

# Andrew Hardt

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(CV last updated September 2023)

## EDUCATION

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- **University of Minnesota** *September 2016 - August 2022*  
Ph. D. in Mathematics, 2022  
Thesis Advisor: Prof. Ben Brubaker  
Dissertation Title: Algebraic Operations via Solvable Lattice Models  
M. S. in Mathematics, 2019
- **Carleton College** *September 2009 - June 2013*  
B.A. in Mathematics, 2013  
Magna Cum Laude, GPA: 3.89

## EMPLOYMENT

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- **University of Illinois Urbana-Champaign** *August 2023 - present*  
RTG Postdoctoral Research Fellow (Mathematics, Combinatorics RTG grant)
- **Stanford University** *September 2022 - August 2023*  
Szégo Assistant Professor of Mathematics

## RESEARCH

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**Research Interests** (for more, see [personal homepage](#))

I am interested in algebraic structures in representation theory, and using integrable systems to learn about Schubert calculus, p-adic representation theory, (non)symmetric function theory, and representations of quantum groups. In particular, I have interests in the following areas:

- Solvable lattice models
- Fock spaces
- Alcove walks
- Crystals
- Representations of Hecke algebras
- Reductive groups and monoids

## Papers and Preprints

- *Lattice Models for Motivic Chern Classes of Schubert Cells* (with B. Brubaker, D. Bump, and H. Spink), *in preparation*.
- *Schur's P and Q-Functions via Exactly Solvable Lattice Models* (with B. Brubaker and C. Korff), *in preparation*.
- *A Factorial Analogue of the Boson-Fermion Correspondence* (with D. Bump, S. Naprienko, and T. Scrimshaw), *in preparation*.
- *Solving the n-Color Ice Model* (as mentor for 2022 Polymath Jr. program), [arXiv:2212.06404](https://arxiv.org/abs/2212.06404).
- *Lattice Models, Hamiltonian Operators, and Symmetric Functions*, submitted for publication, [arXiv:2109.14597](https://arxiv.org/abs/2109.14597).

- *Frozen Pipes: Lattice Models for Grothendieck Polynomials* (with B Brubaker, C. Frechette, E. Tibor, and K. Weber), *Algebr. Comb.* 6 (2023), no.3, 789833. [arXiv:2007.04310](#).
- *Arborescences of Covering Graphs* (with S. Chepuri, C.J. Dowd, G. Michel, S. Zhang, and V. Zhang), *Algebr. Comb.* 5 (2022), no. 2, 319-346.
- *Characters of Renner Monoids and Their Hecke Algebras* (with J. Marx-Kuo, V. McDonald, J. O'Brien, and A. Vetter), *Internat. J. Algebra Comput.* 30 (2020), no. 7, 1505-1535.
- *Restricted Symmetric Signed Permutations* (with J. Troyka), *Pure Math. Appl.*, 23 (2012) 179–217.

## Other Documents

- Algebraic Operations via Solvable Lattice Models, University of Minnesota Dissertation, 2022, [Proquest link](#). (119 pages)
- Finite Hecke Algebras and Their Characters, University of Minnesota Oral Exam Paper, 2019, [link](#). (44 pages)
- Combinatorial Species and Graph Enumeration (with P. McNeely, J. Troyka, and T. Phan), 2013, Carleton College Comprehensive Senior Project, [arXiv:1312.0542](#) (39 pages)

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## CONFERENCES AND SEMINARS ORGANIZED

- AMS-AWM Special Session on Solvable Lattice Models and their Applications Associated with the Noether Lecture, Joint Math Meetings (with A. Aggarwal, B. Brubaker, D. Bump, S. Naprienko, L. Petrov, and A. Schilling), San Francisco, *will be January 2024*
- Young Mathematicians' Conference in Combinatorics (with several co-organizers), UIUC, *will be Summer 2024*
- University of Illinois Algebra-Geometry-Combinatorics Seminar (with I. Cavey, S. Gao, E. Kelley, and A. Yong), UIUC, 2023-present
- Schubert Summer School, (with R. Hodges, E. Kelley, A. St. Dizier, and A. Yong), UIUC, June 2023
- University of Minnesota Student Number Theory Seminar (with J. Dickenson), 2019-20

