AARON POTECHIN

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POSITIONS

University of Chicago — 2018 - Present
Assistant Professor — Chicago, IL

Kungliga Tekniska Högskolan — 2017 - 2018
Postdoc — Stockholm, Sweden
Advised by Johan Håstad, Per Austrin, and Jakob Nordström

Cornell University and the Institute for Advanced Study — 2015 - 2017
Postdoc — Ithaca, NY and Princeton, NJ
Advised by David Steurer and Avi Wigderson

EDUCATION

Massachusetts Institute of Technology — 2015
Ph.D. in Mathematics
Dissertation: "Analyzing Monotone Space Complexity Via the Switching Network Model"
Advised by Jonathan Kelner

University of Cambridge (Part III of the Math Tripos) — 2010
Master of Advanced Study

Princeton — 2009
B.A. in Mathematics (summa cum laude with high honors)
Dissertation: "Bounds on Monotone Switching Networks for Directed Connectivity"
Advised by Boaz Barak and Edward Nelson

AWARDS AND HONORS

"Separating MAX 2-AND, MAX DI-CUT and MAX CUT" — To appear
invited to SICOMP FOCS 2023 special issue
NSF SMALL grant: Further Investigation of the Sum of Squares Hierarchy — 2020-2023
"A Nearly Tight Sum-of-Squares Lower Bound for the Planted Clique Problem" — Published 2019
invited to SICOMP FOCS 2016 special issue
"On the Integrality Gap of Degree-4 Sum of Squares for Planted Clique" — Published 2018
invited to TALG special issue for SODA 2016
"Bounds on Monotone Switching Networks for Directed Connectivity" — Published 2017
invited to JACM
"Bounds on Monotone Switching Networks for Directed Connectivity" — 2010
won the FOCS 2010 Machtey award for best student paper.
NSF Graduate Research Fellowship — 2010-2015
George B. Covington Prize (Outstanding Senior Research in Mathematics at Princeton) — 2009
Churchill Scholarship — 2009
Barry M. Goldwater Scholarship — 2008
Class of 1861 Prize (highest scoring sophomore at Princeton on the Putnam exam) — 2007

STUDENTS ADVISED

Jeremy Chizewer	1st year
Agastya Jha (co-advised by Haotian Jiang)	1st year
Zelin Lv	5th year
Hing Yin (Joseph) Tsang (advised by Andrew Drucker until January 2023)[1]	Graduating[2] Fall 2024
Neng Huang	Graduated 2024
Wenjun Cai (joint Math/CS program, co-advised by Sasha Razborov)[3]	Graduated 2023
Aaron Zhang (left with an MS degree)	
Chris Jones (advised by Andrew Drucker until 2020)[4]	Graduated 2022
Goutham Rajendran (co-advised by Madhur Tulsiani, advised by Janos Simon until July 2021)[5]	Graduated 2022

STUDENTS CO-ADVISED

Bohdan Kivva (joint Math/CS program, advised by Laci Babai)	Graduated 2022

EXTERNAL SERVICE

NSF Panels: 2024, 2024

Program Committee: SODA 2023

Guest editor for the TALG special issue for SODA 2023 papers

Conference reviews (past 5 years): SODA 2025, FOCS 2024, STOC 2024, ICALP 2024, FOCS 2023, CCC 2023, ISSAC 2023, APPROX 2022, FOCS 2022, CCC 2022, ITCS 2022, SODA 2022, FOCS 2021, CCC 2021, STOC 2021, ITCS 2021, FOCS 2020, MFCS 2020, STOC 2020, SODA 2020, CCC 2019, STOC 2019, ICALP 2019

Journal reviews (past 5 years): SICOMP, TOCT, Random Matrices: Theory and Applications, Theoretics, SIMODS, Discrete Mathematics, Journal of Combinatorial Theory Series B, Graphs and Combinatorics, Ars Mathematica Contemporanea

DEPARTMENTAL SERVICE

Co-organizer for UChicago's theory seminar (Invited and hosted 13 speakers)	2018-present
Other Academic Appointee (OAA) committee	2022-present
Graduate matters committee	2019-2022
Graduate admissions committee	2018-2019

