DAIS2021: Assignment #4
Deep Learning

Kyra Ahrens, Tom Weber, Lennart Clasmeier
{ahrens,tomweber}@informatik.uni-hamburg.de,
lennart.clasmeier@studium.uni-hamburg.de

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Introduction

In this assignment, we want to get familiar with deep learning and its pitfalls. We will have a look at how we can train neural networks, possible problems and how we can evaluate trained classifiers.

The assignment has 100 points in total, distributed over the tasks. You need to get at least 50 points to pass this assignment.

1   Autodiff: 10 points

The computation of gradients is one of the core principles of deep learning. One of the more efficient algorithms for that purpose is reverse-mode autodiff, which is employed by all major deep learning frameworks like TensorFlow or PyTorch. In this task, we will try to follow along the steps of the algorithm and solve an example.

The task is modelled as a quiz and can be found on the moodle course of page or by clicking the following link: https://lernen.min.uni-hamburg.de/mod/quiz/view.php?id=57750

2   Activation Functions and Vanishing Gradients: 20 points

The gradient flow through neural networks is modulated by activation functions. Different activation functions can lead to differences in model performance and learning capabilities. Sometimes, the use of specific activation functions in combination with certain architectural choices can lead to problems. One such problem, that will be explored, is the vanishing gradient problem. Please do all the tasks specified in the attached Jupyter notebook *ActivationFunctions.ipynb*.

3   Classifier Evaluation: 20 points

This task presents you with the first steps in PyTorch, a deep learning framework popular in research. We already implemented a model to predict different types of wines. It is up to you to properly evaluate the model's performance in order to judge its actual prediction performance. Please do all the tasks specified in the attached Jupyter notebook *Evaluation.ipynb*.

4   FMSSVRC: 50 points

This task presents you with the Fashion-MNIST small scale visual recognition challenge. The provided notebook contains code that is almost complete for creating and training a deep neural network that performs a complex visual recognition task (recognising different pieces of clothing!). Please do all the tasks specified in the attached Jupyter notebook *FMSSVRC.ipynb*. The main challenge here is to build and

train a performant Multi-Layer Perceptron. The cut-off for a performant model can be considered to be 82% test accuracy.

5   Next Assignment

Now that you have gained some insights into supervised learning, we will proceed with another learning strategy: unsupervised learning. Therefore, refresh yourself with following topics:

- Self-Organized Maps (SOM)

- k-means clustering, DBScan, hierarchical clustering