Matthew vonAllmen

Computer Science PhD Student

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Matthew vonAllmen | SilasLock

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Research Interests

Computer Science. Algorithmic mechanism design, machine learning, prophet inequalities.
Economics. Mechanism design, auction theory, budget pacing, econometrics.

Education

- **Northwestern University** *January 2021 - present*
  Computer Science PhD Degree expected May 2025
- **The Claremont Colleges** *September 2016 - May 2020*
  Double Major
  - Joint Math/CS Major through Harvey Mudd College
  - Mathematical Economics Major through Pitzer College

Publications

- **"Fundamental Limits of Throughput and Availability: Applications to prophet inequalities & transaction fee mechanism design." EC'24.** ***Proceedings of the 25th ACM Conference on Economics and Computation*****, July 2024. { arXiv link }**
  with Aadityan Ganesh, Jason Hartline, and Atanu Sinha
  - Applicable to allocation of compute resources for LLMs
  - Improves welfare guarantees for posted price mechanisms

Working Papers

- **Dashboards with quantal responding agents** *2024 - present*
  with Aadityan Ganesh, Jason Hartline, and Atanu Sinha
  - Comparative study of different dashboard mechanisms with quantal responding agents
  - Uses empirical simulations to test dashboards' welfare and allocation probabilities
- **Duopoly bundling with shared supply** *2024 - present*
  with Jason Hartline and Onno Zoeter
  - Finding conditions when hotel booking platforms can bundle access to customers
- **Calibration bounds and the sign preservation game** *2023 - present*
  with Sidhant Bansal, Meenal Gupta, and Greg Valiant
  - Using low level programming to search for optimal strategies in the sign preservation game
- **Surprisals, P-values, & posteriors: Testing the utility of summary statistics** *2023 - present*
  with Jessica Hullman and Sheng Long
  - Testing which of various summary statistics are most useful for decision problems
- **Mechanism Design and Inequality** *2021 - present*
  with Charlies Cui and Sam Taggart
  - Identifying revenue and welfare optimal mechanisms with two payment methods, time and money

Undergraduate Research

- **Untying Knots with Neural Networks** *2019*
  with David Bachman
  - Analyzed what kinds of knots can be reduced to the unknot via neural networks
  - Designed custom neural network layers intended to mimic ambient isotopies
- **Are Prediction Markets Bayesian?** *2019*
  Senior Seminar Project
  - Tested whether prediction markets engage in Bayesian updating
  - Used novel kernel methods on Intrade price data

Projects

- **N64 Trigonometry: The Folded Polynomial** *2023*
  - Invented superior polynomial approximations to sine, cosine, and arctangent
  - Achieved up to 90-fold improved accuracy compared to state of the art
  - Implemented polynomial approximations in MIPS assembly for the VR4300 microprocessor
  - Results currently used by the N64 modding community
- **Clinic Project** *2019*
  Harvey Mudd College, Ice911 Research and Climformatics
  - Predicted the effects of reflective microspheres when applied to young Arctic ice
- **Hilbert Compression** *Fall 2017*
  Pitzer College [ ]
  - Developed an original image compression algorithm
  - Outperforms standard JPEG compression for a wide class of images
  - Uses adaptive Hilbert curves to improve the locality of the discrete cosine transform

Skills

- **Programming Languages**
  - Strongly proficient in Julia, C#, and Python, proficient with Numba
  - Experienced in website development, proficient in CSS and JavaScript
  - Familiar with Rust, C++, Java, Zig
- **Statistical and Machine-learning Software**
  - Familiar with Keras, PyTorch, and Stata

Work Experience

- **Software Intern** *Summer 2019*
  Okta, NXT Team
  - Reworked the process of changing one's password in the company's web application, so that user inputs are immediately evaluated with each key press
  - Performed both front end and back end work

Teaching Experience

- **TA for COMP_SCI 336: Design & Analysis of Algorithms** *Fall 2024 - present*
  Northwestern Computer Science Department
- **TA for COMP_SCI 213: Intro to Computer Systems** *Fall 2022*
  Northwestern Computer Science Department
- **TA for COMP_SCI 496: AI and Experimental Narrative** *Spring 2022*
  Northwestern Computer Science Department
- **Tutor/grader for Neural Networks** *Fall 2018*
  Harvey Mudd Computer Science Department

Community Service

- **Computer Science PhD Advisory Council Member** *2023 - 2024*
  Northwestern Computer Science Department
  - Coordinated events and advocacy for CS PhD students
- **Environment Working Group Organizer** *2021 - 2022*
  EAAMO (formerly Mechanism Design for Social Good)
  - Coordinated activities, speakers, and events for a group of researchers and students
- **Website Developer** *2016 - 2018*
  Pitzer Outdoor Adventures
  - Developed a web service to help students coordinate hikes and long-distance trips
  - Used SQLAlchemy to protect users' data and to streamline the hiking gear check-out process
- **GM & Lore Writer** *2017 - 2020*
  5C RPG Association
  - Wrote over 200 pages of lore and game materials for an original setting, modelled after events in Islamic history
  - Ran biweekly sessions for other members of the association
- **Staff Reporter** *Fall 2016*
  Pitzer Peel
  - Wrote weekly articles for Pitzer College's campus newspaper
  - Focused on current events, global politics, and the history of mathematics

REFERENCES

1. **Jason Hartline**
   Professor of Computer Science
   Northwestern University
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   Phone: +1 (847) 467-0280
   Relationship: Academic advisor

2. **Atanu Sinha**
   Principal Scientist
   Adobe Research
   Email: atr@adobe.com
   Relationship: Research collaborator