

# Mike Cummings

Mathematics and Computer 6311  
Department of Combinatorics and Optimization  
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## Education

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**University of Waterloo**  
PhD Combinatorics and Optimization  
• Supervisor: Oliver Pechenik

Waterloo, ON  
2024–2028 (expected)

**McMaster University**  
MSc Mathematics  
• Supervisor: Jenna Rajchgot  
• Thesis: Gröbner Geometry for Hessenberg Varieties

Hamilton, ON  
2022–2024

**McMaster University**  
BSc Honours Mathematics and Statistics, *summa cum laude*

Hamilton, ON  
2018–2022

## Papers

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### Published

5. Gröbner geometry for regular nilpotent Hessenberg Schubert cells  
with Sergio Da Silva, Megumi Harada, and Jenna Rajchgot  
*Journal of Pure and Applied Algebra* **228** (2024), no. 7, 107648
4. Geometric vertex decomposition and liaison for toric ideals of graphs  
with Sergio Da Silva, Jenna Rajchgot, and Adam Van Tuyl  
*Algebraic Combinatorics* **6** (2023), no. 4, 695–997

## Software

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3. The GeometricDecomposability package for Macaulay2  
with Adam Van Tuyl  
*Journal of Software for Algebra and Geometry* **14** (2024), no. 1, 41–50  
Software included with versions 1.21 and higher of *Macaulay2*

## Theses

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2. Gröbner Geometry for Hessenberg Varieties  
Master's thesis, McMaster University, 2024  
Supervisor: Jenna Rajchgot

1. Geometric Vertex Decomposition and Hessenberg Patch Ideals  
Undergraduate thesis, McMaster University, 2022  
Supervisors: Sergio Da Silva, Megumi Harada, and Jenna Rajchgot

## Teaching

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### Instructor of Record

McMaster University

2023-24 Applications of Linear Algebra, Math 2LA3

### Teaching Assistant

University of Waterloo

2024-25 Geometry, Math 661 (Masters of Mathematics for Teachers program, CEMC)  
Introduction to Optimization, CO 250  
Introduction to Combinatorics (Non-Specialist Level), Math 229

McMaster University

2023-24 Theory of Linear Algebra, Math 2R03  
Abstract Algebra, Math 3GR3

2022-23 Theory of Linear Algebra, Math 2R03  
Calculus for Math and Stats I, Math 1X03

2021-22 Calculus for Math and Stats II, Math 1XX3

2020-21 Introduction to Mathematical Scientific Computation, Math 1MP3

2019-20 Introduction to Mathematical Scientific Computation, Math 1MP3

## Talks

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The <sup>∨</sup> denotes a virtual talk.

### Research

Gröbner geometry and multidegrees for classes of semisimple Hessenberg varieties

2025 May CanaDAM 2025, University of Ottawa

Geometric vertex decomposition: a computational technique for liaison theory

2025 Mar. Graduate Skills Seminar for the Department of Combinatorics and Optimization,  
University of Waterloo

Graduate Student Combinatorics Conference, University of Southern California<sup>∨</sup>

Combinatorial rules for the geometry of Hessenberg varieties

2024 Nov. Algebraic and Enumerative Combinatorics Seminar, University of Waterloo

### Geometric vertex decomposition: introduction and connections

2024 Feb. Graduate Student Seminar in Number Theory and Algebraic Geometry at Simon Fraser University<sup>v</sup>

### Gröbner geometry for regular nilpotent Hessenberg Schubert cells

2024 Jan. Combinatorial Algebra meets Algebraic Combinatorics at LaCIM à l'Université du Québec à Montréal

2023 Dec. Commutative Algebra session at the CMS 2023 Winter Meeting in Montréal

Mar. Algebra & Algebraic Geometry Seminar at McMaster University

### Degenerations of toric ideals of graphs

2023 May Open problem session, Commutative Algebra and its Interactions with Algebraic Geometry, SLMath/CMND Summer School at the University of Notre Dame