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## INVITED TALKS

- Solvable Lattice Models, Number Theory and Combinatorics, Trinity College, Dublin (*will be June 2024*)
- Lattice models for motivic Chern classes of Schubert varieties, AMS-AWM Special Session on Solvable Lattice Models and their Applications Associated with the Noether Lecture, Joint Math Meetings (*will be January 2024*)
- Solvable lattice models and Grothendieck polynomials, The University of Illinois Algebra-Geometry-Combinatorics Seminar, UIUC (August 2023)
- Solvable lattice models and the boson-fermion correspondence, Integrable Systems & Symmetric Functions Workshop, University of Glasgow (March 2023)
- (Super)symmetric Functions from Solvable Lattice Models and Discrete-Time Hamiltonian Operators, University of Minnesota Combinatorics Seminar (February 2022)

- Solvable lattice models from representations of quantum groups, Academia Sinica, Taipei (virtual), December 2021
- Hamiltonian Operators and Free Fermionic Lattice Models, Solvable Lattice Models Seminar (June 2021)
- Solvable Lattice Models, Statistical Mechanics, and Symmetric Functions, Carleton College Colloquium (June 2021)

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### **SELECTED CONTRIBUTED TALKS**

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- Lattice Models, Hamiltonian Operators, and Symmetric Functions, Joint Mathematics Meetings (April 2022)
- Thesis Showcase, University of Minnesota (April 2022)
- Skating through Math: An Introduction to Ice Models, University of Minnesota Student Combinatorics Seminar (February 2022)
- Lattice Models and Hamiltonians Operators, Graduate Student Combinatorics Conference (April 2021)
- Solvable Lattice Models and Special Functions, New York State Regional Graduate Mathematics Conference (April 2021)
- From Automorphic Forms to Integrable Systems, UMN Student Number Theory Seminar (October 2020)
- Crystal Bases, UMN Student Representation Theory Seminar (August 2020)
- Iwahori Hecke Algebras in Multiple Contexts, UMN Student Number Theory Seminar (March 2020), UGA Graduate Student Seminar (July 2020)
- Alcove Walks (project introduction); UMN Algebra and Combinatorics REU (June 2020)
- Classification of Reductive Algebraic Monoids, UMN Student Combinatorics Seminar (October 2019)
- What is the Biggest (Finite) Number?, UMN Math Club (October 2019)
- What is Number Theory?, UMN Student Number Theory Seminar (September 2019)
- Finite Hecke Algebras and Their Characters, Oral Exam Talk (March 2019)

### **OTHER CONFERENCES ATTENDED**

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- New Connections in Integrable Systems, Remote (September-October 2020)
- Soergel Bimodules and Categorification of the Braid Group Workshop, ICERM, Brown University (February 2020)
- Abel Conference Honoring Robert Langlands, University of Minnesota (November 2018)
- Graduate Student Combinatorics Conference, University of Kansas (April 2017)
- Commutative Algebra Plus, University of Wisconsin-Madison (October 2016)

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### **AWARDS**

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- Joint Mathematics Meetings Travel Grant, 2022 (\$1,300; meetings went virtual)
- Doctoral Dissertation Fellowship, awarded to “the University’s most accomplished PhD candidates” to pursue an “outstanding research project”, University of Minnesota, 2021-22 (\$25,000 award)
- Nominated for Doctoral Dissertation Fellowship, University of Minnesota Mathematics Department, 2021
- Outstanding Teaching Assistant Award (\$500 award), University of Minnesota Mathematics Department, 2018-19
- First Year Summer Fellowship, University of Minnesota Mathematics Department, Summer 2017 (\$2,000)
- Phi Beta Kappa, Carleton College, 2013
- Distinction on Comprehensive Senior Project, Carleton College, 2013

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### UIUC TEACHING

- Fall 2023 – Math 412, Graph Theory

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### STANFORD TEACHING

- Spring 2023 – Math 21, Calculus
- Winter 2023 – Math 121, Galois Theory
- Fall 2022 – Math 51, Linear Algebra, Multivariable Calculus, and Modern Applications

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### MINNESOTA TEACHING

- Spring 2021 – Math 1001, Excursions in Mathematics (*sole lecturer*)  
*Controlled course structure, topics covered, lectures, and assessments; managed 1 TA*  
*Lecture videos posted [here](#).*
- Fall 2020 – Math 3283W, Sequences, Series, and Foundations (*TA*)
- Spring 2020 – Math 3283W, Sequences, Series, and Foundations (*TA*)
- Fall 2019 – Math 1031, College Algebra (*lecturer and course coordinator*)  
*Controlled course structure, topics covered, lectures, and assessments*  
*Coordinated 3 total lecturers and 7 total TAs; directly managed 2 TAs*
- Spring 2019 – Math 1031, College Algebra (*lecturer and course coordinator*)  
*Controlled course structure, topics covered, lectures, and assessments*  
*Coordinated 2 total lecturers and 3 total TAs; directly managed 2 TAs*
- Fall 2018 – Math 1031, College Algebra (*lecturer*)  
*Managed 1 TA*
- Spring 2018 – Math 2574H, Honors Calculus IV (*TA*)
- Fall 2017 – Math 2573H, Honors Calculus III (*TA*)
- Fall 2017 – Designed and taught course at Osher Lifetime Learning Institute (OLLI) for older adults entitled *Math and Proofs*