INVITED TALKS (PAST 5 YEARS)

New Frontiers in Algorithmic Robust Statistics workshop at TTIC	June 2024
Proof Complexity and Beyond workshop at Oberwolfach	March 2024
Complexity of Statistical Inference workshop at Banff	February 2024
UMichigan theory seminar	December 2023
UT Austin theory seminar	October 2023
The Constraint Satisfaction Problem: Complexity and Approximability seminar at Dagstuhl	May 2022
CMU theory seminar	April 2022

[1] I started working with Joseph in 2019. Except for a nice observation he made as an undergraduate, Joseph's thesis is based on our work together.

[2] Joseph has already defended and submitted his thesis.

[3] Wenjun's thesis is based on our work together.

[4] I started working with Chris in 2019. Except for chapter 7, Chris's thesis is based on our work together.

[5] I started working with Goutham in 2019. Except for chapter 2, Goutham's thesis is based on our work together.

UIC theory seminar	April 2022
Rigorous Evidence for Information-Computation Trade-offs workshop at the Simons Institute	September 2021
Proof complexity workshop at Banff	January 2020
SIAM Conference on Applied Algebraic Geometry	July 2019
Association for Symbolic Logic North American Meeting	May 2019
Midwest Theory Day at Purdue	April 2019
IAS Computer Science/Discrete Math Seminar	March 2019

JOURNAL PAPERS

Note: For these papers as well as my conference papers and preprints, co-authors who **were students at the time of the research** are shown in bold. **Students who I mentored** (formally or informally) are marked with an asterisk.

J8. **Dominik Beck***, **Zelin Lv***, and Aaron Potechin. The Sixth Moment of Random Determinants. *Journal of Integer Sequences*, Vol. 26, Article 23.6.3. 2023

J7. Aaron Potechin and Jeffrey Shallit. Lengths of Words Accepted by Nondeterministic Finite Automata. *Information Processing Letters*. Volume 162. 2020

J6. Boaz Barak, **Samuel Hopkins**, Jonathan Kelner, **Pravesh Kothari**, Ankur Moitra, and Aaron Potechin. A Nearly Tight Sum-of-Squares Lower Bound for the Planted Clique Problem. *SIAM Journal on Computing* Special Section on the Fifty-Seventh Annual IEEE Symposium on Foundations of Computer Science (FOCS 2016)[6]. Volume 48 No. 2 p. 687-735. 2019

J5. **Samuel Hopkins**, **Pravesh Kothari**, Aaron Potechin, Prasad Raghavendra, and **Tselil Schramm**. On the Integrality Gap of Degree-4 Sum of Squares for Planted Clique. *ACM Transactions on Algorithms (TALG)* - Special Issue on SODA'16[7]. Volume 14 Issue 3, Article No. 28. p.1-31. 2018

J4. Aaron Potechin. Bounds on Monotone Switching Networks for Directed Connectivity. *Journal of the ACM (JACM)*[8]. Volume 64, Issue 4, Article No. 29. p. 1-48. 2017
Preliminary version in FOCS 2010, won the **Machtey award for best student paper**.

J3. **Siu Man Chan** and Aaron Potechin. Tight Bounds for Monotone Switching Networks Via Fourier Analysis. *Theory of Computing* Vol. 10 Article 15, p. 389-419. 2014
Preliminary version in STOC 2012.

J2. **Andrew Berget**, **Andrew Manion**, Molly Maxwell, Aaron Potechin, and Victor Reiner. The Critical Group of a Line Graph. *Annals of Combinatorics* Volume 16, Issue 3, p. 449-488. 2012

J1. Aaron Potechin. Maximal Caps in AG(6,3). *Designs, Codes, and Cryptography*, Volume 36, Issue 3, p. 243-259. 2008

CONFERENCE PAPERS SELECTED BY PROGRAM COMMITTEES

Totals (including the 4 journal papers listed above which had a preliminary conference version): 8 FOCS papers, 5 STOC papers, 4 ICALP papers, 2 SODA papers, 2 CCC papers, 2 ITCS papers, 2 COLT papers, 1 APPROX paper, 1 RANDOM paper, and 1 NeurIPS paper.

