curriculum vitæ of

Katja Hauser

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Research Interests

I am interested in the structures that arise in neural networks during training. Specifically, I am interested in analysing networks found by magnitude pruning as proposed in the *Lottery Ticket Hypothesis*[1] by means of *Topology*.

In the course of my university studies I have focused on *Scientific Visualization*, *Knowledge Discovery in Databases* and *Machine Learning*. I have written my master's thesis on a specific type of invertible *Normalizing Flow*: the *Invertible Neural Network*[2] (INN).

Keywords: Lottery Ticket Hypothesis, Normalizing Flows, Deep Learning, Scientific Visualization, Knowledge Discovery in Databases

Education

04/2020 – 01/2021 **Ph.D.** in computer science (parental part-time work, 16h/week) Heidelberg University, Germany

Preliminary thesis title: *Practical Application and Theoretical Analysis of Invertible Neural Networks*
Advisors: apl. Prof. Dr. Ullrich Köthe, Prof. Dr. Artur Andrzejak
The first goal of the thesis was to develop an INN[3]-type neural network for complex sequence data. We planned on using it for RNA base calling from nanopore data with focus on the detection of modified bases.

04/2017 – 12/2019 **M.Sc.** in Applied Computer Science (final grade **1.1**) Heidelberg University, Germany

Exploration of INNs
Advisors: apl. Prof. Dr. Ullrich Köthe, Prof. Dr. Artur Andrzejak
Thesis topics:

- **Mode finding in toy data**: finding high probability regions in a learned feature space as well as in a known latent space in INNs[4], creating a mapping of corresponding regions in latent and feature space.
- **High level analysis of the transport process** between feature and latent space in trained INNs (in both directions).
- **Pruning INNs**: several experiments using *layer-wise pruning* by different criteria (e.g., average magnitude of weights or a layer's contribution to the transport) and *iterative magnitude pruning* (i.e., the approach used in the *Lottery Ticket Hypothesis*).
- **Ensembles, uncertainty quantification and outlier detection**: performance of ensembles of INNs, uncertainty quantification using *Deep Ensembles*[5] and outlier detection using *WAIC*[6].

10/2012 – 04/2017 **B.Sc.** in Applied Computer Science (final grade **1.8**) Heidelberg University, Germany

Latent Information Networks from German Newspaper Articles
Advisors: Prof. Dr. Michael Gertz

2012 **Abitur** (final grade **1.4**) Hebel-Gymnasium Schwetzingen, Germany

University entrance qualification

[1] J. Frankle and M. Carbin. *The Lottery Ticket Hypothesis: Finding Sparse, Trainable Neural Networks*, In International Conference on Learning Representations, 2019.

[2] L. Ardizzone, J. Kruse, S. J. Wirkert, D. Rahner, E. W. Pellegrini, R. S. Klessen, L. Maier-Hein, C. Rother, and U. Köthe. *Analyzing Inverse Problems with Invertible Neural Networks*. In International Conference on Learning Representations, 2019.

[3] ibid.

[4] ibid.

[5] B. Lakshminarayanan, A. Pritzel, and C. Blundell. *Simple and Scalable Predictive Uncertainty Estimation using Deep Ensembles*, In Advances in Neural Information Processing Systems, 2017

[6] Following H. Choi, E. Jang, and A. A. Alemi. *WAIC, but Why? Generative Ensembles for Robust Anomaly Detection*, arXiv preprint arXiv:1810.01392, 2018., WAIC: S. Watanabe. Algebraic Geometry and Statistical Learning Theory. 2009.

Family

04/2020 – Present **Parental part-time work** Heidelberg, Germany
I am the primary care giver for my daughter (*01/2020) and currently working part-time (16h/week).

12/2019 – 03/2020 **Maternity leave**[7] Heidelberg, Germany

Teaching and Work Experience

04/2017 – 08/2017 **Student Assistant** for the lecture *Betriebssysteme und Netzwerke*[8] Heidelberg, Germany
I graded homework and exams, planned and taught weekly tutorials for a group of about 30 students.

04/2016 – 09/2016 **Student Assistant** for the lecture *Betriebssysteme und Netzwerke* Heidelberg, Germany
I graded homework and exams, planned and taught weekly tutorials for a group of about 30 students.

10/2015 – 03/2016 **Student Assistant** for the lecture *Einführung in die Praktische Informatik*[9] Heidelberg, Germany
I graded homework and exams, planned and taught weekly tutorials for two groups of about 20 students each with a focus on C++ basics.

11/2014 – 06/2015 **Student Assistant** at the *Visualization and Numerical Geometry* group Heidelberg, Germany
I implemented algorithms for the efficient computation of ray-object intersections in C++.

Skills

Programming Languages

Python – excellent
I wrote the practical homework for several lectures, two student projects and the main work for bachelor's and master's theses in Python.
I have programming experience, among others, with `numpy`, `scipy` and `pytorch`, `matplotlib` and `networkx`, `pymongo` and `re`.

C++ – working knowledge
C++ was the main focus of two courses (mandatory programming course and *Object Oriented Programming for Scientific Computing* (grade 1.0)). I used it for the practical homework in an additional lecture.
I taught basic concepts (including pointers, inheritance and templates) as tutor (10/2015 - 04/2016).
C++ was the main programming language during my work as a student assistant (11/2014 - 06/2015).

R – working knowledge
I used R for the practical homework in one lecture and as the main programming language in a student project (grade: 1.0).

Haskell, Java, Octave – solid understanding
I obtained a basic familiarity with these languages using them for the practical homework in one (Haskell, Java) to two (Octave) lectures each.

Proficiency in IT Tools

git – excellent
I used `git` as version control system for several projects, including my bachelor's and master's theses.
I have a safe handling and understanding of the basic work flow (add-commit-push), setting up repositories, branching, reverting and merging, as well as some advanced functionality (changing the commit history). I am experienced with the use of `git` in the context of group projects.

[7] By German regulation 6 weeks before due-date and 8 weeks after giving birth.
[8] Operating Systems and Networks
[9] Introduction to Practical Computer Science

LaTeX – working knowledge

I compiled numerous reports and presentations, as well as my bachelor's and master's theses using LaTeX.

command line tools – working knowledge

I have a good familiarity with basic operations (navigation, file creation and deletion, package management, process monitoring, searching). I am comfortable with writing small scripts for automization including the use of `parallel`.

svn – working knowledge

I used `svn` as version control system for two projects. I have a safe handling on the basic work flow.

Language Skills

German – native speaker
English – fluent (CEFR[10] C2)
Russian – very good command (CEFR B2)

Experiences Abroad

08/2017 – 01/2018 **Semester abroad** at *Saint Petersburg State University* Saint Petersburg, Russia

Since the campus of the sciences and the campus of the humanities lie apart about 1.5hrs by public transport (one way), I did a full-time language course.

Miscellaneous

In my spare time I like to do bouldering, standard and latin dances and sew garments for my family and myself.

[10] Overview over the levels of language proficiency as defined in the Common European Framework of Reference (CEFR)