Caroline J. Klivans

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Research Interests

Algebraic, Geometric, Topological, Applied Combinatorics: simplicial complexes, matroids, hyperplane arrangements, polytopes, combinatorial Laplacians, quasisymmetric functions, chip-firing models.

Appointments

Professor, Brown University
Division of Applied Mathematics (2024 –)

Affiliated Faculty, BTPC
Brown Theoretical Physics Center (2020 – present)

Education

Ph.D. Massachusetts Institute of Technology (2003)
Applied Mathematics Department, Advisor: Richard Stanley
Thesis: Combinatorial Properties of Shifted Complexes

B.A. Cornell University (1999)
Mathematics Department, Advisor: Louis Billera

Previous Appointments

Deputy Director, ICERM
Institute for Computational and Experimental Research in Mathematics (2020 – 2024)

Associate Professor, Brown University
Division of Applied Mathematics (2018 – 2024)

Associate Director, ICERM
Institute for Computational and Experimental Research in Mathematics (2015 – 2020)

Research Member, MSRI
Semester program: Geometric and Topological Combinatorics (Fall 2017)

Visitor, ICERM
Semester program: Topology in Motion (Fall 2016)

Adjunct Professor, Lecturer, Senior Lecturer Brown University
Division of Applied Mathematics and Department of Computer Science
(2011 – 2015, 2015 – 2016, 2016 – 2018)

Research Scholar and Senior Lecturer, The University of Chicago
Departments of Mathematics and Computer Science (2008 – 2011)

Visiting Scholar of Mathematics, Cornell University (2009 – 2010)

L.E. Dickson Instructor and VIGRE postdoctoral fellow, The University of Chicago
Departments of Mathematics and Computer Science (2004 – 2008)

Instructor, Cornell University
Computing and Information Science (Spring 2004)

Postdoctoral Fellow, MSRI
Special semester in Discrete and Computational Geometry (Fall 2003)

Publications

Submitted

S. Brauner, G. Doepalen-Barry, S. Kara, C. Klivans, L. Schneider. A Three-Regime Theorem for Flow-Firing.
Submitted for Journal Publication. https://arxiv.org/abs/2303.02526

C. Klivans, P. Liscio. Move and Configuration Posets.
Submitted for Journal Publication. https://arxiv.org/abs/2202.02821

M. Calkins, S.J. Gates, C. Klivans. Supersymmetry and representation theory in low dimensions.
In revision for Notices of the American Mathematical Society. https://arxiv.org/pdf/2012.09211

Published

Y. Baryshnikov, C. Klivans, N. Kosar, On the topology of no k-equal spaces.
Advances in Applied Mathematics 2023
https://arxiv.org/abs/1708.00032

K. Iga, C. Klivans, J. Kostiuk and C. Yuen. Eigenvalues and Critical Groups of Adinkras.
Advances in Applied Mathematics vol. 143, 2023.
https://arxiv.org/abs/2202.02821

C. Klivans and N. Saldanha, Domino tilings and flips in dimensions 4 and higher.
Algebraic Combinatorics vol. 5, no. 1, 2022
https://arxiv.org/abs/2007.08474

P. Felzenszwalb, C. Klivans, A. Paul, Clustering with semidefinite programming
and fixed point iteration.
Journal of Machine Learning Research 23 (190) 2022.
https://arxiv.org/pdf/2012.09202

C. Klivans and P. Liscio, Confluence in labeled chip-firing.
Journal of Combinatorial Theory Series A vol. 186 2022.
Extended abstract appeared at FPSAC 2020.

J. Freire, C. Klivans, P. Milet, N. Saldanha, On the connectivity of three dimensional tilings.
Transactions of the American Mathematical Society, 2021.

P. Felzenszwalb, C. Klivans, A. Paul. Iterated linear optimization.
Quarterly of Applied Mathematics, 2021.

P. Felzenszwalb and C. Klivans, Flow-firing processes.
Journal of Combinatorial Theory A, vol. 177, 2021.

Book: C. Klivans, The Mathematics of Chip-firing,
Publisher: CRC Press. 2019.

G. Benkart, C. Klivans, V. Reiner, Chip firing on Dynkin diagrams and McKay quivers.
Mathematische Zeitschrift, 290, 2018.

