CURRICULUM VITAE
MAHRUD SAYRAFI

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EMPLOYMENT

2025 – 2026	**McMaster University**	Britton Postdoctoral Fellow
	RESEARCH GROUP: Combinatorial Algebraic Geometry	
2025 Spring	**Fields Institute for Research in Mathematical Sciences**	Postdoctoral Fellow
	THEMATIC PROGRAM: Commutative Algebra and Applications	
2024 Fall	**Max Planck Institute for Mathematics in the Sciences**	Postdoctoral Fellow
	RESEARCH GROUP: Nonlinear Algebra	

EDUCATION

2024	Ph.D.	**University of Minnesota, Twin Cities**	ADVISOR: Christine Berkesch
		THESIS: Diagonalization, Direct Summands, and Resolutions of the Diagonal	
2017	B.A.	**University of California, Berkeley** (with Honors)	ADVISOR: David Eisenbud
		THESIS: Local Computations in `Macaulay2`	
2016		**Math in Moscow** (semester abroad at the Independent University of Moscow)	

AWARDS

2023 – 2024	Doctoral Dissertation Fellowship, University of Minnesota
2020	Honorable Mention, Graduate Research Fellowships Program, NSF
2018 – 2020	John Ordway Fellowship, School of Mathematics, University of Minnesota

GRANTS

2023	NSF Workshop Grant DMS-2302476 for M2Week
	Co-PI and organizer for the Macaulay2 Workshop & Mini-school in Minneapolis, MN.
2022	NSF Workshop Grant DMS-2206872 for GradMoCCA
	Co-PI and organizer for the Graduate Meeting on Combinatorial Commutative Algebra.

PUBLICATIONS

2024	3. "A short resolution of diagonal for smooth projective toric varieties of Picard rank 2"
	M. K. Brown. *Algebra & Number Theory* **18-10** (2024), 1923-1943.
2020	2. "The virtual resolutions package for Macaulay2"
	A. Almousa, J. Bruce, and M. C. Loper. *J. of Software for Algebra & Geometry* **10** (2020), 51–60.
2017	1. "What is the optimal way to prepare a Bell state using measurement and feedback?"
	L. Martin and K. B. Whaley. *Quantum Sci. & Technol.* **2** (2017), no. 4.

PREPRINTS

2025	5. "Connection Matrices in Macaulay2"	arXiv:2504.01362
	P. Görlach, J. Koefler, A.-L. Sattelberger, H. Schroeder, N. Weiss, F. Zaffalon. Submitted.	
2024	4. "Splitting of vector bundles on toric varieties"	
	Submitted.	arXiv:2412.19793
2024	3. "Computing Direct Sum Decompositions"	
	D. Mallory. Submitted.	arXiv:2412.19799
2022	2. "Bounds on multigraded regularity"	
	J. Bruce, and L. Cranton Heller. Submitted.	arXiv:2208.11115
2021	1. "Characterizing multigraded regularity and virtual resolutions on products of projective spaces"	
	J. Bruce, and L. Cranton Heller. Submitted.	arXiv:2110.10705

Iɴᴠɪᴛᴇᴅ Tᴀʟᴋs (selected)

Conferences

2024 July Effective Methods in Algebraic Geometry, MPI MiS, Leipzig, Germany
     May   Spring Western AMS Sectional Meeting, San Francisco State University
     Jan. Joint Math Meetings, San Francisco, California
2023 Oct. Fall Central AMS Sectional Meeting, Creighton University, Omaha
     Jul. SIAM Applied Algebraic Geometry Conference, Eindhoven University, the Netherlands
     Jul. Géométrie Algébrique en Liberté, University of Warwick, UK
     Apr. CA+ Conference, University of Minnesota, Twin Cities
     Mar. Spring Southeastern AMS Sectional Meeting, Georgia Tech, Atlanta
2022 Oct. Fall Western AMS Sectional Meeting, University of Utah, Salt Lake City
     Sep. Fall Central AMS Sectional Meeting, University of Texas, El Paso
     May   Macaulay2 Conference, Cleveland State University
2021 Apr. Spring Central AMS Sectional Meeting, University of Cincinnati (virtual)
2019 Aug. SIAM Applied Algebraic Geometry Conference, Universität Bern, Switzerland
2018 Jan. Joint Mathematics Meetings, San Diego, California

