



Hochschule Hof

Exam Subject: Applied Deep Learning
Appointment: XX.XX.XXXX
Permitted Aids: One Din A4 page handwritten
Examiner:

Matriculation number:

Important notes:

1. Please check the assignment sheets for completeness:
 - 1 Cover page
 - 10 task pagesso a total of 11 pages.
2. Write the solutions directly after the task on the respective sheets. If you notice during the processing that there is not enough space on the task sheets, use the back pages and write the corresponding solutions on them with a fully qualified indication of the sub-task processed in each case (e.g. "Task 2, Sub-task 1a").
3. This sheet, as well as all assignment sheets or other sheets related to the assignments, must be marked with your **matriculation number**.
4. Tasks or parts of tasks are only considered solved if the individual solution steps are legible and understandable. Only one solution may be submitted per task.

To be filled in by the examiner

Interruptions:

from _____ to _____
from _____ to _____

Comments:

(grade)

Signature of first examiner

(grade)

Signature second examiner

Matriculation number:

1 Neural networks

- a) Explain the terms bias, variance, and bias-variance trade-off.

- b) Which activation function do you use in the last layer of an NN for multi-class classification?

- c) What is momentum at the SGD? In what way is it helpful?

- d) What is batch normalization?

- e) Describe a Possible Data - Imputation Technique.

- f) Why are CNNs better for processing image data?

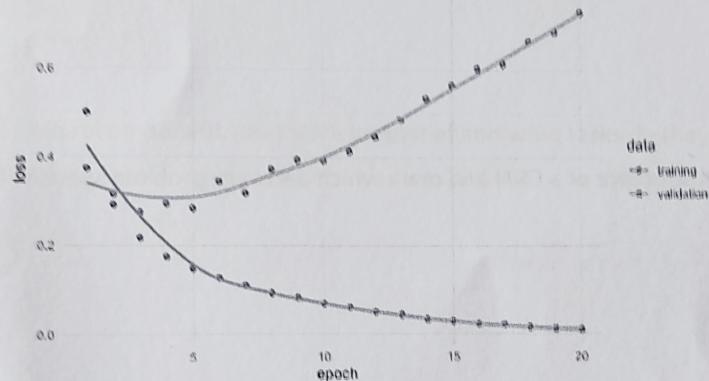
Matriculation number:

g) Describe the steps to perform a normalization of the data.

h) What is the difference between normalization and standardization?

i) What is k-fold cross validation?

j) What is the problem here? How can you recognize this? (2P)



k) How many parameters need to be trained when we apply a 3x3x3 filter to a 32x32x3 image in a CNN? (2P)

Matriculation number:

2 Transfer Learning

- a) What is the difference between a classical ML approach and an approach with transfer learning?
 - b) What is the difference between hard and soft parameter sharing and in which context is it used?
 - c) Explain the most common form of fine-tuning in deep neural networks.
 - d) Draw the rough structure of a CNN and mark which parts are problem specific.

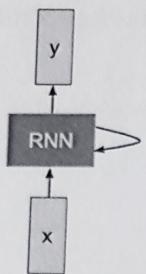
3 RNNs

- a) Describe the problems of MLPs and CNNs in processing time series data.

 - b) Give an example of a many-to-one and a one-to-one task.

Matriculation number: _____

- c) Sketch an unrolling of the following mesh for 3 consecutive inputs x_1, x_2, x_3 .



- d) What components do LSTMs consist of and what tasks do they perform?

- e) What is meant by vanishing gradient?

Matriculation number:

4 NLP

- a) Describe what is meant by 1-hot coding. What does it refer to in the field of NLP and why is coding necessary?

- b) What would all n-grams be at n=3 for the following input?

Mary had a little lamb, little lamb, little lamb,

- c) What is the advantage of so-called word embeddings, such as those resulting from Word2Vec?

- d) What are the dimensions of an embedding matrix defined by?

- e) Explain the difference between CBOW and Skipgram.

Matriculation number: _____

- f) Why are positional encodings necessary for transformers?

- g) Explain the difference between greedy decoding and beam decoding for transformers.

5 Reinforcement Learning

- a) Explain the difference between a rational agent and an omniscient agent.

- b) What is meant by the PEAS environment of a rational agent? Briefly explain the function of each of these components.

- c) Explain the difference between a deterministic environment and a stochastic environment.

Matriculation number:

- d) Give one example each of a dynamic and static environment, including the agent's task.

- e) What is a table-driven agent and what are its drawbacks?

- f) Explain the Exploitation Exploration Trade-off

- g) What is the Bellmann equation in the context of Q-learning? Name the individual components.
$$Q(s,a) = \max_a Q(s,a)$$

- h) What is the effect of learning rate alpha in the context of Q-learning?

- i) Explain which hyperparameters of a neural network you can specify very easily in Deep-Q learning and why.

Matriculation number:

6 Code Understanding

Consider the following source code snippet:

```
class DataModel(pl.LightningModule):
    def __init__(self):
        super(DataModel, self).__init__()
        self.loss = nn.MSELoss()
        self.layers = nn.Sequential(nn.Flatten(),
                                   nn.Linear(784, 64),
                                   nn.ReLU(),
                                   nn.Dropout(),
                                   nn.Linear(64, 64),
                                   nn.ReLU(),
                                   nn.Dropout(),
                                   nn.Linear(64, 10))

    def configure_optimizers(self):
        params = self.parameters()
        optimizer = optim.SGD(params=params, lr = 0.01)
        return optimizer
```

a) How many layers does this neural network have?

b) How many input parameters?

c) How classes should be classified here?

d) What is the learning rate?