C24. Ilias Diakonikolas, Sushrut Karmalkar, Shuo Pang, and Aaron Potechin. Sum-of-Squares Lower Bounds for Non-Gaussian Component Analysis. FOCS 2024

C23. Aaron Potechin and **Aaron Zhang***. Bounds on the Total Coefficient Size of Nullstellensatz Proofs of the Pigeonhole Principle and the Ordering Principle. ICALP 2024

C22. Pravesh Kothari, Aaron Potechin, and **Jeff Xu***. Sum-of-Squares Lower Bounds for Independent Set on Ultra-Sparse Random Graphs. STOC 2024

[6]Invited to the special section dedicated to the top 6-10 papers of the conference.
[7]Invited to the special issue dedicated to the top 6-10 papers of the conference.
[8]Invited by JACM as one of the 2-3 best papers of the conference.

C21. Susanna F. de Rezende, Aaron Potechin, and Kilian Risse. Clique Is Hard on Average for Unary Sherali-Adams. FOCS 2023

C20. **Joshua Brakensiek***, **Neng Huang***, Aaron Potechin, and Uri Zwick. Separating MAX 2-AND, MAX DI-CUT, and MAX CUT. FOCS 2023[9]

C19. **Jun-Ting Hsieh**, Pravesh Kothari, Aaron Potechin, and **Jeff Xu***. Ellipsoid Fitting Up to a Constant. ICALP 2023

C18. Aaron Potechin, Paxton Turner, **Prayaag Venkat***, and Alex Wein. Near-optimal fitting of ellipsoids to random points. COLT 2023

C17. **Chris Jones***, Aaron Potechin, **Goutham Rajendran***, and **Jeff Xu***. Sum-of-Squares Lower Bounds for Densest k-Subgraph. STOC 2023

C16. Aaron Potechin and **Goutham Rajendran***. Sub-exponential time Sum-of-Squares lower bounds for Principal Components Analysis. NeurIPS 2022

C15. Gil Cohen, Dor Minzer, **Shir Peleg**, Aaron Potechin, and Amnon Ta-Shma. Expander Random Walks: The General Case and Limitations. ICALP 2022

C14. **Chris Jones*** and Aaron Potechin. Almost-Orthogonal Bases for Inner Product Polynomials. ITCS 2022

C13. **Chris Jones***, Aaron Potechin, **Goutham Rajendran***, Madhur Tulsiani, and **Jeff Xu***. Sum-of-Squares Lower Bounds for Sparse Independent Set. FOCS 2021

C12. Adam Kurpisz, Aaron Potechin, and **Elias Samuel Wirth**. SoS certification for symmetric quadratic functions and its connection to constrained Boolean hypercube optimization. ICALP 2021

C11. **Joshua Brakensiek***, **Neng Huang***, Aaron Potechin, and Uri Zwick. On the Mysteries of MAX NAE-SAT. SODA 2021

C10. **Mrinalkanti Ghosh***, **Fernando Granha Jeronimo***, **Chris Jones***, Aaron Potechin, and **Goutham Rajendran***. Sum-of-Squares Lower Bounds for Sherrington-Kirkpatrick via Planted Affine Planes. FOCS 2020

C9. **Neng Huang*** and Aaron Potechin. On the Approximability of Presidential Type Predicates. APPROX 2020

C8. Aaron Potechin. Sum of squares bounds for the total ordering principle. CCC 2020

C7. Aaron Potechin. On the Approximation Resistance of Balanced Linear Threshold Functions. STOC 2019

C6. Aaron Potechin. Sum of squares lower bounds from symmetry and a good story. ITCS 2019

C5. **Samuel Hopkins**, Pravesh Kothari, Aaron Potechin. Prasad Raghavendra, **Tselil Schramm**, and David Steurer. The Power of Sum-of-Squares for Detecting Hidden Structures. FOCS 2017

