Perceptron Learning Algorithm

**Objective:**

Write a Program to implement the Perceptron Learning Algorithm using numpy in Python. Evaluate the performance of a single perceptron for NAND and XOR truth tables as input datasets.

**Description:**

A perceptron is a single-layer neural network and the simplest artificial neural network. It consists of input nodes, weights, a bias term, and an activation function.

* Weighted sum is calculated by multiplying the inputs with the weights and adding them.
* Activation function classifies the output using these weighted sums.

If weighted sum >= 0, then output = 1

If weighted sum < 0, then output = 0

**Description of code:**

1. **Class perceptron –**

* Initializes the weights and bias to 0.
* It contains an activation function that classifies the output.
* A predict function that predicts the output using the activation function.
* A train function that trains the model to find the required weights.
* An evaluate function that calculates the accuracy.

1. **Training and Evaluation for NAND Gate -**

* The NAND truth table (nand\_X) and labels (nand\_y) are defined.
* The perceptron is trained using the train() method.
* The model accuracy is calculated using the evaluate() function.
* The predictions for all inputs in the NAND table are displayed.

1. **Training and Evaluation for XOR Gate**

* The XOR truth table (xor\_X) and labels (xor\_y) are defined.
* The perceptron is trained and evaluated on the XOR data.
* Accuracy is computed, and predictions for all XOR inputs are printed.

**Output:**

Training Perceptron for NAND Gate

NAND Perceptron Accuracy: 1.0

Predictions for NAND Truth Table:

Input: [0 0], Prediction: 1

Input: [0 1], Prediction: 1

Input: [1 0], Prediction: 1

Input: [1 1], Prediction: 0

Training Perceptron for XOR Gate

XOR Perceptron Accuracy: 0.5

Predictions for XOR Truth Table:

Input: [0 0], Prediction: 1

Input: [0 1], Prediction: 1

Input: [1 0], Prediction: 0

Input: [1 1], Prediction: 0

**Performance:**

NAND Gate

- Accuracy: 1.0 (100%)

- Predictions: Correct for all inputs.

XOR Gate

- Accuracy: Approximately 0.5 (50%)

- Predictions: Incorrect for half inputs.

**My comments:**

* The perceptron cannot work properly on non-linearly separable data. Because of this, the perceptron is unable to learn the XOR gate.
* To improve this, we can use multi-layer perceptron.