- Spring 2017 – Math 1272, Calculus II (*TA*)
- Fall 2016 – Math 1271, Calculus I (*TA*)
- Spring 2013 – Carleton College Math 352, Abstract Algebra II (*grader*)

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### REU MENTORING

I was the assistant mentor for the following projects in the Polymath Jr. program (2021-22):

- Solvable lattice models (2022)
- Gelfand-Tsetlin Polytopes (2021)

I was the mentor (project leader) for the following project in the University of Minnesota Combinatorics and Algebra REU in 2020:

- Alcove Walks and Whittaker Functions (N. Borade, M. Huynh, H. Twiss)

I was a TA (assistant mentor) for the following projects in the University of Minnesota Combinatorics and Algebra REU (2018-19):

- Arborescences of Covering Graphs (2019; C.J Dowd, V. Zhang, S. Zhang)
- Dihedral Sieving on Cluster Complexes (2019; Z. Stier, J. Wellman, Z. Xu)
- Homomesy and Rowmotion on the Trapezoid Poset (2019; Q. Dao, J. Wellman, C. Yost-Wolff, S. Zhang)
- Metaplectic Analogues of Gelfand-Graev Models (2019; Q. Dao, N. Kenshure, F. Lin, C. Meng, Z. Stier, C. Yost-Wolff)
- Characters of Renner Monoids and Their Hecke Algebras (2018; J. Marx-Kuo, V. McDonald, J. O'Brien, A. Vetter)
- Generating Functions for f-Vectors and the cd-Index of Weight Polytopes (2018; J. Gao, V. McDonald)

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### OUTREACH

- Gave a talk on lattice models at Palo Alto High School math club, November 2022
- Instructor at MathCEP Saturday Morning Math, fun math sessions for 6th-8th graders, Spring 2022
- Panelist for session on Advocacy for Mathematics and Science Policy, Joint Mathematics Meetings, April 2022
- Met with staffers for Sen. Smith (MN) and Rep. Omar,
- Counsellor for the Minnesota Program in Mathematics (MPM), a program for underrepresented undergraduates in mathematics, Winter 2021

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### PROFESSIONAL SERVICE

- Have been a referee for:
  - Communications of the AMS, Spring 2022
  - Minnesota Journal of Undergraduate Mathematics, Spring 2021

- Paper reviewer, zbMATH, 2020-22
- Session chair at
  - Joint Math Meetings, Contributed Paper Session on Lattices and Geometries II, Spring 2022
  - Graduate Student Combinatorics Conference, Spring 2021

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### UNIVERSITY SERVICE

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- Committe Member for Slava Naprienko's Ph.D. Dissertation Defense (Stanford), Spring 2023
- Paper reader for Jackson Hampton's Senior Honor's Thesis (Minnesota), Spring 2021
- Co-organizer for a series of department Town Halls where graduate students had a chance to meet candidates for Department Head (Minnesota), Fall 2020
- Facilitator for the teacher training portion of the new graduate student orientation (Minnesota), Fall 2020
- Mentor, Directed Reading Program, 2017-21
- Peer Mentor (Minnesota), 2017-18
- I have written recommendation letters for over a dozen students I have taught or mentored, ranging from summer internships to fellowships to undergraduate and graduate programs, including Ph. D. programs in mathematics.

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### PROFESSIONAL DEVELOPMENT

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- Teaching Assistant and Postdoc Professional Development Program Certificate; attended a series of 6 lectures, and wrote a capstone 3 page teaching reflection paper.
- Attendee at *Speaking Sciences* Conference, University of Minnesota (January 2019)

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### OTHER EXPERIENCE

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- Swimming Commentator, 2018-present
- Contributing Writer, SwimSwam.com, 2018-19
- Interim Co-President, UMN Triathlon Team, 2017
- ACT/SAT Tutor, 2015-18
- Assistant Swim Coach, University of St. Thomas, 2013-16