

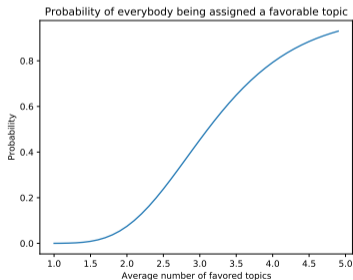


## Seminar Neural Networks and Deep Learning



## Today

- Kick-Off Meeting
- Some Formalities
- Short Overview of the Topics



- Choose a couple topics
  - Since we are only a few, you can make these requests quite complicated (I prefer topic 1, but I would also take 3 or 7, except when I can do it in german, then I would prefer topic 12)
- Send your choice to [Simon.Kluettermann@cs.tu-dortmund.de](mailto:Simon.Kluettermann@cs.tu-dortmund.de) (till tomorrow 20.10.2021 23:59)
- You will be assigned one in the next days
- Earlier submission will not be preferred, so take your time



## Objective of this Seminar

- Introduction to a wide range of machine learning
  - Researching current scientific ideas
  - Understanding state-of-the-art techniques
  - Writing a clear and concise scientific report
  - Presenting and discussing your findings

→Not a bad start for a final thesis.... →maybe just talk to your supervisor about this



## Timeline

- 1 3min Presentations in Class (November 2, 15:30-17:00)
  - 2 Presentation in Class (Weekly, Tuesdays 15:30-17:00, starting November 9)
  - 3 Discussion of your Topics (afterwards)
  - 4 Writing of your Report (till two weeks after your Presentation)
- All parts required!
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- Everything will be done in english. If this is a problem for you, please write [Simon.Kluettermann@cs.tu.dortmund.de](mailto:Simon.Kluettermann@cs.tu.dortmund.de)



## Tasks of this Seminar

- 1 Choose a couple of topics from our list, you will be assigned to one of them
- 2 Read and understand the chapters given to you
- 3 Find, read and understand related literature. Try to get a wide picture of your Topic.
  - You will often find alternative sources
  - Some Topics include a programming sections, but for all topics some programming can be useful.
- Final Results:
  - Presentation (30min +10min questions)
  - Written Report (at least 6 Pages double column, ACM template equivalent. Imagine yourself explaining your Topic to another student)



## Topics

- Based on a Book "Neural Networks and Deep Learning"
- by C. Aggarwal, ISBN 978-3-319-94463-0
- Freely available through University Network (Springer Link)
- Some Topics contain programming assignments. We suggest using google colab for them.

Week 1: November 9

**Topic1:** Basics of NN, Feed Forward Networks, loss functions and activations  
Chapters 1.2,1.4,1.5 and train a simple Dense Neural Network on MNIST

**Topic2:** Alternative Models, Least Square Regression and SVMs  
Chapters 2.1-2.4

Week 2: November 16

**Topic1:** What is Backpropagation?

Chapters 3.1,3.2 and 3.7

**Topic2:** How to use Backpropagation

Chapters 3.3-3.6



## Week 3: November 23

**Topic1:** Methods against overfitting: Regularisation, Early Stopping and Ensemble Methods  
Chapters 4.4-4.6

**Topic2:** Advanced training methods: Continuation/Curriculum Learning, Parameter Sharing  
and Pretraining  
Chapters 4.7-4.9

Week 4: November 30

**Topic1:** What are recurrent NN and Echo State Networks/Reservoir Computing  
Chapters 7.1-7.4 also train a simple RNN

**Topic2:** Compare LSTMs and GRUs  
Chapters 7.5 and 7.6, also briefly summarize 3 applications for RNNs (see for example Chapter 7.7)

## Week 5: December 7

### **Topic1:** Convolutions in Practice

Chapter 8.2, the Introductions to convolutions from AIMA4, pages 811-813 and train a simple convolutional neural network on MNIST

### **Topic2:** Convolutions in Theory

Chapters 8.1, 8.3 and briefly summarize 3 applications (see for example chapter 8.6)



## Week 6: December 14

### **Topic1:** Hopfield Networks and Boltzmann Machines

Chapters 6.1-6.4 and briefly summarize 1-2 applications (see for example chapter 6.5) or implement a simple model

### **Topic2:** Graph Machine Learning

Chapter 2.7 + 1 other source, my suggestions: [distill.pub](https://distill.pub) on GNN



Week 7: December 21

**Topic1:** Explaining Autoencoders

Chapter 2.5 and train a simple Autoencoder on MNIST

**Topic2:** Advanced Autoencoder concepts

Chapters 4.10 and 8.5



Week 8: January 11

**Topic1:** Introduction to Reinforcement Learning

Chapters 9.1-9.4 also implement an RL algorithm for a simple game

**Topic2:** Advanced RL algorithms

Chapters 9.5, 9.6 and briefly summarize 3 applications for RL (for example Chapter 9.7)



## Week 9: January 18

### **Topic1:** GANs

Chapter 10.4 and train a simple GAN on MNIST

### **Topic2:** A brief summary of unsupervised Machine Learning

A Paper, for example "A Survey on Unsupervised Machine Learning Algorithms for Automation, Classification and Maintenance" by Khanum et al 2015



Week 10: January 25

**Topic1:** Attention Mechanisms

Chapters 10.2 and look for alternative sources!

**Topic2:** Competitive Learning

Chapters 10.5 and look for alternative sources!





- Week 1: Intro to ML \*2
- Week 2: Backpropagation \*2
- Week 3: Training techniques \*2
- Week 4: Recurrent NN \*2
- Week 5: Convolutions \*2
- Week 6: Boltzmann Machines, Graph ML
- Week 7: Autoencoders \*2
- Week 8: Reinforcement Learning \*2
- Week 9: GANs, unsupervised ML
- Week 10: Attention Mechanisms and Competitive Learning