BURAK VARICI

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Education

Rensselaer Polytechnic Institute, Troy, NY — May 2020 - (expected) June 2024
Ph.D. in Electrical Engineering, Advisor: Prof. Ali Tajer — GPA: 3.93/4.0

Rensselaer Polytechnic Institute, Troy, NY — August 2018 - May 2020
M.S. in Electrical Engineering — GPA: 3.9/4.0

Bogazici University, Istanbul, Turkey — September 2013 - June 2018
B.S. in Electrical & Electronics Engineering — GPA: 3.43/4.0

Research Interests

My research centers on the intersection of causality and machine learning. The overarching goal is to develop a methodology that models our world through a causality lens, capitalizing on shared causal mechanisms across diverse data environments. To achieve this, I use the language of *causal interventions* in a wide range of problems, including but not limited to unsupervised representation learning, causal structure learning, and the design of sequential interventions. More recently, my emphasis has been on causal representation learning from interventions, and exploring its potential applications.

Research Experience

RPI Information Sciences Group — Troy, NY
RPI-AIRC Scholar, Advisor: Prof. Ali Tajer — January 2020 - Present

Causal Representation Learning from Interventions
- Designed a novel framework for analyzing causal representation learning via score functions under interventions. Established identifiability results along with probably correct algorithms.
- Published our results for general transformations at AISTATS [C4]. The manuscript for the results on linear transformations is to be submitted to JMLR [P2], an earlier version is available in arXiv [P1].

Intervention Design via Causal Bandits
- Designed causal bandit algorithms with relaxed assumptions compared to the prior work. Established lower and upper bound regret guarantees. Published one paper at JMLR [J1].

Scalable Interventional Structure Learning
- Developed consistent algorithms for efficient learning of intervention targets and improving the structure learning of causal graphs.
- Published papers for both causally sufficient (NeurIPS [C2]) and causally insufficient systems (UAI [C3]).

Structure Learning of Undirected Graphical Models
- Developed algorithms for structure learning of shared subgraphs for multiple undirected graphical models, and analyzed sample complexities. Published one paper at AISTATS [C1].

RPI Intelligent Systems Laboratory — Troy, NY
Graduate Research Assistant, Advisor: Prof. Qiang Ji — August 2018 - December 2019
- Researched on low-cost eye-gaze tracking systems, and leveraged probabilistic methods to personalize deep models with limited annotation.

Boğaziçi University Signal and Image Processing Laboratory — Istanbul, Turkey
Senior Design Project, Advisor: Prof. Murat Saraclar — October 2017 - May 2018
- Investigated deep learning techniques for Query-by-example speech search on low-resource languages.
- Completed Bachelor thesis titled "Query-by-Example Speech Search with Neural Networks".

University of Wisconsin-Madison Madison, WI
Undergraduate Research Assistant, Advisor: Dr. Xinyu Zhang Summer 2016

- Researched on tracking the orientation of batteryless objects via RFID tags.
- Analyzed characteristics of frequency channels to integrate localization to Gyro in the Air project.

Professional Experience

Visiting Research Scholar at MIT-IBM Watson AI Lab Cambridge, MA
Mentors: Dr. Dmitriy Katz-Rogozhnikov, Dr. Prasanna Sattigeri, Dr. Dennis Wei Fall 2022

Proposed a framework for causal discovery from a mixture of DAGs, and established identifiability conditions for causal relationships in the mixture. Published one paper at TMLR [J2].

The Rensselaer-IBM AIRC Collaboration
AI Horizons Extern, Mentors: Dr. Prasanna Sattigeri, Dr. Karthikeyan Shanmugam May - August 2020

Researched on combining the causal discovery process with generative modeling and inducing a latent space representative of the underlying structure.

Speech Enabled Smart Technologies Istanbul, Turkey
Research Intern June - August 2017

Built neural networks for a speaker identity verification system.

