Department of Computer Science, Electrical and Space Engineering
Luleå University of Technology

D7041E "Applied artificial intelligence"

(Please report any found inconsistencies to Evgeny as soon as you find them)

LAB 5: Artificial Neural Network and Backpropagation

1. Introduction

In this lab we will work with model-based classifiers and supervised learning. We will continue to classify hand-written digits from the publicly available dataset MNIST. In this lab you will use a Jupyter notebook Lab5_ANN_backprop, which is available in Canvas.

Task 1. Multi-layer perceptron and backpropagation

Multi-layer perceptron was one of the first successful neuro-inspired computational models. In its original version, however, it was very difficult to parametrize and optimize, as such its performance was in many practical cases sub-optimal. Backpropagation algorithm was a breakthrough solution, which paved the way to the modern development of the artificial neural network technology and deep learning. The goal of this task is to understand the fundamentals of the backpropagation algorithm and study classification performance of the multi-layer perceptron.

1. Understand the implementation structure of the multilayer perceptron in Jupyter notebook Lab5_ANN_backprop.
   a. Be able to explain the principle of backpropagation algorithm;

b. Be able to explain the meaning and the role of the Softmax function;
c. Be able to name typically used non-linear output functions and implications of choosing one or another for implementation.
d. The code in the provided Jupyter notebook will stop execution at several points. Find the places in the code, where the execution breaks, answer the questions, comment out the exit line and run the code again.

2. Run the code with the suggested configuration of the hyperparameters: number of epochs = 70 and learning rate =0.05. What is the classification accuracy?

3. Run the code with Learning rate =0.005 and Learning rate =0.5. Explain the observed differences in the functionality of the multi-layer perceptron.

4. Extend the code implementing the ReLU output function. Run the perceptron with the suggested by default configuration of hyperparameters: number of epochs = 70 and learning rate =0.05. What is the classification accuracy?

Congrats, you have just become familiar with fundamentals of the Artificial Neural Networks and Backpropagation algorithm! Well done!