Seminars

2024 Dec. Technische Universität Berlin, Discrete Geometry Seminar
     Dec. Universität Osnabrück, Algebra Seminar
     Dec. Universität Bielefeld, BIREP Seminar
     Nov. University of Edinburgh, Hodge Institute, EDGE Geometry Seminar
     Oct. Friedrich-Schiller-Universität Jena, Algebra Seminar
     May   University of Oregon, Eugene, Algebra Seminar
     Apr. UC Berkeley, Commutative Algebra and Algebraic Geometry Seminar
     Mar. University of Michigan, Ann Arbor, Commutative Algebra Seminar
     Feb. Georgia Tech, Atlanta, Algebra Semina
     Feb. Washington University in St. Louis, Combinatorics Seminar
2023 Nov. University of Notre Dame, Algebraic Geometry and Commutative Algebra Seminar
     Apr. University of Nebraska - Lincoln, Commutative Algebra Seminar
     Feb. Texas A&M University, Algebra and Combinatorics Seminar
     Jan. University of Illinois, Chicago, Commutative Algebra Seminar
2022 Oct. University of Utah, Algebraic Geometry Seminar
     Oct. Arizona State University, Number Theory and Algebra Seminar
2021 Oct. Georgia Tech, Algebra Seminar
     Oct. Auburn University, Algebra Seminar
     Feb. ICERM semester in Combinatorial Algebraic Geometry, Grad/Postdoc Seminar (virtual)

Posters

2024 Oct. Group actions, combinatorics, and Fano varieties, Universität Innsbruck, Austria
     Sep. Syzygies and Hilbert Schemes, Jagiellonian University, Kraków, Poland
     Jan. Connections Workshop: Commutative Algebra, SLMath, Berkeley
2023 Nov. Western Algebraic Geometry Symposium, Washington University in St. Louis
     May   MSRI/SLMath Summer School in Commutative Algebra, University of Notre Dame
2022 Nov. Western Algebraic Geometry Symposium, UC Riverside
     Jun. Pan-American School in Commutative Algebra, CIMAT, Mexico
2017 Aug. SIAM Applied Algebraic Geometry Conference, Georgia Tech, Atlanta

Teaching and Mentoring Experience
School of Mathematics, University of Minnesota, Twin Cities
2023	Spring	MATH 1272: instructor of record for Calculus II (class of approx. 100 students).
2022	Fall	MATH 8253: graded homework for Algebraic Geometry (graduate course).
2022	Spring	MATH 1272: instructor of record for Calculus II (class of approx. 90 students).
2019 – 2021		MATH 2243: TA for Linear Algebra & Differential Equations (six sections total).
2018	Fall	MATH 1271: TA for Calculus I (two sections total).

2020	Summer	REU: mentored P. Cranford, A. Peng, and V. Srinivasan towards `arXiv:2106.12667`.
2019 & 2022		DRP: mentored five undergraduate students in weekly reading projects.

Department of Mathematics, UC Berkeley
2015	Spring	Math113: graded homework for Abstract Algebra.
2014	Fall	Math116: graded homework and assisted the instructor for Mathematical Cryptography.

Math Center, Irvine Valley College
2013 – 2014	Tutored lower-div courses including linear algebra, differential equations, and discrete math.

Mathobotix, Irvine, CA
2012 – 2014	Developed curriculum for computer science-based problem-solving using Python.

Conference and Workshop Organization
2024 Nov. **Macaulay2 in the Sciences Workshop**
Three-day workshop on computational algebra with 45 participants in Leipzig, Germany.
2023 Jun. **Macaulay2 Workshop & Mini-school**
Weeklong event in computational commutative algebra bringing 70 researchers to Minneapolis.
2022 May **Graduate Meeting on Combinatorial Commutative Algebra**
Weekend graduate event with 12 speakers bringing 70 students and postdocs to Minneapolis.

Mathematical Service
2018 – 2023 **Directed Reading Program**, University of Minnesota, Co-founder and co-organizer
Matched over 250 undergraduate and graduate students in guided mathematics reading projects.
2019 – 2022 **Student Commutative Algebra Meeting**, University of Minnesota, Co-organizer
Held a weekly meetup of friendly neighborhood commutative algebra students.
2021 Apr. **Graduate Student Combinatorics Conference**, Session Chair
Chaired the session on Combinatorial Algebraic Geometry.
2017 – 2018 **Pauline Sperry Undergraduate Lecture Series**, UC Berkeley, Organizer
Inaugurated an annual lecture aimed at providing a role model for marginalized students in math.

Referee Work:
Journal of Pure and Applied Algebra, Journal of Software for Algebra and Geometry

Broader Outreach
2019 – 2023 **Vincent Hall Thespians, University of Minnesota**, Performer
Helped with first-time teaching assistant orientation through situational comedy.
2023 Jan. **Minnesota Project in Mathematics**, Counselor
Helped with workshops and mentored two undergraduate projects during the week-long program.
2019 – 2020 **AMS Graduate Student Blog**, Staff Writer
Wrote about finding community through mathematical art and history.
2018 Jul. **Girls Who Code @ Cloudflare**, Workshop Leader
Instilled an appreciation for mathematics in high school girls using elliptic cryptography puzzles.
2016 – 2017 **Mathematics Undergraduate Student Association**, UC Berkeley, President
Helped build an inclusive and diverse community among undergraduate math students at Berkeley.
2014 & 2015 **Berkeley mini Math Tournament**, Grader and Lecturer
Instilled an appreciation for knot theory in advanced elementary and middle school students.