Publications

C4 **B. Varıcı**, E. Acartürk, K. Shanmugam, and A. Tajer, "General Identifiability and Achievability for Causal Representation Learning", *to appear in International Conference on Artificial Intelligence and Statistics (AISTATS), 2024.*

P2 **B. Varıcı**, E. Acartürk, K. Shanmugam, A. Kumar, and A. Tajer, "Score-based Causal Representation Learning: Linear and General Transformations", *in preparation to be submitted to JMLR.*

P1 ***B. Varıcı****, E. Acartürk, K. Shanmugam, A. Kumar, and A. Tajer, "Score-based Causal Representation Learning with Interventions", arXiv:2301.08230, 2023.*

J3 *Z. Yan, A. Mukherjee,* ***B. Varıcı****, and A. Tajer, "Robust Causal Bandits for Linear Models", going through minor revision for publication at Journal on Selected Areas in Information Theory (JSAIT).*

J2 ***B. Varıcı****, D. Katz-Rogozhnikov, A. Tajer, D. Wei, and P. Sattigeri, "Separability Analysis for Causal Discovery in Mixture of DAGs", Transactions on Machine Learning Research (TMLR), 2024.*

J1 ***B. Varıcı****, K. Shanmugam, P. Sattigeri, and A. Tajer, "Causal Bandits for Linear Structural Equation Models", Journal of Machine Learning Research (JMLR), 2023.*

C3 ***B. Varıcı****, K. Shanmugam, P. Sattigeri, and A. Tajer, "Intervention Target Estimation in the Presence of Latent Variables", The Conference on Uncertainty in Artificial Intelligence (UAI), 2022.*

C2 ***B. Varıcı****, K. Shanmugam, P. Sattigeri, and A. Tajer, "Scalable Intervention Target Estimation in Linear Models", Neural Information Processing Systems (NeurIPS), 2021.*

C1 ***B. Varıcı****, S. Sihag, and A. Tajer, "Learning Shared Subgraphs in Ising Model Pairs", International Conference on Artificial Intelligence and Statistics (AISTATS), 2021.*

Talks

Causal Representation Learning Workshop at NeurIPS 2023
Score-based Causal Representation Learning from Interventions

IBM Causal Reinforcement Learning Group 2023
Causal Bandits for Linear Structural Equation Models

Skills and Coursework

Technical: Python, TensorFlow/PyTorch, MATLAB

Relevant Graduate Courses: Learning from Data, Deep Learning, Probabilistic Graphical Methods, Distributed Machine Learning, Trustworthy Machine Learning, Bandit Algorithms, Computational Optimization, Computer Vision, Speech Processing.

Awards & Honors

NeurIPS Top Reviewer	2023
UAI Top Reviewer	2023
Jerry Dziuba ECSE Graduate Student Service Award	2022
Belsky Award for Computational Sciences and Engineering	2022
The Rensselaer-IBM AIRC Fellowship	2020
Undergraduate Science Fellowship of Government of Turkey	2013 - 2018
University Entrance Exam - Ranked 276^{th} out of 1.8 million candidates	2013
Turkish National Mathematical Olympiad - Silver Medal	2012
International Balkan Mathematical Olympiad - Silver Medal	2012

Teaching Experience

Teaching Assistance, Rensselaer Polytechnic Institute — Troy, NY
ECSE 2410: Signals and Systems — Spring 2020

Teaching Assistance, Rensselaer Polytechnic Institute — Troy, NY
ECSE 2610: Computer Components and Operations — Spring 2019

Teaching Assistance, Rensselaer Polytechnic Institute — Troy, NY
ECSE 1010: Introduction to Electrical, Component and Systems Engineering — Fall 2018

Service

Reviewer: NeurIPS (2021, 2022, 2023), UAI (2023), AAAI (2023), AISTATS (2024), IEEE Transactions on Signal Processing

References

Prof. Ali Tajer, Associate Professor
Department of ECSE, Rensselaer Polytechnic Institute, Troy, NY
Email: tajer@ecse.rpi.edu

Dr. Karthikeyan Shanmugam, Senior Research Scientist
Google Research India, Bengaluru, India
Email: karthikeyanvs@google.com

Dr. Prasanna Sattigeri, Principal Research Scientist and Manager
MIT-IBM Watson AI Lab, Cambridge, MA
Email: psattig@us.ibm.com