

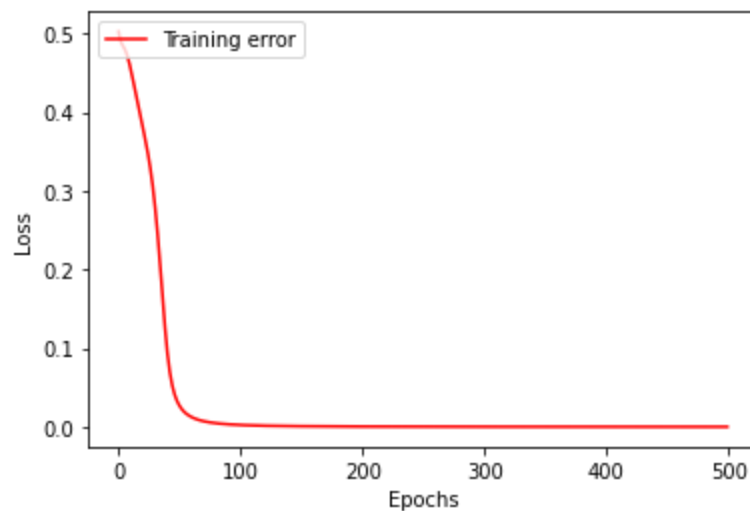
## Question 1:

I have implemented backpropagation on the feed forward neural network with 2 nodes in the first layer, 3 nodes in the hidden layer and 1 output node which is the last layer.

I first used a learning rate of 0.01 and tried different number of epochs and observed that the accuracy of the model is not increasing more than 50% even after 500 epochs. I observed that it was due to a small learning rate.

I then increased the value of learning rate to 0.1 and again observed the accuracy and this time it improved to 56%.

Now, I boosted the learning rate to 1 and the model learnt the XNOR logic and it was able to give 100% accuracy with 500 epochs and it can be seen that it converged around 100 epochs.



I have also displayed the weights in the python notebook which gave me the result of **100% accuracy**.

This shows that multi-perceptron and multi-layer networks **can learn non-linearly separable data and can learn complex functions**.

## Question 2:

In this I have used a 3-input 1-output logic table as a dataset for XOR, AND, OR and NAND and used them to design and implement a perceptron learning rule.

I designed the perceptron learning rule as discussed in the class and started with weights randomly assigned. This ensured that I got **unique decision boundaries**.

I also fine tuned the number of epochs to 20 for the learning rate set as 1. I tried out a set of values for numbers of epochs like 1, 10, 20, 50, 100. Less number of epochs will not give the model enough iterations to learn and more number of epochs is more useful as the learning becomes stable and constant after a number of iterations.

I have also shown examples and trained weights in the implementation file. The final accuracies I got for XOR, AND, OR and NAND are 50%, 100%, 100% and 100% respectively.

The reason for lesser accuracy for XOR is that **XOR is not linearly separable**. It can also be deduced from the 3D graphical representation.

The reason for higher accuracy for AND, OR and NAND is that **AND, OR and NAND are linearly separable**. It can also be deduced from the 3D graphical representation.