11 The final project

The final project consists of two parts

1. Some applied Python stuff,

2. Some computations 'by hand".

Please present your findings as two .pdf files (use a pdf-merger if necessary), one for each part. The python stuff related file should be a "report-like" .pdf which explains the outcomes of your tasks and how you obtained them, an explanation of the used methods, ... The solution of the "by hand" example is a scan of the handwritten calculations of the given task.

What to do in detail?

11.1 Python part

The goal: Use a group-dependent subset of the well known mnist data-set to train and compare two models which do a binary classification.

To get the group-specific data set you need two numbers

1. the group number, which is the 6 digit number obtained by concatenating the last three digits of the group members student IDs and use this group number.

2. the group digit which is the third digit of your group number.

To obtain the data set take 10000 random-samples of the Mnist data set according to your group number - enter your group number in the python code where the data set is generated. Then your two models should learn to classify your group digit correctly.

The tasks:

1. Work through the provided code and explain the model. In particular explain what the SGD-Classifier does/ how it works? If helpful, extend the code to clarify what is the concept of the model, what it predicts, etc. Finally explain the model evaluation.

2. Extend the provided notebook and apply a Convolutional Neural Network (CNN) to the same binary classification task. There are many online tutorials for the Mnist dataset with CNNs - pick any of those and adapt them to your groups data set and the binary classification task. Experiment a bit with some of the hyper-parameters of the used model, explain what your model does (indicate how CNNs work, no details are necessary but feel free to add them) and what hyper-parameters you have picked.

3. Compare both of your models? Which one is better, which one would you recommend?

Present the key steps and the findings of your data set in a nicely written report. Include python code, graphs, ..

11.2 By hand part

To individualize your network first fix the following numbers. Let

- α be the median of the digits of the group number,

- $\beta = 2 +$ remainder of the group number divided by 7,

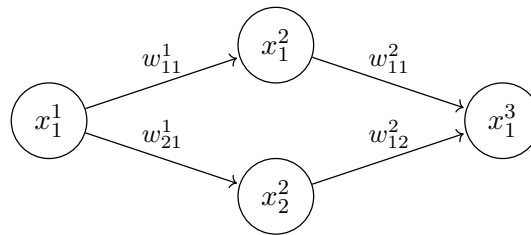- γ group digit

Given is the simple neural network:

Figure 8: Neural network

The starting weights are

$$w_{11}^1 = \alpha/20, \quad w_{21}^1 = (\alpha + \beta)/20, \quad w_{11}^2 = 0.1, \quad w_{12}^2 = 0.3.$$

and the training data has the two points $(0.2, \beta/10)$ and $(0.6, \gamma/10)$.

Let the activation function be the sigmoid function and the loss function MSE. Compute the gradient of the loss function w.r.t. the weights. Highlight the recursive character of the derivation (as far as possible in this simple neural net) and compute two training epochs of backpropagation by hand using stochastic gradient descent.