Other Work Experience
2020 & 2022 Fall **Mathematical Sciences Research Institute**, Macaulay2 Developer (see below)
2018 Summer **Cloudflare, Inc.** Cryptography Engineering Intern
Launched multiple products involving Tor, Keyless SSL, and distributed randomness generation.
2017 Winter **Proton Research, Inc.** Cryptography Research and Development Intern
Added support for elliptic curve cryptography in OpenPGP.js.

Workshops and Summer Schools (selected)

2023 Sep. **Syzygies and mirror symmetry**, American Institute of Mathematics, Pasadena, California
Topics: resolutions of the diagonal for toric varieties, homological mirror symmetry

Jul. **Géométrie Algébrique en Liberté**, University of Warwick, UK
Topics: Mori Dream Spaces and quiver GIT, klt singularities, the geometry of curves

Jun. **MRC Derived Categories, Arithmetic and Geometry**, AMS
Topics: Frobenius pushforwards and F-thickness of the blowup $\text{Bl}_5\mathbf{P}^2$

May **MSRI/SLMath Summer School in Commutative Algebra**, University of Notre Dame
TA for mini-course on the geometry of nonstandard syzygies by Daniel Erman

2022 Dec. **RTG Workshop on Birational Complexity**, SCGP, Stony Brook University
Topics: rationality, curves in algebraic varieties, the Cremona group, measures of irrationality

Jun. **Pan-American School in Commutative Algebra**, CIMAT, Mexico
Topics: positive characteristic methods, toric varieties, DG algebras, modules of differentials

2021 Spr. **Combinatorial Algebraic Geometry**, ICERM
Topics: Schubert varieties, toric varieties, tropical varieties, cluster algebras and varieties

2018 May **RTG Summer School in Commutative Algebra**, University of Utah
Topics: limits in positive characteristic, symbolic powers, differential operators, and syzygies.

Mar. **Geometry of Redistricting Workshop**, University of San Francisco
Topics: gerrymandering, voting rights, discrete geometry and graph theory

Open Source Development

Since 2017 **Macaulay2 Internals**
I have contributed to various internal components of Macaulay2, including the engine, interpreter, core mathematical routines, and documentation. I have also contributed to the following packages:

Since 2023 **DirectSummands**: for decomposing modules and coherent sheaves, with D. Mallory.

Since 2023 **Varieties**: for computations involving projective varieties, including complexes of coherent sheaves and their morphisms, with D. Mallory, R. Ramkumar, G. Smith, K. VandeBogert.

Since 2020 **NormalToricVarieties**: added support for pullbacks of coherent sheaves over toric maps, and computations on the Cox ring of toric varieties whose class group has torsion.

Since 2021 **Truncations**: added support for truncations of modules with respect to arbitrary cones, for instance on simplicial toric varieties where the nef and effective cones differ.

Since 2020 **Saturation**: improved and added to core routines for computing annihilators, saturations, and quotients of ideals and modules, with J. Chen and M. Stillman.

Since 2019 **FGLM**: for computing Gröbner bases of zero-dimensional ideals, with D. Peifer.

Since 2018 **VirtualResolutions**: see paper above, with A. Almousa, J. Bruce, and M. Loper.

Since 2017 **LocalRings**: for symbolic computations over local rings, with M. Stillman.

Professional

Memberships:
AMS, SIAM Activity Group on Algebraic Geometry.

Programming:
Proficient in Macaulay2, C/C++, Python, and Node.js.
Experienced in Go, Rust, SageMath, and IDL.
Familiar with Julia, Mathematica, MATLAB, and Haskell.

Other Research Experience

2017 Summer **Institute for Quantum Computing**, University of Waterloo
Topics: quantum error correcting codes from algebraic curves under John Watrous.

2015 – 2016 **Berkeley Quantum Information and Computation Center**, UC Berkeley
Topics: control theory & entanglement generation under Leigh Martin and Birgitta Whaley.

2014 Summer **Institute for Quantum Information and Matter**, Caltech
Topics: quantum game theory and semi-definite optimization under Thomas Vidick.

2013 Summer **Jet Propulsion Laboratory**, NASA
Topics: secure multiparty computation and secret sharing systems under Ed Chow.

References

Christine Berkesch	David Eisenbud	Craig Westerland
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Advisor		Teaching