Exercise 16: Implementation of a Backpropagation Network

Summer Term 2024

It is now time to program your own backpropagation network. The goal is to have a running program with which you can do further exercises. In order to ease this task quite a bit and in order to focus on the algorithmic issues rather than on tedious implementation details we have again prepared a framework for you. Since this exercise still requires some time, you are expected to do this programming as a **homework** and bring the result to the next class!

Review: Please, review the following **questions:**

1. What is the definition of one backpropagation step?

2. What are the main steps and loops in order to do one single backpropagation cycle?

3. What is the definition of the momentum term α?

To Do: Implement a backpropagation network.

Tasks: Happy programming!

1. Download the prepared material from
   `http://www.imd.e-technik.uni-rostock.de/ma/rs/lv/hosc/nn.zip`
2. **Read the API documentation.** You are strongly advised to do so!
3. Implement the main functions in the file `bp.c` of a simple backpropagation network. Please note that the given code material does not provide any backpropagation functionality but demonstrates how to use the network functions. You might want to start with a simple 1-1-1 network that should be realizing an inverter. How many training patterns do you need? This unit is to make sure that your backpropagation code is working well, and the `prt-`functions are mainly for debugging purposes ◡̈. Save this program version for later usage.
4. Add the momentum term α to your program. The required data structures are already included in the programming environment. With $\alpha = 0$, your program should exhibit exactly the same behavior as before. For test purposes, use a small learning rate, e.g., $\eta = 0.1$, and gradually increase the momentum, e.g., from $\alpha = 0, \alpha = 0.1$, to $\alpha = 0.2$. You should be observing an accelerated learning process.

   Question: What is the maximal reasonable value for α?

Have fun, Theo and Ralf.