

# SEAN GRATE

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## EDUCATION

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**Auburn University, Auburn** August 2020 –August 2025  
Ph.D., Mathematics  
Advisor: Hal Schenck  
Dissertation Title: *Problems in Computational Algebraic Geometry: Lefschetz Properties and Toric Varieties*

**University of Kentucky, Lexington** August 2016 –May 2020  
B.S. in Mathematics with minors in History and Classics, *cum laude*

## PROFESSIONAL EXPERIENCE

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**Iowa State University Department of Mathematics** August 2025–Present  
*Postdoctoral Research Associate*

**Auburn University Department of Mathematics and Statistics** August 2020–August 2025  
*Graduate Teaching Assistant*

**University of Kentucky Department of Computer Science** May 2019–August 2020  
*Undergraduate Research Assistant*

## PUBLICATIONS

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- [4] Ayah Almousa, Shiliang Gao, Sean Grate, Daoji Huang, Patricia Klein, Adam LaClair, Yuyuan Luo, and Joseph McDonough. “The MatrixSchubert package for Macaulay2”. *Journal of Software for Algebra and Geometry* (2025), to appear. arXiv: 2312.07393 [math.AG].
- [3] Nasrin Altafi, Roberta Di Gennaro, Federico Galetto, Sean Grate, Rosa M. Miró-Roig, Uwe Nagel, Alexandra Seceleanu, and Junzo Watanabe. “Betti numbers for connected sums of graded Gorenstein Artinian algebras”. *Trans. Amer. Math. Soc.* 378.2 (2025), pp. 1055–1080. ISSN: 0002-9947,1088-6850. DOI: 10.1090/tran/9286. URL: <https://doi.org/10.1090/tran/9286>.
- [2] Sean Grate and Hal Schenck. “Betti tables forcing failure of the weak Lefschetz property”. *Lefschetz properties—current and new directions*. Vol. 59. Springer INdAM Ser. Springer, Singapore, [2024] ©2024, pp. 155–164. ISBN: 978-981-97-3885-4; 978-981-97-3886-1. DOI: 10.1007/978-981-97-3886-1\_8. URL: [https://doi.org/10.1007/978-981-97-3886-1\\_8](https://doi.org/10.1007/978-981-97-3886-1_8).
- [1] Hunter Blanton, Sean Grate, and Nathan Jacobs. “Surface Modeling for Airborne Lidar”. *IGARSS 2020 - 2020 IEEE International Geoscience and Remote Sensing Symposium*. 2020, pp. 1110–1113. DOI: 10.1109/IGARSS39084.2020.9323522.

## PREPRINTS

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- [4] Haile Gilroy, Sean Grate, and Melinda Lanius. “Graph theoretic reflection to foster alignment in coordinated courses”. *International Journal of Mathematical Education in Science and Technology* (2024). Positive referee reports, now in revision.
- [3] Nicholas Gaubatz, Sean Grate, and Haile Gilroy. “Minimal out-neighborhoods in the  $F$ -Lattice”. In preparation.
- [2] Sean Grate. “Combinatorial bounds on the Castelnuovo-Mumford regularity of toric surfaces”. In preparation.
- [1] Herman Chau, Spencer Daugherty, Sean Grate, J. Carlos Martínez Mori, and Anna Pun. “The combinatorics of stable Tamari posets”. In preparation.

## AWARDS AND HONORS

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- Auburn University DMS Baskervill Endowed Mathematics Fellowship 2024
- Auburn University DMS Teaching Citation Award 2022, 2024
- Auburn University DMS Bennett Fellowship 2023
- Auburn University DMS Research Citation Award 2021, 2022
- Auburn University COSAM Outstanding GTA Award 2022
- Best Presentation at UK Computer Science Summer Research Program August 9th, 2019
- University of Kentucky Dean’s List Multiple semesters 2016-2020
- Kentucky Educational Excellence Scholarship (KEES) (\$2,225 per year) 2016-2020
- University of Kentucky Provost Scholarship (\$1,500 per year) 2016-2020

## CONFERENCE TALKS

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- “Combinatorial bounds on the Castelnuovo-Mumford regularity of toric surfaces”, Mathematical Conference of the Americas, July 2025
- “Castelnuovo-Mumford regularity of toric surfaces”, SIAM Conference on Applied Algebraic Geometry, July 2025
- “Combinatorial bounds on the Castelnuovo-Mumford regularity of toric surfaces”, AWM Research Symposium, May 2025
- “Castelnuovo-Mumford regularity of toric surfaces”, Joint Mathematics Meeting, January 2025
- “Castelnuovo-Mumford regularity of toric surfaces”, AMS Fall Central Sectional, September 2024
- “Betti tables forcing failure of the Weak Lefschetz Property”, Combinatorial Algebra meets Algebraic Combinatorics (CAAC), January 2024
- “Betti tables forcing failure of the Weak Lefschetz Property”, Workshop on Lefschetz Properties in Algebra, Geometry, Topology and Combinatorics, May 2023

## SEMINAR TALKS

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- “Combinatorial bounds on the Castelnuovo-Mumford regularity of toric surfaces”, Virtual, Syzygies and Mirror Symmetry Seminar, February 2025
- “Betti tables forcing failure of the weak Lefschetz property”, University of Nebraska-Lincoln, Commutative Algebra Seminar, October 2024

