

BIJAN MAZAHERI

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I am a computer scientist and mathematician interested in the synthesis and transportability of knowledge from and between multiple data sources. My work spans the fields of causality, data fusion, and distribution shift. I am currently pursuing a Ph.D. in Computing and Mathematical Sciences at Caltech supported by a NSF Graduate Research Fellowship and an Amazon AI4Science Fellowship. I have experience ranging from full stack web development to theoretical research on methods.

EDUCATION

California Institute of Technology - Pasadena, CA

Oct 2017 - present

Ph.D. Candidate

NSF Graduate Research Fellowship

Amazon AI4Science Research Fellowship

Cambridge University (Emmanuel College) - Cambridge, UK

Oct 2016 - Jun 2017

Mathematics Part 1B

Supported by a Herchel Smith Fellowship

Additional classes in Computer Science and Mathematics Part II

Williams College - Williamstown, MA

Sep 2012 - Jun 2016

Bachelor of Arts

Majors: Physics and Computer Science, GPA: 3.92

Honors: Highest Honors (Physics), Phi Beta Kappa, Sigma Xi, Magna Cum Laude

RESEARCH TOPICS

Data Fusion: Most datasets restrict their focus to a subset of topics. We have developed “Expert Graphs” to study consistencies and inconsistencies in partial, but overlapping expertise. As it turns out, this problem is deeply related to issues in voting theory, such as the Cordocet Paradox.

Mixture Models for Causality: Combining datasets induces universal confounding on a structural causal model (SCM). Controlling for such a confounder involves treating each dataset separately, defeating the purpose of the combined dataset. Assuming a bound on the number of types of sources turns the problem into a mixture model, allowing identification of within-source probability distributions. This perspective expands the notion of causal identifiability, as many graphically unidentifiable relationships can be identified.

Domain Adaptation and Transportability: I am interested in using causal principles to guide models that are robust to distribution shift in datasets. Our work uses concepts from causality and information theory to inform how auxiliary training tasks can improve robustness to distribution shift.

WORK EXPERIENCE

Amazon Research Causality Lab - Tübingen, Germany*Oct 2022 - Feb 2023**Applied Scientist Intern (L5)*

Worked with Mila Hardt, Atalanti Mastakouri, and Dominik Janzing

Amazon's Causality lab work in conjunction with software developers to research and develop causality-based products for AWS clients. I worked in the research half, but developed experience with their code review process. Our paper was accepted to UAI 2023.

BioDiscovery - El Segundo, CA*Jun 2017 - Sep 2017**Intern*

BioDiscovery maintains a software product for analyzing genomes. As an intern I developed methods for clustering cancers based on their genomes and implemented it within the company stack. Our work has now been integrated into their software and presented at a conference.

IBM T.J. Watson Research Center - Yorktown Heights, NY*Jun 2016 - Sep 2016**Intern*

Worked with Dr. Victor Kravets (mentor) and Dr. Andrew Sullivan (manager).

Projects included non-greedy and map-reduce algorithms for factoring sum of products representations. The goal of this project was to find more efficient mappings of circuits onto 2-dimensional chips.

TEACHING EXPERIENCE

Markov Chain Monte Carlo*Spring 2022*

Head TA for Leonard Schulman's new class.

PUBLICATIONS

B. Mazaheri, A. Mastakouri, D. Janzing, M. Hardt. "*Causal Information Splitting: Engineering Proxy Features for Robustness to Distribution Shifts.*" UAI 2023 (to appear).

S. Gordon, ***B. Mazaheri**, Y. Rabani, L. Schulman. "*Identifying Discrete Mixtures of Bayesian Networks.*" CLeaR 2023.

S. Jain, **B. Mazaheri**, N. Raviv, J. Bruck. "*Glioblastoma signature in the DNA of blood-derived cells*" PLoS ONE 16(9): e0256831. 2021.

B. Mazaheri, S. Jain, J. Bruck. "*Expert Graphs: Synthesizing New Expertise via Collaboration.*" IEEE ISIT 2021.

S. Gordon, ***B. Mazaheri**, Y. Rabani, L. Schulman. "*Source Identification for Mixtures of Product Distributions.*" COLT 2021.

B. Mazaheri, S. Jain, J. Bruck. "*Robust Correction of Sampling Bias using Cumulative Distribution Functions.*" NeurIPS 2020.

* = Authorship order is alphabetical.

PREPRINTS

B. Mazaheri. "*Evaluation of Causal Structure Contamination due to Dataset Merging.*"

B. Mazaheri, S. Jain, M. Cook, J. Bruck. "*Combining Binary Classifiers Leads to Nontransitive Paradoxes.*"

Accepted IEEE Transactions on Information Theory 2022 but retracted due to inability to attend conference in person.

S. Gordon, ***B. Mazaheri**, Y. Rabani, L. Schulman. “*The Sparse Hausdorff Moment Problem, with Applications to Topic Models.*” arXiv 2020.

S. Jain, **B. Mazaheri**, N. Raviv, J. Bruck. “*Cancer Classification from Healthy DNA using Machine Learning.*” bioRxiv 2019.

S. Jain, **B. Mazaheri**, N. Raviv, J. Bruck. “*Short Tandem Repeats Information in TCGA is Statistically Biased by Amplification.*” bioRxiv 2019.

* = Authorship order in Theoretical CS is alphabetical. Co-authorship is implied.

PATENTS

S. Jain, **B. Mazaheri**, N. Raviv, J. Bruck. “*Mutation profile and related labeled genomic components, methods and systems.*” 2019.

PROJECTS

LACCTiC.com

Sep 2021 - present

I have developed a website for ranking collegiate cross country with 10,000 regular users. The website implements methods I have developed for adjusting performances in varying conditions. I’ve implemented the backend using Django, frontend using React, and host my database within an AWS framework.

AWARDS/GRANTS

National Science Foundation Graduate Research Fellowship

Awarded Spring 2019

Awarded in 2019 for a proposal to research confounding influence in causal networks.

Amazon AI4Science Research Fellowship

Awarded Spring 2022

Funding for research with the potential to aid scientific discovery.

WORKSHOPS

Simon’s Institute for Theory of Computing: Causality

Spring 2022

4 week workshop on Causal Inference methods.

TALKS

Simon’s Institute for Theory of Computing: Causality Reunion

May 2023

Title: “Causal Discovery under Limited Global Confounding”

MENTORSHIP

Caltech Cross Country Team

Sep 2018 - present

Assistant Coach

Mentoring and supporting undergraduate students at Caltech.