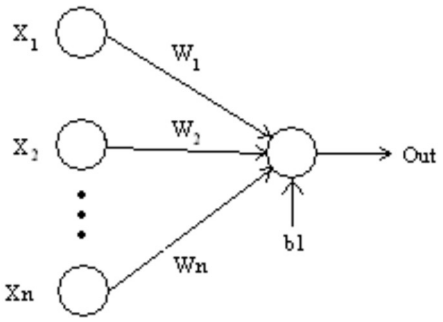
Assignment on Perceptron

Perceptron Learning for Linearly Separable Data
Introduction:

Neural networks can be used to recognize pattern for given input.

A simple single layer feed forward neural network which has a ability to learn and differentiate data sets is known as a perceptron as shown in the following figure.



A perceptron is defined by the equation:

$$Net = \sum_{i=0}^{n} x_i w_i + b$$

By iteratively "learning" the weights, it is possible for the perceptron to find a solution to linearly separable data.

Problem: Write a program to find a solution for 2-input **OR/AND/NOR/NAND** gate as given below (learn the perceptron for the following pattern and determine the output for a given input pattern) using perceptron learning algorithm:

OR		
X1	**X2**	**Out**
0	0	0
1	0	1
0	1	1
1	1	1

AND		
X1	**X2**	**Out**
0	0	0
1	0	0
0	1	0
1	1	1

NAND		
X1	**X2**	**Out**
0	0	1
1	0	1
0	1	1
1	1	0

NOR		
X1	**X2**	**Out**
0	0	1
1	0	0
0	1	0
1	1	0

Use ***sigmoid activation function*** to learn the network. Modify the weight iteratively using ***delta rule***.

Explanation: If we want to solve the above problem we first need to initialize our variables of interest, including the input, desired output, bias, learning coefficient and weights.

Example:

```
input = [0 0; 0 1; 1 0; 1 1];
desired_out = [0;1;1;1];
bias = -1;
coeff = 0.7;
weights = random value;
```

The **input** and **desired_out** are self explanatory, with the **bias** is initialized to a constant. This value can be set to any non-zero number between -1 and 1. The **coeff** represents the learning rate, which specifies how large of an adjustment is made to the network weights after each iteration. If the coefficient approaches 1, the weight adjustments are modified more conservatively. Finally, the weights are randomly assigned.

Sigmoid Function:

$$out_j = \frac{1}{1+e^{-y}}$$

Delta Rule:

$$\Delta w = w - w_{old} = -\eta \frac{\partial E}{\partial w} = +\eta \delta x \quad \text{or} \quad w = w_{old} + \eta \delta x$$

where $\boldsymbol{\delta = y_{target} - y}$ and η (**coeff**) is a constant that controls the learning rate.