

Kevin Shu

kevinshu.me

Present Address

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Education

PhD Student, Georgia Institute of Technology, Atlanta, GA

August 2019-Present

- In the Algorithms, Combinatorics, and Optimization program, under the Mathematics department.
- Advised by Grigoriy Blekherman.
- Research interests mostly involve semidefinite programming and applications of sparse semidefinite programming to industrial applications.
- 4.0 GPA

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

Publications

Approximate PSD-Completion for Generalized Chordal Graphs

2021

- Follow up to previous paper.
- Gives quantitative bounds for a certain approximation of a sparse semidefinite program.
- Hosted on the arxiv.

Extreme Nonnegative Quadratics over Stanley Reisner Varieties

2021

- Uses powerful mathematical concepts from algebraic topology and algebraic geometry to study PSD matrix completion.
- Useful for detailed understanding of sparse semidefinite programming.
- Hosted on the arxiv.

Causal Channels

2021

- Describes a connection between causal theory, which is a topic in probability regarding the distinction between correlational and causal data.
- Gives quantitative methods for analysing possible discrepancies in data due to confounding variables.
- Hosted on the arxiv.

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

2021

- Describes a relaxation of a collection of matrices where certain block submatrices are PSD, giving exact bounds on their minimum eigenvalues.
- Hosted on the arxiv.

Sums of Squares and Sparse Semidefinite Programming, with Grigoriy Blekherman

	<p>2020</p> <ul style="list-style-type: none"> • Accepted for publication in SIAM Journal for Applied Algebra and Geometry. • Gives approximations of sparse semidefinite programs using ideas from algebraic geometry and graph theory. <p>Syntactic Structures and Code Parameters, with Matilde Marcolli</p> <p>2017</p> <ul style="list-style-type: none"> • Published in Mathematics in Computer Science. • Describes the connection between the syntactic parameters framework in linguistics with coding theory and theoretical physics.
Talks and Presentations Given	<p>Poster on Sparse Semidefinite Programs, presented at the MIP and IPCO conferences</p> <p>2021</p> <ul style="list-style-type: none"> • Describes work on approximating sparse semidefinite programs using a relaxation based on the relationship between nonnegative and sum-of-squares quadratics. • Won honorable mentions in both poster competitions. <p>Causal Inference and Optimization, presented at the ACO Student Seminar</p> <p>2021</p> <ul style="list-style-type: none"> • Describes work on connections between causality theory and polynomial optimization. <p>Lightning Talk on Hyperbolic Relaxations of Locally-PSD Matrices. , presented at the ICERM - Symmetry, Randomness, and Computations in Real Algebraic Geometry.</p> <p>2020</p> <ul style="list-style-type: none"> • Describes work on a relaxation of the positive semidefinite cone where only certain submatrices of a given matrix are required to be positive semidefinite.
Academic Honors	<p>2021 Honorable Mention at the MIP Conference Poster Competition</p> <p>2021 Honorable Mention at the IPCO Conference Poster Competition</p> <p>2021 David L. Brown Fellowship from the Georgia Tech Math Department</p> <p>2018 National Science Foundation Graduate Research Fellowship Recipient</p> <p>2018 Georgia Institute of Technology President's Fellowship Recipient</p>
Research Experience	<p>Research Assistantship, Georgia Tech, Atlanta, GA</p> <p>Summer 2020</p> <ul style="list-style-type: none"> • Funded in part by NSF grant DMS-1901950 and the ACO department. • Advised by Grigoriy Blekherman. <p>Research in Causality, Caltech, Pasadena, CA</p> <p>Aug 2018-Jul 2019</p> <ul style="list-style-type: none"> • Developed theory of causality and developed bounds on probability distributions. • Applied geometric and linear programming in search of bounds. • Advised by Leonard Schulman. <p>Research in Linguistics, Caltech, Pasadena, CA</p> <p>Aug 2017-Jul 2018</p> <ul style="list-style-type: none"> • Explored connections between linguistics and physical models. • Used algebraic geometry to compute phylogenetic trees. • Advised by Matilde Marcolli.

Teaching Experience

Number Theory Lecture Assistant, Georgia Tech, Atlanta, GA

Jan 2021-May 2021

- Graded homework and gave office hours for an undergraduate number theory course.

Differential Equations Teaching Assistant, Georgia Tech, Atlanta, GA

Jan 2020-May 2020

- Graded homework and gave recitations in second year differential equations course.

Linear Algebra Teaching Assistant, Georgia Tech, Atlanta, GA

Aug 2019-Dec 2019

- Graded homework and gave recitations in first year linear algebra course.
- Covered introductory linear algebra material.

Advanced Algorithms Teaching Assistant, Caltech, Pasadena, CA

Jan 2018-Mar 2018

- Graded homework and gave recitations in graduate level algorithms course.
- Covered multiplicative weights learning, streaming algorithms, spectral graph theory, semidefinite programming.

Linear Algebra Teaching Assistant, Caltech, Pasadena, CA

Sep 2017-Dec 2017

- Graded homework for the applied linear algebra course, including topics like linear algebra, including spectral graph theory, polynomial interpolation, and principal components analysis.
- Gave 1 hour of office hours per week.

Introduction to Algorithms Teaching Assistant, Caltech, Pasadena, CA

Jan 2017-Mar 2017

- Graded homework and gave recitations in undergraduate level algorithms course.
- Covered graph algorithms, greedy algorithms, dynamic programming, matroids.

Leadership Activities

Senior Class President, Caltech, Pasadena, CA

2018-2019

- Organized 200 seniors for events such as class trips and senior gifts.
- Implemented a new resource scheduling system based on algorithmic techniques that made a process that used to take several days take only a couple hours.
- Organized rooms, dining, and transportation for over a hundred students for the class trip, including finding funding from a variety of sources in order to ensure the trip was possible.
- Acted as a liason between faculty and students.

Board of Control Secretary, Caltech

2017

- Handled issues relating to academic dishonesty across the school.
- Investigated cases of academic dishonesty .
- Determined, in 20 cases of academic dishonesty, what response was required by the school, in some cases involving student suspensions.
- Organized meetings, gathered evidence, and acted as liason between the faculty and students.

Outreach Activities

First Year Mentor, Georgia Tech, Atlanta, Georgia

2020-2021

- Aided 2 first year graduate students in adjusting to graduate school during pandemic.
- Gave advice about course scheduling, time management, which helped students succeed in courses.

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

- Read through lecture notes on game theory with an undergraduate student
- Supervised project involving studying games of imperfect information with chance.

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.

Computer Skills

Languages: C++, Java, Python, HTML, Javascript
Software: Flask server development, L^AT_EX, vim