EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

MATHEMATISCH-
NATURWISSENSCHAFTLICHE FAKULTÄT
Cognitive Modeling Group

Current Advances in
Deep and Recurrent Neural Networks
SS 2018

Dr. Sebastian Otte

Cognitive Modeling
University of Tübingen

EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

- Responsible contact:
  Dr. Sebastian Otte

  Cognitive Modeling Group
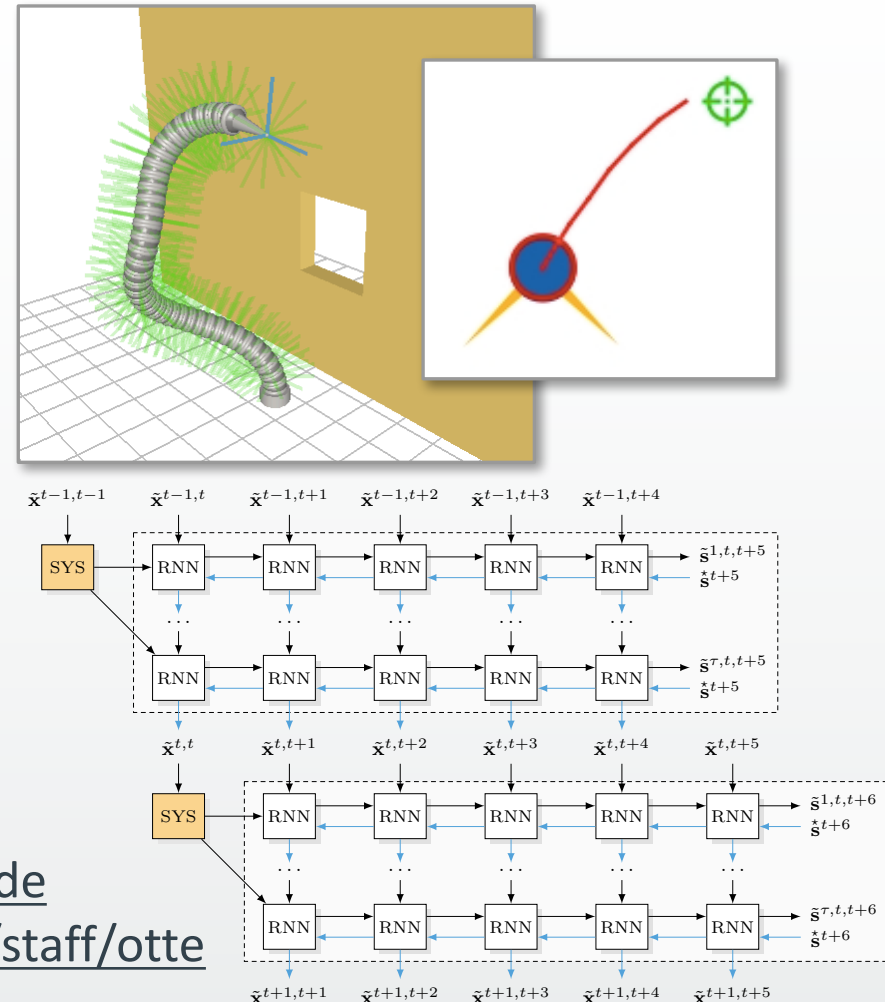 Computer Science Department
  University of Tübingen

  Room C 420
  Sand 14
  72076 Tübingen, Germany

  Phone: +49 7071 29 70481
  Fax: +49 7071 29 5719
  Email: sebastian.otte@uni-tuebingen.de
  WWW: http://cm.inf.uni-tuebingen.de/staff/otte

- This seminar is about Deep and Recurrent Neural Networks
  - Discussing the pros and cons of some
    - (more or less) recent key papers in the field of Deep Learning
    - very recent advances
    - ... and some exotic stuff
  - Covering methodological aspects as well as applications

  - **Recommended requirements**: a certain amount of background knowledge...

Important terms (things you should know)

- Back-Propagation (BP)
- Back-Propagation Through Time (BPTT)
- Multi-Layer Perceptrons
- Gradient-Descent (with momentum or Nesterov momentum), RMSprop, Adam
- Autoencoder
- Evolutionary Optimization
- Recurrent Neural Networks (RNNs)
- Vanishing gradient problem
- Long Short-Term Memorys (LSTMs)
- Gated Recurrent Units (GRUs)
- Bidirectional RNNS (BRNNs)
- Multi-Dimensional Multi-Directional (MDMDRNNs)
- Convolutional Neural Networks (CNNs)

- Rectified Linear Units (ReLU), dead ReLUs, ELUs …
- Pooling techniques (max pooling etc.)
- Stochastic vs. batch vs. mini-batch learning
- Over-fitting vs generalization
- Training set vs. test set vs. validation set
- Regularization
- L1, L2, regularization
- Dropout/Dropconnect
- Batch-Normalization (BN)
- (Residual Networks)
- (Deconvolution)
- …

Learning Goals

- Learning about recent advances in the field of DNNs and RNNs
- Training your skills
  - Reading scientific literature
  - Understanding complex coherencies
  - Excerpting and condensing essential information
  - Scientific writing
    - Clear formulations
    - Correct citing
    - …
  - Talking freely and explaining complex things to others
- Learning to obtain a critical perspective
- Having fun!

