Mike Cummings

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Education

University of Waterloo — Waterloo, ON
PhD Combinatorics and Optimization — 2024–
- Supervisor: Oliver Pechenik

McMaster University — Hamilton, ON
MSc Mathematics — 2022–2024
- Supervisor: Jenna Rajchgot
- Thesis: Gröbner Geometry for Hessenberg Varieties

McMaster University — Hamilton, ON
BSc Honours Mathematics and Statistics, *summa cum laude* — 2018–2022

Papers

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

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

Theses

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, Jenna Rajchgot

Teaching

Instructor of Record

Summer 2024	Applications of Linear Algebra, Math 2LA3

Teaching Assistant

Winter 2025	Introduction to Optimization, CO 250	
Fall 2024	Introduction to Combinatorics (Non-Specialist Level), Math 229	One section
Winter 2024	Theory of Linear Algebra, Math 2R03	Two sections
Fall 2023	Abstract Algebra, Math 3GR3	One section
Winter 2023	Theory of Linear Algebra, Math 2R03	Two sections
Fall 2022	Calculus for Math and Stats I, Math 1X03	Three sections (of seven)
Winter 2022	Calculus for Math and Stats II, Math 1XX3	Two sections (of seven)
Spring 2021	Introduction to Mathematical Scientific Computation, Math 1MP3	Two sections
Spring 2020	Introduction to Mathematical Scientific Computation, Math 1MP3	Two sections

Math Help Centre

Fall 2021	Calculus for Math and Stats I, Math 1X03
Spring 2021	Matlab for Linear Algebra I, Math 1B03 and Math 1ZC3
Winter 2021	Engineering Mathematics II-B (Linear Algebra I), Math 1ZC3
Fall 2020	Calculus for Math and Stats I, Math 1X03

Talks

The $^\vee$ denotes a virtual talk.

Research

Geometric vertex decomposition: a computational technique for liaison theory
- March 2025, Graduate Skills Seminar for the Department of Combinatorics and Optimization, University of Waterloo

Combinatorial rules for the geometry of Hessenberg varieties
- November 2024, Algebraic and Enumerative Combinatorics Seminar, University of Waterloo, ON, CAN

Geometric vertex decomposition: introduction and connections
- February 2024, Graduate Student Seminar in Number Theory and Algebraic Geometry at Simon Fraser University, BC, CAN$^\vee$

Gröbner geometry for regular nilpotent Hessenberg Schubert cells
- January 2024, Combinatorial Algebra meets Algebraic Combinatorics at LaCIM à l'Université du Québec à Montréal, QC, CAN
- December 2023, Commutative Algebra session at the CMS 2023 Winter Meeting in Montréal, QC, CAN
- March 2023, Algebra & Algebraic Geometry Seminar at McMaster University, ON, CAN

Degenerations of toric ideals of graphs
- May 2023, Open problem session at the SLMath/CMND Summer School on Commutative Algebra and its Interactions with Algebraic Geometry at the University of Notre Dame, IN, USA

An introduction to Hessenberg varieties
- August 2022, Mathematics & Statistics Undergraduate Summer Research Seminar at McMaster University, ON, CAN

Geometric vertex decomposition
- May 2022, Mathematics & Statistics Undergraduate Summer Research Seminar at McMaster University, ON, CAN

Poster

TBD
- January 2025, CAAC 2025 at the Fields Institute and University of Toronto, ON, CAN

Gröbner geometry for regular nilpotent Hessenberg Schubert cells
- June 2023, CMS 2023 Summer Meeting in Ottawa, ON, CAN
- May 2023, SLMath/CMND Summer School on Commutative Algebra and its Interactions with Algebraic Geometry at the University of Notre Dame, IN, USA

Expository

An introduction to algebraic geometry
- April 2024, Student Math Colloquium at Niagara University, NY, USA

Graph colouring, symmetric functions, and open problems
- November 2023, Casual Math Seminar at McMaster University, ON, CAN

Play with your food: Brussel sprouts and other games on graphs
- April 2023, Casual Math Seminar at McMaster University, ON, CAN

Conferences Attended

Conferences with future dates are tentative. The † indicates that funding was received to attend and the $^\vee$ denotes a virtual conference.

2025 Feb. Computational Interactions between Algebra, Combinatorics, and Discrete Geometry, IPAM, UCLA, CA, USA†

Jan. Combinatorial Algebra meets Algebraic Geometry at the Fields Institute and University of Toronto, ON, CAN†

2024 Jun. AlCoVE: an Algebraic Combinatorics Virtual Expedition at the University of Waterloo, ON, CAN$^\vee$

May Macaulay2, Computational Algebraic Geometry, and String Theory at the University of Utah, UT, USA†

Why are we teaching mathematics today?, FYMSiC$^\vee$

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

2023 Dec. 2023 CMS Winter Meeting in Montréal, QC, CAN†

Nov. Route 81 Conference on Commutative Algebra and Algebraic Geometry at Syracuse Univeristy, NY, USA

Jun. AlCoVE: an Algebraic Combinatorics Virtual Expedition at the University of Waterloo, ON, CAN$^\vee$

2023 CMS Summer Meeting at the University of Ottawa, ON, CAN†

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

8th Lake Michigan Workshop on Combinatorics and Graph Theory at the University of Notre Dame, IN, USA†

Teaching: The Backstage of Our Courses, FYMSiC$^\vee$

Jan. Combinatorial Algebra meets Algebraic Combinatorics at the University of Waterloo, ON, CAN†

2022 Dec. 2022 CMS Winter Meeting in Toronto, ON, CAN

Jun. ISM Discovery School: Geometry and Combinatorics of Hessenberg Varieties at the Université du Québec à Montréal, QC, CAN†

Scholarships and Awards

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 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
2019–22 Dean's Honour List
2021 NSERC USRA, supervisors: Sergio Da Silva, Jenna Rajchgot, Adam Van Tuyl, $8,120

Service

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

2022– Canadian Mathematical Society
American Mathematical Soceity