

# Mike Cummings

Mathematics and Computer 6311  
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## Education

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<b>University of Waterloo</b> PhD Combinatorics and Optimization	Waterloo, ON 2024–2028 (expected)
• Supervisor: Oliver Pechenik	
<b>McMaster University</b> MSc Mathematics	Hamilton, ON 2022–2024
• Supervisor: Jenna Rajchgot	
• Thesis: Gröbner Geometry for Hessenberg Varieties	
<b>McMaster University</b> BSc Honours Mathematics and Statistics, <i>summa cum laude</i>	Hamilton, ON 2018–2022

## Papers

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### Preprints

2. Webs and smooth components of two column Springer fibers
1. Corrigendum to “Counting two-column Young tableaux corresponding to smooth components of Springer fibers” [J. Algebraic Comb. 61:18 (2025)] (by R. Mansour)  
with Ronit Mansour  
Submitted

### 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

Webs and smooth components of two column Springer fibers

2026 Jan. CAAC 2026, Dalhousie University

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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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 Banashewski 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