Kevin Shu

kevinshu.me

Work

Postdoctoral Researcher, Computing and Mathematical Sciences California Institute of Technology, Pasadena, CA
August 2024-Present

Education

PhD, Algorithms Combinatorics and Optimization, Georgia Institute of Technology, Atlanta, GA
August 2019-2024

- Advised by Grigoriy Blekherman.
- 4.0 GPA

B.S. in Mathematics, Computer Science, California Institute of Technology, Pasadena, CA, June 2018
GPA 3.9

Publications

Accelerated Objective Gap and Gradient Norm Convergence for Gradient Descent via Long Steps with Ben Grimmer, and Alex Wang
2024

- Published in **Informs Journal on Optimization** in 2025

Symmetric Hyperbolic Polynomials with Greg Blekherman, and Julia Lindberg
2023

- Published in **Journal of Pure and Applied Algebra** in 2025.

Hidden convexity, optimization, and algorithms on rotation matrices with Akshay Ramachandran, and Alex L. Wang
2023

- Published in **Mathematics of Operations Research** in 2024.

Linear Principal Minor Polynomials: Hyperbolic Determinantal Inequalities and Spectral Containment
2022

- Published in **International Mathematics Research Notices** in 2022.

Hyperbolic Relaxation of k-Locally Positive Semidefinite Matrices, with Grigoriy Blekherman, Santanu Dey, Shengding Sun
2021

- Published in the **SIAM Journal on Optimization** in 2022.

Sums of Squares and Sparse Semidefinite Programming, with Grigoriy Blekherman
2021

- Published in **SIAM Journal for Applied Algebra and Geometry** in 2021.

Syntactic Structures and Code Parameters, with Matilde Marcolli
2017

- Published in **Mathematics in Computer Science**.
- Describes the connection between the syntactic parameters framework in linguistics with coding theory and theoretical physics.

Preprints

Beyond Minimax Optimality: A Subgame Perfect Gradient Method with Ben Grimmer, and Alex Wang
2025
- Hosted on the arxiv.

Accelerated Gradient Descent via Long Steps with Ben Grimmer, and Alex Wang
2023
- Hosted on the arxiv.

Quadratic Programming with Sparsity Constraints via Polynomial Roots
2022
- Hosted on the arxiv.

Talks and Presentations Given

Algebraic Methods in Convex Optimization, presented at the UCLA Math Colloquium
2025

Semialgebraic Methods in Convex Optimization, presented at the Joint Mathematics Meetings
2025

Hidden convexity, optimization, and algorithms on rotation matrices , presented at the Informs Optimization Society conference
2024

Symmetric Hyperbolic Polynomials, presented at the SIAM Conference on Applied Algebraic Geometry
2023

Sparse Regression and PCA via Polynomial Roots, presented at the SIAM Conference on Optimization
2023

Hyperbolicity Cones and Sparse Optimization, presented at the MIT LIDS seminar
2023

Symmetrically Hyperbolic Polynomials, presented at the Öberwolfach Meeting on New Directions in Algebraic Geometry
2023

Sparse Quadratic Programs via Polynomial Roots, presented at the Carnegie Mellon University ACO seminar
2023

Sparse Quadratic Programs via Polynomial Roots, presented at the Centrum Wiskunde and Informatica Networks and Optimization seminar
2022

Approximating Sparse Semidefinite Programs, presented at the INFORMS conference
2021

Poster on Sparse Semidefinite Programs, presented at the MIP and IPCO conferences
2021

Causal Inference and Optimization, presented at the ACO Student Seminar
2021

Lightning Talk on Hyperbolic Relaxations of Locally-PSD Matrices , presented at the ICERM - Symmetry, Randomness, and Computations in Real Algebraic Geometry.
2020

Academic Honors

2022 ACO-ARC Fellowship
2022 ARCS Foundation award
2021 Honorable Mention at the MIP Conference Poster Competition
2021 Honorable Mention at the IPCO Conference Poster Competition
2021 David L. Brown Fellowship from the Georgia Tech Math Department
2018 National Science Foundation Graduate Research Fellowship Recipient
2018 Georgia Institute of Technology President's Fellowship Recipient

Conference Organization

Coorganizer for the Georgia Tech Student Algebra Seminar, Georgia Tech, GA
August 2022-December 2023

Coorganizer for the Special Session on Convexity, SIAM Conference on Applied Algebraic Geometry, Georgia Tech, GA
July 2023

Organizer for the AMS Special Session on Algebraic Methods in Algorithms, Spring 2023 Southeastern Section Meeting of the AMS, Georgia Tech, GA
March 2023

Research Experience

Visiting Scholar, Max-Planck Institute for Mathematics in the Sciences, Leipzig, Germany
Summer 2022

- Working under the supervision of Rainer Sinn and Bernd Sturmfels.

Research Assistantship, Georgia Tech, Atlanta, GA
Summer 2020

- Funded in part by NSF grant DMS-1901950 and the ACO department.
- Advised by Grigoriy Blekherman.

Outreach and Community Service

Representative for the Diversity, Equity, and Inclusion committee, Georgia Tech, GA
2022-2023

First Year Mentor, Georgia Tech, Atlanta, Georgia
2020-2021

Directed Reading Program Mentor, Georgia Tech, Atlanta, Georgia
2020-2021

Senior Class President, Caltech, Pasadena, CA

2018-2019

Board of Control Secretary, Caltech
2017

Teaching Experience

Differential Equations Teaching Assistant, Georgia Tech, Atlanta, GA
Aug 2022-Dec 2022

Differential Equations Teaching Assistant, Georgia Tech, Atlanta, GA
Aug 2021-Dec 2021

Number Theory Lecture Assistant, Georgia Tech, Atlanta, GA
Jan 2021-May 2021

Differential Equations Teaching Assistant, Georgia Tech, Atlanta, GA
Jan 2020-May 2020

Linear Algebra Teaching Assistant, Georgia Tech, Atlanta, GA
Aug 2019-Dec 2019

Advanced Algorithms Teaching Assistant, Caltech, Pasadena, CA
Jan 2018-Mar 2018

Linear Algebra Teaching Assistant, Caltech, Pasadena, CA
Sep 2017-Dec 2017

Introduction to Algorithms Teaching Assistant, Caltech, Pasadena, CA
Jan 2017-Mar 2017

Work Experience

Full-time Software Engineer, Google, Mountain View, CA
August 2018-July 2019

- Full stack web development for a data labelling service (Crowd-Compute)
- Lead an initiative to update authentication/authorization to more modern technologies.
- Added a major feature for tracking work in the system.
- Managed production releases and infrastructure issues.
- Worked with C++, Java.

Software Engineering Intern, Google, Mountain View, CA
Aug 2018-Jul 2019

- Gathered data from online sources by parsing Reddit pages.
- Built a machine learning model to provide movie recommendations.
- Worked with C++, Python.