

# Mike Cummings

Mathematics and Computer 6311  
Department of Combinatorics and Optimization  
University of Waterloo  
Waterloo ON N2L 3G1

mikecummings.ca  
mike.cummings@uwaterloo.ca

## Education

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**University of Waterloo**  
PhD Combinatorics and Optimization

Waterloo, ON  
2024–

- Supervisor: Oliver Pechenik

**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

3. The GeometricDecomposability package for Macaulay2  
with Adam Van Tuyl  
*Journal of Software for Algebra and Geometry* **14** (2024), no. 1, 41–50
2. 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
1. 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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1. GeometricDecomposability, a *Macaulay2* package to check whether ideals are geometrically vertex decomposable, and related methods  
with Adam Van Tuyl

## 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

## Talks

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The  $\vee$  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 $\vee$

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 $\vee$

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  $\vee$  denotes a virtual conference.

2026 Mar. Cluster Algebras, Webs, and Canonical Bases, BIRS

Jan. Combinatorial Algebra meets Algebraic Combinatorics, Dalhousie University

2025 Dec. 2025 CMS Winter Meeting, Toronto

Nov. Computation in Representation Theory, ICERM

Jun. *Macaulay2* Workshop: Madison 2025, University of Wisconsin–Madison

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

- May AlCoVE: an Algebraic Combinatorics Virtual Expedition 2025<sup>∨</sup>  
CanaDAM 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 2024<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 2023<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
- 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  
University of Waterloo President's Graduate Scholarship, \$10,000 per year
- 2024 McMaster Graduate Student Association Travel Assistance Grant, \$500
- 2023–24 Ontario Graduate Scholarship, \$10,000  
Bernhard Banaszewski 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

## Teaching

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### Instructor of Record

McMaster University

- 2023-24 Applications of Linear Algebra, Math 2LA3

### Teaching Assistant

University of Waterloo

- 2025-26 Introduction to Combinatorics (Advanced Level), Math 249
- Combinatorial Algebraic Geometry, Math 439/739
- 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
- Calculus for Math and Stats I, Math 1X03
- 2020-21 Introduction to Mathematical Scientific Computation, Math 1MP3
- Matlab for Linear Algebra I, Math 1B03/1ZC3
- Linear Algebra I (Engineering Math II-B), Math 1ZC3
- Calculus for Math and Stats I, Math 1X03
- 2019-20 Introduction to Mathematical Scientific Computation, Math 1MP3

## Professional Activities

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### Service

- 2025– Graduate Student Representative for the Department of Combinatorics and Optimization, University of Waterloo

## Organization

2023–24 McMaster Casual Math Seminar

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

with Hainan Xu

## Referee

(1) Electronic Journal of Combinatorics

## Professional Membership

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2022– Canadian Mathematical Society

American Mathematical Society