
Research Interests

Machine Learning Theory, Strategic Classification, Algorithmic Fairness, Transfer Learning

Education

01/2019- University of Waterloo, Cheriton School of Computer Science.

Present Doctor of Philosophy (Ph.D.) in Computer Science.

- **Advisor:** Prof. Shai Ben-David.
- **Research Areas:** Machine Learning Theory, Fairness and Interpretability of ML models.
- **Relevant Courses:** ML techniques for Systems and Systems for ML, Security and Privacy for AI and ML, ML in Bioinformatics.

04/2015- Eberhard Karls University Tübingen.

12/2018 Masters in Cognitive Science.

- **Advisors:** Prof. Ulrike von Luxburg and Prof. Ruth Urner.
- **Thesis:** Domain Adaptation Under Causal Assumptions.[📄]
- **Specialization:** Machine Learning Theory.
- **Relevant Courses:** Machine Learning: Algorithms and Theory, Machine Learning Theory, Deep Neural Networks.

05/2011- LMU, Ludwig Maximilian University of Munich.

03/2015 Bachelors Degree, Major in Mathematics, Minor in Computer Science.

- **Advisor:** Prof. Christina Kuttler.
- **Thesis:** Comparison of the Hodgekin-Huxley-Model to the Fitzhugh-Nagumo-Model.
- **Specialization:** Mathematical Modeling of Biological Systems.
- **Relevant Courses:** Logic, Theory of Computation, Stochastics, Numerical Analysis, Randomized Algorithms.

Publications

Learning Losses for Strategic Classification [📄], *Tosca Lechner and Ruth Urner*, to appear at the Workshop on Learning and Decision-Making with Strategic Feedback - Workshop @ NeurIPS 2021, accepted to AAAI 2022.

Open Problem: Are all VC-classes CPAC learnable?[📄], *Sushant Agarwal, Nivasini Ananthakrishnan, Shai Ben-David, Tosca Lechner, Ruth Urner*, COLT 2021 Open Problems.

Impossibility results for Fair Data Representation[📄], *Tosca Lechner, Shai Ben-David*, under review for ALT 2022, extended arxiv version with Nivasini Ananthakrishnan and Sushant Agarwal.

Identifying Regions of Trusted Predictions [📄], *Nivasini Ananthakrishnan, Shai Ben-David, Tosca Lechner, Ruth Urner*, UAI 2021.

Point-wise Confidence Scores for Binary Classification Models[📄], *Nivasini Ananthakrishnan, Shai Ben-David, Tosca Lechner*, accepted as poster for SafeAI 2021.

On Learnability with Computable Learners[📄], *Sushant Agarwal, Nivasini Ananthakrishnan, Shai Ben-David, Tosca Lechner and Ruth Urner*, ALT 2020.

Ongoing Projects

Semi-supervised classification and conformal prediction for generative models, with Niki Hasrati and Shai Ben-David.

We analyse the sample complexity for semi-supervised learning and conformal prediction for Gaussian mixture models

Learning Manipulation for Strategic Classification, with Ruth Urner.

We aim to leverage unlabeled data as well as data from different task to learn an appropriate manipulation structure for strategic classification. We also want to take into account different manipulation capabilities between subpopulations to facilitate fair strategic classification.

A Principled View on Outlier Detection, with Ruth Urner and Chester Wyke.

We aim toward a formal characterization of outlier detection algorithms by desired properties, such as stability under small variations in the input dataset.

Fast Tracking Algorithm for highly-dynamic Single-Molecule Localization Microscopy Data, with Marc Endesfelder, Christoph Schießl, Bartosz Turkowyd and Ulrike Endesfelder.

We introduced a new algorithm for tracking highly-dynamic live-cell data from single-molecule localization microscopy utilizing Bayesian network which has been in use in research projects[Ⓞ]

Individual Fairness and Fair Representation, with Sushant Agarwal, Nivasini Anathakrishnan, Shai Ben-David and Ruth Urner.

Previous Research Experience

09/2017-
05/2018 **Research Assistant**, "Transfer Learning under Causal Assumptions", Max-Planck-Institute for Intelligent Systems, Tübingen, Advisors: Ruth Urner, Bernhard Schölkopf.

We analysed several formalizations of the criterion of 'Independence of Cause and Mechanism' to yield guarantees for domain adaptation. We proved lower bounds on the sample complexity of domain adaptation learners for cases with additional assumptions on the underlying causal data-structure.

06/2017-
07/2017 **Research Assistant**, "Theory of Machine Learning", Max-Planck-Institute for Intelligent Systems, Tübingen, Advisor: Ruth Urner.

We extended guarantees for domain adaptation from binary to multi-label classification setting.

05/2016-
09/2016 **Research Internship**, "Transmission of signals between prefrontal and parietal neurons involved in numerosity processing", University of Tübingen, Department: Biology, Animal Physiology, Chair: Andreas Nieder.

We analysed single cell neural data from two brain-regions involved in numerosity processing for Granger causality to detect possible top-down processing.

Teaching Experience

10/2011-
Present **Teaching Assistant**, "Analysis I", "Linear Algebra I & II", "Machine Learning Theory", "Logic", "Introduction to AI", "Algorithms", conducted tutorials and graded assignments and exams.

04/2015-
07/2016 **Instructor**, "Mathematics and Statistics", University of Applied Sciences Neu-Ulm, gave 4 hour long lectures each week, conducted tutorials and conceived and marked exams.

Scholarships & Awards

Vector Research Grant, Vector Institute, Toronto, Sept 2020-Sept 2021, Sept 2019 -Sept 2020, Jan 2019-Sep 2019, 6000\$(CAD), 6000\$(CAD), 3000\$(CAD) respectively.

Provost Doctoral Entrance Award, University of Waterloo, Jan-Dec 2019, 5000\$(CAD).

PROMOS Travel Scholarship, University of Tuebingen/DAAD, Feb-Mar 2018, 750 Euro.

Deutschland-Stipendium, National German scholarship Programm, May 2011-Mar 2013, 300 Euro/month.

Reviewer

Conferences **COLT 2018, IJCAI 2019, ICML 2021, ALT 2021.**

Activities

07/2021-
08/2021 **Participation at Deep Learning Theory Summer School at Princeton**, seven day summer school for Theory of Deep Learning.

07/2017 **Participation at Pre-Doc Summer School on Learning Systems at ETH Zurich**, one week summer school for Machine Learning.

04/2013-
10/2016 **Establishment and Organization of the Annual Biomodels Academy[Ⓞ]**, CdE e.V. (students association).

09/2009-
12/2013 **Member of the board**, Quod Erat Demonstrandum e.V.[Ⓞ] (students math association).

Skills

Languages **German (native), English (fluent), French (basic).**
Programming **Python, R, Java, MATLAB, C++.**