C4. Aaron Potechin and David Steurer. Exact Tensor Completion with Sum of Squares. COLT 2017

C3. Aaron Potechin. A Note on Amortized Branching Program Complexity. CCC 2017

C2. **Dhruv Medarametla*** and Aaron Potechin. Bounds on the Norms of Uniform Low Degree Graph Matrices. RANDOM 2016

C1. Raghu Meka, Aaron Potechin, and Avi Wigderson. Sum of Squares Lower Bounds for Planted Clique. STOC 2015

PREPRINTS

P14. **Dominik Beck***, **Zelin Lv***, and Aaron Potechin. On the second moment of the determinant of random symmetric, Wigner, and Hermitian matrices. arXiv 2409.14620. 2024

P13. **Neng Huang***, Will Perkins, and Aaron Potechin. Hardness of sampling for the anti-ferromagnetic Ising model on random graphs. arXiv 2409.03974. 2024

P12. Aaron Potechin and **Hing Yin (Joseph) Tsang***. On induced subgraphs of H(n,3) with maximum degree 1. arXiv 2405.15004. 2024

P11. **Wenjun Cai*** and Aaron Potechin. On Mixing Distributions Via Random Orthogonal Matrices and the Spectrum of the Singular Values of Multi-Z Shaped Graph Matrices. arXiv 2206.02224.

[9]Invited to the special issue dedicated to the top 6-10 papers of the conference.

2022

P10. **Bohdan Kivva*** and Aaron Potechin. Exact nuclear norm, completion, and decomposition for random overcomplete tensors via degree-4 SOS. arXiv 2011.09416. 2020

P9. Aaron Potechin and **Goutham Rajendran***. Machinery for Proving Sum-of-Squares Lower Bounds on Certification Problems. arXiv 2011.04253. 2020
A version of this paper, "Sub-exponential time Sum-of-Squares lower bounds for Principal Components Analysis", appeared in NeurIPS 2022

P8. **Wenjun Cai*** and Aaron Potechin. The Spectrum of the Singular Values of Z-Shaped Graph Matrices. arXiv 2006.14144. 2020

P7. Aaron Potechin and **Hing Yin Tsang***. A Conjecture on Induced Subgraphs of Cayley Graphs. arXiv 2003.13166. 2020

P6. **Kwangjun Ahn***, **Dhruv Medarametla***, and Aaron Potechin. Graph Matrices: Norm Bounds and Applications. arXiv 1604.03423. 2020
This is a major update of the paper "Bounds on the Norms of Uniform Low Degree Graph Matrices." which appeared in RANDOM 2016.

P5. Aaron Potechin and Liu Yang. A Note on Property Testing Sum of Squares and Multivariate Polynomial Interpolation. arXiv 1709.03198. 2017

P4. Aaron Potechin. A Note on a Problem of Erdős and Rothschild. arXiv 1412.1838. 2014

P3. Aaron Potechin. Improved Upper and Lower Bound Techniques for Monotone Switching Networks for Directed Connectivity. arXiv 1302.3726. 2013

P2. **Joshua Brakensiek*** and Aaron Potechin. Bounds on the Size of Sound Monotone Switching Networks Accepting Permutation Sets of Directed Trees. arXiv 1301.3780. 2013

P1. **Kevin Carde**, **Joe Loubert**, Aaron Potechin, and **Adrian Sanborn**. Proof of Han's Hook Expansion Conjecture. arXiv 0808.0928. 2008

VOLUNTEERING

Session leader for Math Circles of Chicago	2023-present
Volunteer tutor for the UChicago Office of Special Programs	2018-2019
Mentor for MITxplore	2012-2015

HIGH SCHOOL RESEARCH MENTORING

PRIMES student: Dhruv Medarametla (Intel semifinalist)	2014-2015
RSI students:	
Joshua Brakensiek (won a Davidson fellowship) and Gil Goldshlager (Intel semifinalist)	2013
Eric Mannes (Intel semifinalist) and Jessica Ohrlein	2012