

# PERCEPTRON - IRM2016502

This is the implementation for a single two-input, one-output neuron in a neural network which learns using training data and tests on test data.

The two input perceptron is trained on sample data and using a graph, it is shown that as training proceeds, the error between predicted output and target output is reduced. This means that the perceptron is learning to predict output for cases satisfying the function (here, linearly separable functions).

Here,

$h(x) = \text{summation of } (\text{weights} \times \text{input})$

$g(h) = 1/(1 + \exp^{**}(-h))$  ..it is the sigmoid function and acts as the activation function.

Our goal is to find a (linear) function  $(w_1)x_1 + (w_2)x_2 + w_0$  such that it separates the two classes of outputs (0 or 1), given the two inputs.

The weights are adjusted based on the training data to minimize the error.

A number of epochs (iterations) are done for each of the training data instances and error is found as the difference between the predicted output and target output.

The weights are adjusted based on the formula

$$\text{delta\_w} = -1 \text{learning\_rate}(\text{predicted\_output} - \text{target\_output}) * \text{input\_value}$$

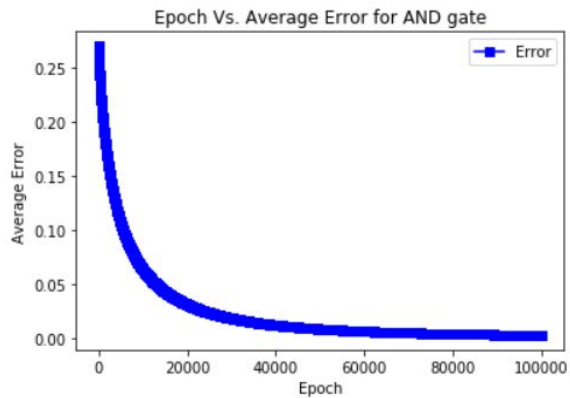
The training and graphs are also done for the boolean gates - AND, OR, NAND, NOR, XOR and the graphs are plotted.

Since XOR is not linearly separable, it cannot be put into any of the classes defined by the line  $(w_1)x + (w_2)y + w_0$ . This can also be seen as the perceptron predicts only one case correct out of the 4 cases possible.

The correctness of the perceptron can be seen by the produced output on testing and the nature of error vs epoch graph.

Below are the error vs epoch graphs

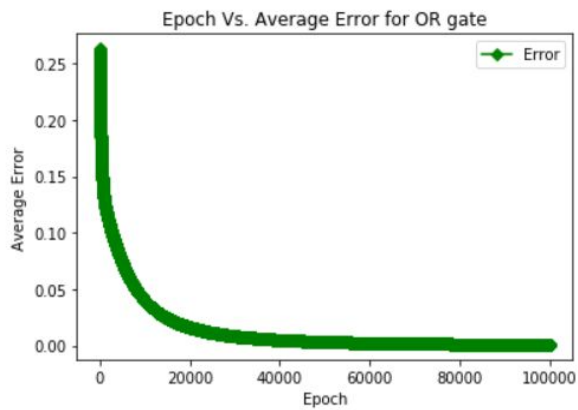
----- AND GATE -----  
[[ '0', '0', '0'], [ '0', '1', '0'], [ '1', '0', '0'], [ '1', '1', '1']]  
w0 is: -8.518537479059036 w1 is: 5.559322232999739 w2 is: 5.5592601293004105



0.0 0.0 0  
0.0 1.0 0  
1.0 0.0 0  
1.0 1.0 1

Accuracy % - 100.0

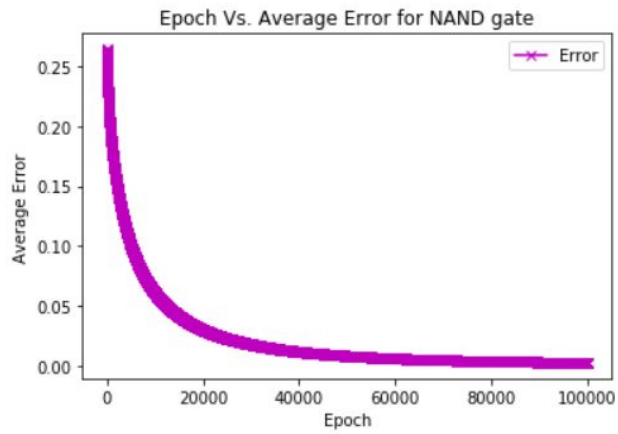
----- OR GATE -----  
w0 is: -2.9113887898284805 w1 is: 6.775967075885015 w2 is: 6.775642377456278



0.0 0.0 0  
0.0 1.0 1  
1.0 0.0 1  
1.0 1.0 1

Accuracy % - 100.0

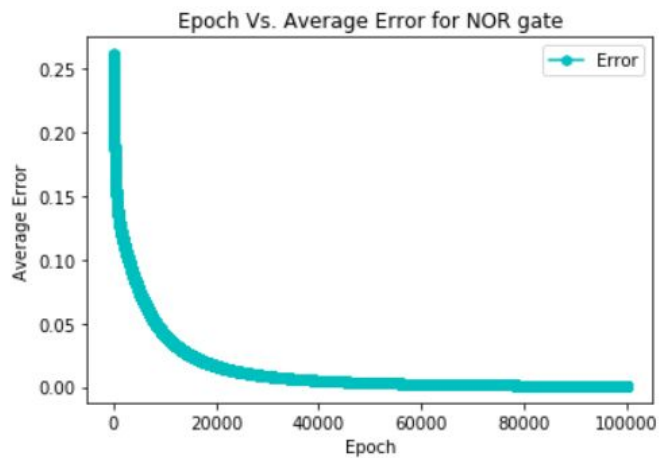
----- NAND GATE -----  
w0 is: 8.531581062624333 w1 is: -5.568056079433697 w2 is: -5.567988142901181



0.0 0.0 1  
0.0 1.0 1  
1.0 0.0 1  
1.0 1.0 0

Accuracy % - 100.0

----- NOR GATE -----  
w0 is: 2.909331761557346 w1 is: -6.772255995588895 w2 is: -6.7712788268721384



0.0 0.0 1  
0.0 1.0 0  
1.0 0.0 0  
1.0 1.0 0

Accuracy % - 100.0