

Mike Cummings

Mathematics and Computer 6311
Department of Combinatorics and Optimization
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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

- 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
- 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

- 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

- 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

McMaster University

2023-24 Applications of Linear Algebra, Math 2LA3

Teaching Assistant

University of Waterloo

2024-25 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

The [∨] denotes a virtual talk.

Research

Geometric vertex decomposition: a computational technique for liaison theory

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

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[∨]

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

Conferences with future dates are tentative. The [∨] denotes a virtual conference.

2025 May AlCoVE: an Algebraic Combinatorics Virtual Expedition at the University of Waterloo, ON, CAN[∨]

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

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

Why are we teaching mathematics today? FYMSiC[∨]

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 University, NY, USA

Jun. AlCoVE: an Algebraic Combinatorics Virtual Expedition at the University of Waterloo, ON, CAN[∨]

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[∨]

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
- 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 Society