- “Betti tables and Lefschetz properties”, University of Nebraska-Lincoln, Commutative Algebra Reading Seminar, October 2024
- “Betti numbers of connected sums of graded Artinian Gorenstein algebras”, Purdue University, Commutative Algebra Seminar, October 2024
- “Betti tables forcing failure of the weak Lefschetz property”, Purdue University, Student Commutative Algebra Seminar, October 2024
- “Betti tables and Lefschetz properties”, University of Kentucky Algebra Seminar, November 2023
- “Lefschetz properties and Artinian rings”, McNeese State University Math Seminar, November 2023
- Auburn University
  - “The stable Tamari lattice”, Discrete Math Seminar, November 2024
  - “Betti numbers of connected sums of graded Artinian Gorenstein algebras”, Algebra Seminar, September 2024
  - “How-To: Making a website”, Graduate Student Seminar, August 2024
  - “Betti tables and Lefschetz properties”, Algebra Seminar, February 2024
  - “Suturing the severed didactic tetrahedron: Graph-Theoretic reflection to foster alignment in coordinated courses”, Auburn University DBER Seminar, February 2024
  - “Leveraging software for mathematics and graduate school”, Graduate Student Seminar, September 2023
  - “A brief introduction to tropical geometry”, Graduate Student Seminar, August 2022
  - “An overview of topological data analysis”, Math Club, February 2022
  - “A brief introduction to tropical geometry”, Algebra Seminar, November 2021
  - “Computations in topological data analysis”, Graduate Algebra Seminar, August 2021
  - “Tropical algebra”, Graduate Algebra Seminar, July 2021
  - “Geometry in noncommutative algebra”, First Year Graduate Student Seminar, January 2021
  - “What/Why/How of neural networks”, First Year Graduate Student Seminar, November 2020

## POSTER PRESENTATIONS

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- “Castelnuovo-Mumford regularity of toric surfaces”, Commutative Algebra in the South (CATS), April 2025
- “Castelnuovo-Mumford regularity of toric surfaces”, Mid-Atlantic Algebra, Geometry, and Combinatorics (MAAGC) Workshop, March 2025
- “Castelnuovo-Mumford regularity of toric surfaces”, Combinatorial Algebra meets Algebraic Combinatorics (CAAC), January 2025
- “Betti numbers of connected sums of graded Artinian Gorenstein algebras”, UweFest, August 2024
- “Betti tables forcing failure of the weak Lefschetz property”, BrianFest, August 2023

## CONFERENCE AND WORKSHOP ORGANIZATION

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- Co-organizer (with Thiago Holleben and Anton Dochtermann)  
AMS Special Session on algebraic combinatorics and combinatorial commutative algebra  
New Orleans, LA October 2025

## CONFERENCES AND WORKSHOPS ATTENDED

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- Mathematical Congress of the Americas July 2025
- SIAM Conference on Applied Algebraic Geometry July 2025
- Collaborate@ICERM June 2025
- Workshop on Weak and Strong Lefschetz Properties Across Mathematics June 2025
- Workshop on the Applications of Commutative Algebra May 2025
- AWM Research Symposium May 2025
- Meetings in Applied Algebraic Geometry (MAAG) April 2025
- Macaulay2 Workshop April 2025
- Commutative Algebra in the South (CATS) April 2025
- Mid-Atlantic Algebra, Geometry, Combinatorics (MAAGC) March 2025
- CA+ March 2025
- Combinatorial Algebra meets Algebraic Combinatorics (CAAC) January 2025
- Apprenticeship Program in Commutative Algebra January 2025
- Joint Mathematics Meetings January 2025
- AMS Fall Central Sectional Meeting September 2024
- UweFest August 2024
- AMS MRC on Algebraic Combinatorics June 2024
- Computational Algebraic Geometry and String Theory June 2024
- JM Invariant at 60 May 2024
- Combinatorial Algebra meets Algebraic Combinatorics (CAAC) January 2024
- SIAM Texas-Lousiana Sectional Meeting November 2023
- BrianFest August 2023
- Macaulay2 Week June 2023
- SLMath Commutative Algebra Summer School May 2023
- Workshop on Lefschetz Properties in Algebra, Geometry, Topology and Combinatorics May 2023
- Commutative Algebra in the South (CATS) April 2023
- SLMath Tropical Geometry Summer School August 2022

# TEACHING EXPERIENCE

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- Iowa State University
  - Recitation
    - \* MATH 1660 Calculus II Fall 2025
  - Instructor of Record
    - \* MATH 2070 Matrices and Linear Algebra Spring 2026
- Auburn University
  - Instructor of Record
    - \* MATH 1610 Calculus I Spring 2022
    - \* MATH 1120 Precalculus Algebra Fall 2021
  - Recitation Leader
    - \* MATH 1610 Calculus I Fall 2022, Spring 2023, Fall 2023
    - \* MATH 1620 Calculus II Spring 2024, Fall 2024
  - Tutor
    - \* MATH 1120 Precalculus Algebra
    - \* MATH 1610 Calculus I
    - \* MATH 1620 Calculus II
    - \* MATH 1680 Business Calculus I

# SERVICE

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- President of the Mathematics Club at Auburn University 2021-2024
- Secretary for the Auburn University DMS Graduate Student Council August 2022-August 2023
- Graduate Student Representative on the Auburn University DMS Graduate Student Council August 2021-August 2023

# OUTREACH

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- Destination STEM October 2022, October 2023
- Auburn Mathematical Puzzle Challenge (AMP'd) November 2022
- University of Kentucky Math Club 2016-2020
- Expanding Your Horizons workshop mentor 2019
- Julia Robinson Math Festival volunteer 2019

# TECHNICAL STRENGTHS

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Software & Tools	Python, Macaulay2, PyTorch, SageMath
Macaulay2 Packages	MatrixSchubert, Permutations