- Seminar requirements
  - **Critical and analytical confrontation** with state-of-the-art research topics in the field of DNNs and RNNs
  - Writing an **extended summary paper**
    - Summary of one scientific paper (or multiple papers on a specific topic)
    - 3 pages including references and figures
    - Two-column, IEEE template (LaTeX)
    - Texts in English!
  - Writing **reviews** for two other students' papers
    - At least 1 000 (maximal 1 500) non-whitespace characters per review
    - Should contain a brief summary as well as strengths and weaknesses of the paper
  - Preparing and holding a **25 min talk** with an additional **15 min discussion**
    - Talks can be in English as well (optional, voting)

Modalities

- Registration for this seminar
  - Via Ilias platform (you need your campus login)
    https://ovidius.uni-tuebingen.de/ilias3/goto.php?target=crs_1667722
  - Course password: `cogmod18`
- Assignment of the topics
  - 20+ pre-selected topics (later slides)
  - Random assignment biased by priority and "earliness" of request
  - Indication of priorities for three topics (1 highest, 3 lowest priority)
  - Please select three different topics with three different priorities (1, 2, and 3)
  - Additionally: Proposal of another, unlisted paper (selecting three of the listed topics is still mandatory)

- Priority submission
  - Submission deadline: **April 23, 2017, 23:59 CEST**
  - Via email: sebastian.otte@uni-tuebingen.de
  - Please use "[Seminar Adv. Deep Learning :: Topic]" as subject
- Paper submission (PDF + BibTeX file)
  - Via Ilias exercise (will be online soon)
  - Paper submission deadline: **June 17, 2018, 23:59 CEST**
  - Reviewers will be assigned soon afterwards
  - Review submission deadline: **July 15, 2018, 23:59 CEST**
- Grading
  - $\approx$ 45% paper, 45% talk, and 10% reviews
- Attending all talks and participating the discussions is mandatory!
  - We reserve the right for a grade penalty (-0.3) in case of unexcused absence

- **Very Deep Networks (B)**
  - Deep Residual Networks, CVPR 2016
    https://arxiv.org/abs/1512.03385
  - Deep Residual Networks, ECCV 2016
    https://arxiv.org/abs/1603.05027
  - Deep Networks with Stochastic Depth, ECCV 2016
    https://arxiv.org/abs/1603.09382

- **Densely Connected Convolutional Networks (B)**
  - CVPR 2017
    https://arxiv.org/abs/1608.06993

- **Generative Adversarial Networks I**
  - NIPS 2014
    https://papers.nips.cc/paper/5423-generative-adversarial-nets

- **Generative Adversarial Networks II+ (M)**
  - Wasserstein Generative Adversarial Networks, ICML 2017
    http://proceedings.mlr.press/v70/arjovsky17a.html
  - Synthesizing Audio with Generative Adversarial Networks, ???
    https://arxiv.org/abs/1802.04208

B Early topics,
       already assigned!

M Multiple assignments
       possible

- Multimodal Unsupervised Image-to-Image Translation, ???
  https://arxiv.org/abs/1804.04732

- **Single Shot MultiBox Detector**
  - ECCV 2016
    https://arxiv.org/abs/1512.02325

- **Capsule Networks**
  - NIPS 2017
    http://papers.nips.cc/paper/6975-dynamic-routing-between-capsules

- **Recurrent Weighted Average Networks**
  - https://arxiv.org/abs/1703.01253

- **Recurrent Highway Networks**
  - ICML 2017
    https://arxiv.org/abs/1607.03474

- **Nested LSTMs**
  - ACML 2017
    https://arxiv.org/abs/1801.10308

B Early topics,
     already assigned!
M Multiple assignments
     possible

- **Optimization and Regularization (M)**

  - SGD vs. Adam and Co., NIPS 2017
    https://arxiv.org/abs/1705.08292

  - Recurrent Batch Normalization, ICLR 2017
    https://arxiv.org/abs/1603.09025

  - Batch Kalman Normalization, ???
    https://arxiv.org/abs/1802.03133

- **Spherical CNNs**

  - ICLR 2018
    https://arxiv.org/abs/1801.10130

- **Variational Autoencoders I**

  - ICLR 2014
    https://arxiv.org/abs/1312.6114

  - ICML 2015
    https://arxiv.org/abs/1410.6460

- **Variational Autoencoders II**

  - A hierarchical recurrent variational autoencoder for music, ???
    https://arxiv.org/abs/1803.05428

B   Early topics,
        already assigned!

M   Multiple assignments
        possible

Selected Topics

- **Wasserstein Auto-Encoders**
  - ICLR 2018
    https://arxiv.org/abs/1711.01558
- **Bayesian Deep Learning**
  - NIPS 2017
    https://arxiv.org/abs/1703.04977
- **Efficient Deep Learning (M)**
  - ShuffleNet, ???
    https://arxiv.org/abs/1707.01083
  - Multi-Scale Dense Networks, ICLR 2018
    https://arxiv.org/abs/1703.09844
  - Training and Inference with Integers in Deep Networks, ICLR 2018
    https://arxiv.org/abs/1802.04680
- **Fooling Deep Networks**
  - Literature research
- **Ethics in artificial intelligence/deep learning**
  - Literature research

B Early topics, already assigned!

M Multiple assignments possible