?

A machine-based algorithm used for **supervised learning of various binary sorting tasks is called Perceptron.**

Furthermore, Perceptron also has an essential role as an **Artificial Neuron or Neural link in detecting** certain input data computations in business intelligence.

A perceptron model is also classified as one of the best and most specific types of Artificial Neural networks.

Being a supervised learning algorithm of binary classifiers, we can also consider it a single-layer neural network with four main parameters:

1.   input values,

2. weights

3.   Bias, net sum,
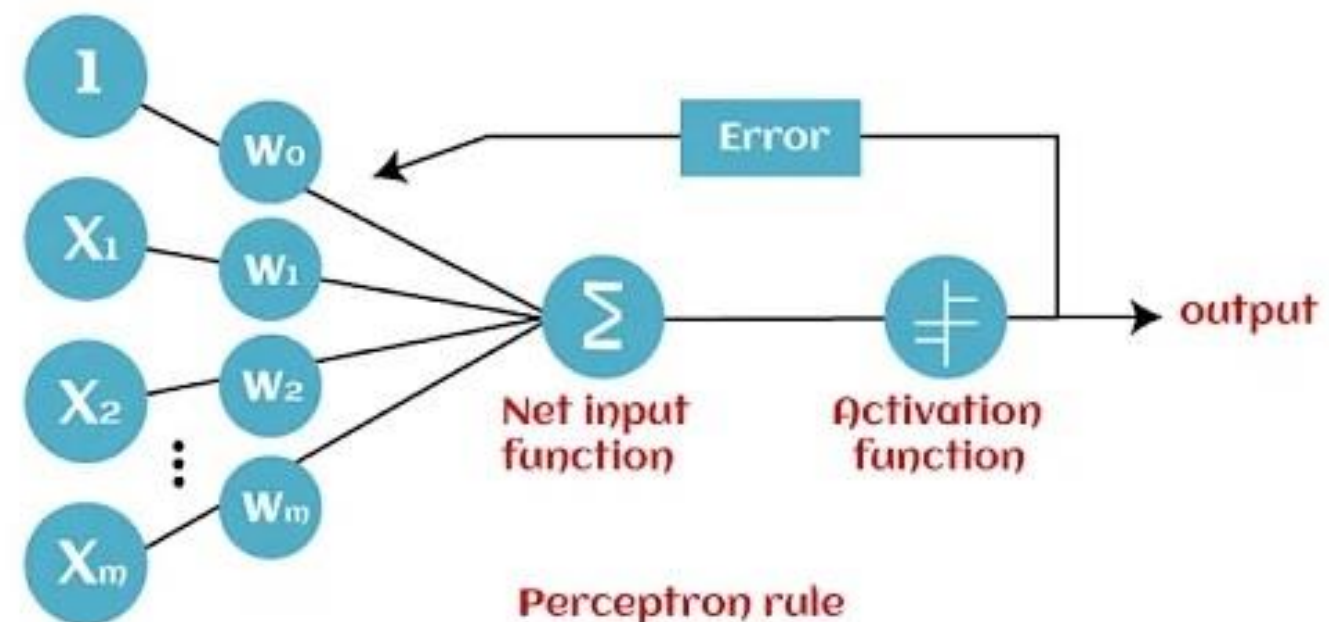
4. an activation function.

6

Perceptron learning Algorithm

How Does Perceptron Work?

The perceptron model begins with multiplying all input values and their weights, then adds these values to create the weighted sum.

Further, this weighted sum is applied to the activation function 'f' to obtain the desired output. This activation function is also known as the step function and is represented by 'f.'

Perceptron rule

Perceptron learning Algorithm

This step function or Activation function is vital in ensuring that output is mapped between (0,1) or (-1,1).

Take note that the weight of input indicates a node's strength. Similarly, an input value gives the ability the shift the activation function curve up or down.

Step 1: Multiply all input values with corresponding weight values and then add to calculate the weighted sum. The following is the mathematical expression of it:

$$\sum w_i * x_i = x_1*w_1 + x_2*w_2 + x_3*w_3 + \ldots .x_4*w_4$$

Add a term called bias 'b' to this weighted sum to improve the model's performance.

8

Step 2: An activation function is applied with the above-mentioned weighted sum giving us an output either in binary form or a continuous value as follows:

$$Y = f(\sum w_i * x_i + b)$$

Perceptron learning Algorithm

Types of Perceptron models

Single Layer Perceptron model: One of the easiest ANN(Artificial Neural Networks) types consists of a feed-forward network and includes a threshold transfer inside the model. The main objective of the single-layer perceptron model is to analyze the linearly separable objects with binary outcomes. A Single-layer perceptron can learn only linearly separable patterns.

Multi-Layered Perceptron model: It is mainly similar to a single-layer perceptron model but has more hidden layers.

Forward Stage: From the input layer in the on stage, activation functions begin and terminate on the output layer.

Backward Stage: In the backward stage, weight and bias values are modified per the model's requirement. The backstage removed the error between the actual output and demands originating backward on the output layer. A multilayer perceptron model has a greater processing power and can process linear and non-linear patterns. Further, it also implements logic gates such as AND, OR, XOR, XNOR, and NOR.

Perceptron learning Algorithm

Advantages:

A multi-layered perceptron model can solve complex non-linear problems.

It works well with both small and large input data.

Helps us to obtain quick predictions after the training.

Helps us obtain the same accuracy ratio with big and small data.

Disadvantages:

In multi-layered perceptron model, computations are time-consuming and complex.

It is tough to predict how much the dependent variable affects each independent variable.

The model functioning depends on the quality of training.

Perceptron learning Algorithm

Characteristics of the Perceptron Model

•It is a machine learning algorithm that uses supervised learning of binary classifiers.

•In Perceptron, the weight coefficient is automatically learned.

•Initially, weights are multiplied with input features, and then the decision is made whether the neuron is fired or not.

•The activation function applies a step rule to check whether the function is more significant than zero.

•The linear decision boundary is drawn, enabling the distinction between the two linearly separable classes +1 and -1.

•If the added sum of all input values is more than the threshold value, it must have an output signal; otherwise, no output will be shown.

Limitation of Perceptron Model

•The output of a perceptron can only be a binary number (0 or 1) due to the hard-edge transfer function.

•It can only be used to classify the linearly separable sets of input vectors. If the input vectors are non-linear, it is not easy to classify them correctly.

Neural Networks/19ECT303-AIML/Mr.N.Arunkumar AP/ECE/SNSCT