

# Neural Networks and Backpropagation

## Applied ML in Engineering - Exercise 11

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Students are asked to perform the forward and backward pass of a simplistic data set through a minimal artificial neural network *by hand*, i.e. without the use of any high-level programming library. The network will be manually trained to make predictions on the XOR case.

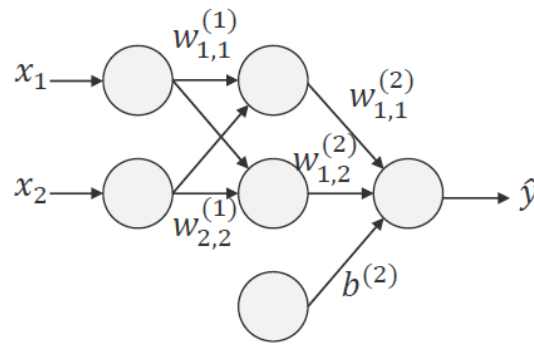


Figure 1: Structure of the simple ANN: input layer, hidden layer, output layer

$x_1$	$x_2$	$y$
0	0	1
0	1	0
1	0	0
1	1	1

Table 1: XOR data

### Problem 1

- Consider the network depicted in Figure 1 for this exercise and the data set provided in Table 1.
- Use sigmoid activations for all neurons
- Initialize all weights and the bias at 0.5
- Use the MSE loss function
- Use gradient descent with a learning rate of  $\alpha = 0.05$

## **Problem 2**

If you want to avoid doing all the calculations by hand, try to implement the forward and the backward pass in Python and automate the training process using the implementation of the optimizers obtained in the last week's exercise.

## **Problem 3**

Implement the problem using Tensorflow Sequential API by adapting the sample code that was shown during the lecture for the MNIST classification task. (See ISIS for the `.py` file)