

Matthew vonAllmen

Computer Science PhD Student

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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 2026
- **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 under 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** 2022 - 2023
 - 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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Relationship: Academic advisor

2. **Atanu Sinha**

Principal Scientist
Adobe Research
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Relationship: Research collaborator