## 4.4. Experiment No. 4

Aim:

With a suitable example demonstrate the perceptron learning law with its decision regions using python. Give the output in graphical form.

Objective: To learn perceptron laws with decision regions.

Theory: Neural networks are a branch of —Artificial Intelligence". Artificial Neural Network is a system loosely modeled based on the human brain. Neural networks are a powerful technique to solve many real world problems. They have the ability to learn from experience in order to improve their performance and to adapt themselves to changes in the environment. In addition to that they are able to deal with incomplete information or noisy data and can be very effective especially in situations where it is not possible to define the rules or steps that lead to the solution of a problem. In a nutshell a Neural network can be considered as a black box that is able to predict an output pattern when it recognizes a given input pattern. Once trained, the neural network is able to recognize similarities when presented with a new input pattern, resulting in a predicted output pattern.

$$\text{Sum} = f(\textstyle\sum w_i * x_i + b)$$

Where b represents bias value, x_i is the input and w_i is the weight of ith neuron (node).
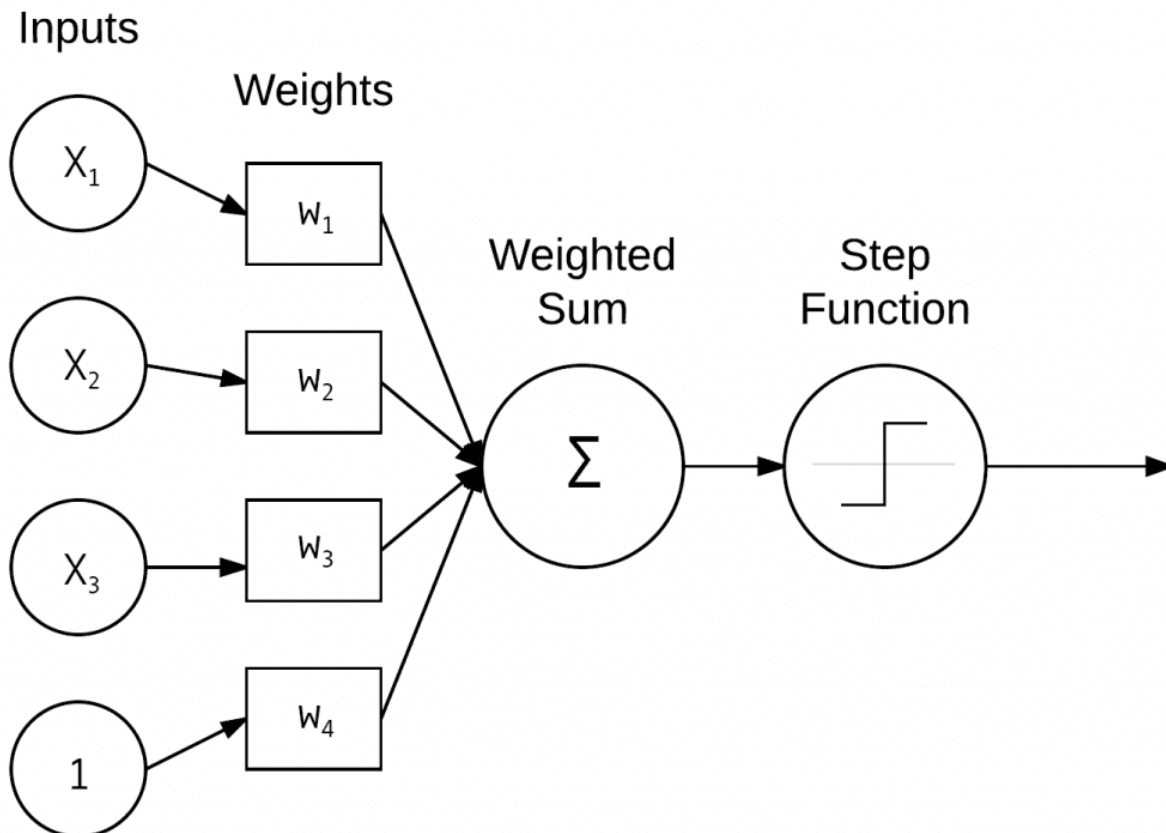
Algorithm:

Perceptron Learning Algorithm: The perceptron learning rule was originally developed by Frank Rosenblatt in the late 1950s. Training patterns are presented to the network's inputs; the output is computed. Then the connection weights are modified by an amount that is proportional to the product of the difference between the actual output, y, and the desired output, d, and the input pattern, x. The algorithm is as follows:

1. Initialize the weights and threshold to small random numbers.
2. Present a vector x to the neuron inputs and calculate the output.
3. Update the weights according to: where d is the desired output, t is the iteration number, and eta is the gain or step size, where $0.0 < n < 1.04$.
$w_j(t+1) = w_j(t) + \Pi(d-y)x$
Repeat steps 2 and 3 until:
1. the iteration error is less than a user-specified error threshold.
2. a predetermined number of iterations have been completed.

Applications:

1. Perceptron is a machine learning algorithm for supervised learning of binary classifiers.
2. In Perceptron, the weight coefficient is automatically learned.
3. Initially, weights are multiplied with input features, and the decision is made whether the neuron is fired or not.
4. The activation function applies a step rule to check whether the weight function is greater than zero.
5. The linear decision boundary is drawn, enabling the distinction between the two linearly separable classes +1 and -1.

Conclusion:

In this way have successfully implemented perceptron learning law with its decision regions using python.

Outcome:

Upon completion of this experiment, students will be able to:
Experiment level outcome (ELO1): Demonstrate the perceptron learning law with its decision regions.

Questions:

1. What is the learning algorithm?
2. What is the Perception learning algorithm?
3. What are the primary components of a perceptron?
4. What are the types of perception model?