### An introduction to Hessenberg varieties

2022 Aug. Mathematics & Statistics Undergraduate Summer Research Seminar, McMaster University

### Geometric vertex decomposition

2022 May Mathematics & Statistics Undergraduate Summer Research Seminar, McMaster University

## Poster

### Geometric vertex decomposition, substitution, and toric ideals of graphs

2025 Feb. Computational Interactions between Algebra, Combinatorics, and Discrete Geometry, IPAM

Jan. CAAC 2025 at the Fields Institute and University of Toronto

### Gröbner geometry for regular nilpotent Hessenberg Schubert cells

2023 Jun. CMS 2023 Summer Meeting in Ottawa

May SLMath/CMND Summer School on Commutative Algebra and its Interactions with Algebraic Geometry at the University of Notre Dame

## Expository

### An introduction to algebraic geometry

2024 Apr. Student Math Colloquium at Niagara University

### Graph colouring, symmetric functions, and open problems

2023 Nov. Casual Math Seminar at McMaster University

### Play with your food: Brussel sprouts and other games on graphs

2023 Apr. Casual Math Seminar at McMaster University

## Conferences Attended

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Conferences with future dates are tentative. The <sup>∨</sup> denotes a virtual conference.

2025 Jun. Séminaire de Mathématiques Supérieures 2025: An Introduction to Recent Trends in Commutative Algebra, Fields Institute

May AlCoVE: an Algebraic Combinatorics Virtual Expedition, University of Waterloo<sup>∨</sup>  
CanADAM (Canadian Discrete and Algorithmic Math Conference) 2025, University of Ottawa

Mar. Graduate Student Combinatorics Conference, University of Southern California<sup>∨</sup>

Feb. Computational Interactions between Algebra, Combinatorics, and Discrete Geometry, IPAM

Jan. Combinatorial Algebra meets Algebraic Geometry, Fields Institute and University of Toronto

2024 Jun. AlCoVE: an Algebraic Combinatorics Virtual Expedition, University of Waterloo<sup>∨</sup>

May Macaulay2, Computational Algebraic Geometry, and String Theory, University of Utah

Why are we teaching mathematics today? FYMSiC<sup>∨</sup>

Jan. Combinatorial Algebra meets Algebraic Combinatorics, LaCIM à l'Université du Montréal à Québec

2023 Dec. 2023 CMS Winter Meeting, Montréal

Nov. Route 81 Conference on Commutative Algebra and Algebraic Geometry, Syracuse University

Jun. AlCoVE: an Algebraic Combinatorics Virtual Expedition, University of Waterloo<sup>∨</sup>  
2023 CMS Summer Meeting, University of Ottawa

May MSRI/SLMath CMND Summer School: Commutative Algebra and its Interactions with Algebraic Geometry, University of Notre Dame

8<sup>th</sup> Lake Michigan Workshop on Combinatorics and Graph Theory, University of Notre Dame

Teaching: The Backstage of Our Courses, FYMSiC<sup>∨</sup>

Jan. Combinatorial Algebra meets Algebraic Combinatorics, University of Waterloo

2022 Dec. 2022 CMS Winter Meeting, Toronto, ON

Jun. ISM Discovery School: Geometry and Combinatorics of Hessenberg Varieties, Université du Québec à Montréal

## Scholarships and Awards

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All values Canadian dollars.

- 2024–27 NSERC Canada Graduate Scholarship–Doctoral, \$40,000 per year
- 2024–25 University of Waterloo President’s Graduate Scholarship, \$10,000
- 2024 McMaster Graduate Student Association Travel Assistance Grant, \$500
- 2023–24 Ontario Graduate Scholarship, \$10,000
- Bernhard Banaschewski Ontario Graduate Scholarship, \$5,000
- Milos Novotny Fellowship, \$4,000
- 2022–23 NSERC Canada Graduate Scholarship–Masters, \$17,500
- Milos Novotny Fellowship, \$2,500
- 2022 NSERC USRA, supervisor: Adam Van Tuyl, \$8,400
- 2021 NSERC USRA, supervisors: Sergio Da Silva, Jenna Rajchgot, Adam Van Tuyl, \$8,120

## Service

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### Organization

- 2023–24 McMaster Casual Math Seminar  
co-organizer with Alexi Block Gorman (Winter 2023), Justin Gebel (Fall 2023–Winter 2024), Dicle Mutlu, and Adele Padgett
- 2022 McMaster Math & Stats Undergraduate Summer Research Seminar  
co-organizer with Hainan Xu

## Professional Membership

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- 2022– Canadian Mathematical Society
- American Mathematical Society