Machine Learning
Exercise 7: Manual calculation of the forward and backward pass for a simple Neural Network

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July 24, 2023

Abstract

This exercise focuses on getting a deeper understanding of the inner workings of a simple neural network by making you perform the calculations and resulting weight updates by hand.

Task 1: Understand the algorithm

- Information about neural networks can be found in the materials accompanying this course as well as here.
- Make sure you understand how the data is propagated through the different layers of the neural network, especially during the backward pass.
- The calculations should be written down by hand and you should be able to explain the equations.

Task 2: Calculate the results of the forward pass

- The network plus its parameter values can be found in fig. 1 on the next page. The Sigmoid function ($S(x) = \frac{1}{1+e^x}$) is used for activation of the network's neurons.
- Calculate the results of the forward pass for the two neurons in the hidden layer and additionally the output layer. The "target" values represent the expected/correct values for the input data.

Task 3: Calculate the results of the backward pass and update the network weights

- Use the results from Task 2 to determine the correct values for the updated weights.
- Make sure you write down the derivations that are needed in order to fulfill this exercise.
- Your task is to calculate the updated values for all weights after the first backward pass.
- The *learning rate* for this network is set to 0.1.
- Tip: The derivative of the Sigmoid function is $S'(x) = S(x) * (1 - S(x))$

Task 4: Implement the neural network in Python

- Please download the Jupyter notebook for this exercise from here as it contains useful information, code snippets, help and some directions for the following tasks.
- Follow the instructions in the notebook.
- Try to print out as many information during the forward and backward pass as needed to verify your calculations.

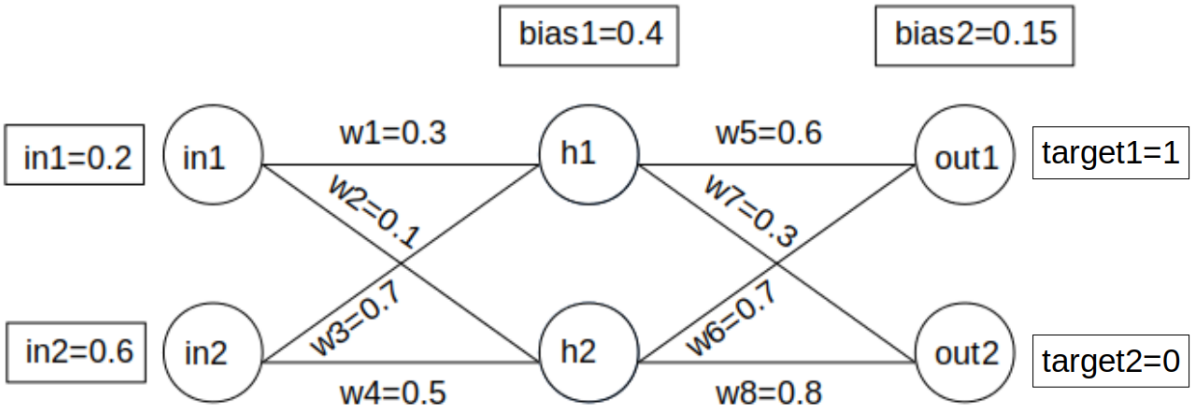

Figure 1: Simple neural network.