A. Duval, C. Klivans and J. Martin, The Partitionability Conjecture.
The Notices of the American Mathematical Society, 64(2), 2017.

O. Bernardi and C. Klivans, Directed rooted simplicial forests.
The Electronic Journal of Combinatorics, 23(4), 2016.

J. Guzman, C. Klivans, Chip-firing on general invertible matrices.
SIAM Journal on Discrete Mathematics, 30(2), 2016.

A. Duval, B. Goeckner, C. Klivans, J. Martin, A non-partitionable Cohen-Macaulay simplicial complex.
Advances in Mathematics, Vol. 299, 2016.

R. Ehrenborg, C. Klivans, and N. Reading, Coxeter arrangements in three dimensions.
Beitrage zur Algebra and Geometrie / Contributions to Algebra and Geometry, 2016.

F. Breuer, C. Klivans, Scheduling Problems.
Journal of Combinatorial Theory, Series A Vol. 139, 2016.

A. Duval, C. Klivans, and J. Martin, Simplicial and Cellular Trees.
IMA Volume Book Chapter in *Recent Trends in Combinatorics*, 2015.

J. Guzman, C. Klivans, Chip-firing and energy minimization on M-matrices.
Journal of Combinatorial Theory, Series A, vol. 132, 2015.

J. Steenbergen, C.Klivans, and S. Mukherjee, A Cheeger-Type Inequality on Simplicial Complexes.
Advances in Applied Mathematics vol. 56, 2014.

A. Duval, C. Klivans, and J. Martin, Cuts and flows of cell complexes.
Journal of Algebraic Combinatorics 1-31, 2014.
Extended abstract appeared in FPSAC (Formal Power Series and Algebraic Combinatorics) 2013.

A. Duval, C. Klivans, and J. Martin, Critical groups for simplicial complexes.
Annals of Combinatorics vol. 17, Issue 1, 2013.
Extended abstract appeared in FPSAC (Formal Power Series and Algebraic Combinatorics) 2011.

C. Klivans, E. Swartz, Projection volumes of hyperplane arrangements.
Discrete and Computational Geometry vol. 46, No. 3, 2011.

M. Drton, C. Klivans, A geometric interpretation for the coefficients of the characteristic polynomial of a reflection arrangement.
Proceedings of the American Mathematical Society, vol. 138, 2010.

A. Duval, C. Klivans, and J. Martin, Cellular spanning trees and Laplacians of cubical complexes.
Advances in Applied Mathematics, Special issue in tribute to Dennis Stanton, vol. 46, 2011.

R. Basri, P. Felzenszwalb, R. Girshick, D. Jacobs, and C. Klivans, Visibility Constraints on Features of 3D Objects.
IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2009.

A. Duval, C. Klivans, and J. Martin, Simplicial spanning trees and generalized matrix-tree theorems.
Transactions of the American Mathematical Society, vol. 361, 2009.

C. Klivans, K. Nyman, and B. Tenner, Relations on generalized degree sequences.
Discrete Mathematics vol. 30, Issue 13, 2009.

C. Klivans, Shifted matroid complexes.
Preprint.

C. Klivans and V. Reiner, Shifted set families, degree sequences, and plethysm.
The Electronic Journal of Combinatorics, vol. 15, no.1, 2008.

C. Klivans, Threshold graphs, shifted Complexes, and graphical Complexes.
Discrete Mathematics, vol. 307, no. 21, 2007.

F. Ardila, C. Klivans, and L. Williams, The positive Bergman complex of an oriented matroid.
European Journal of Combinatorics, vol. 27, no. 4, 2006.

F. Ardila and C. Klivans, The Bergman complex of a matroid and phylogenetic trees.
Journal of Combinatorial Theory, Series B, vol. 96, Issue 1, 2006.
Extended abstract appeared in FPSAC (Formal Power Series and Algebraic Combinatorics) 2004.

C. Klivans, Obstructions to shiftedness.
Discrete and Computational Geometry vol. 33, no. 3, 2005.

C. Klivans, Combinatorial properties of shifted complexes.
Ph.D. Thesis, MIT June 2003.

C. Klivans, Mobile robotics navigation.
DIMACS Technical Report Summer 1998.

Teaching

Brown University
Operations Research APMA 1210, Fall 2020, 2021
Statistical Inference, APMA 1650, Fall 2011, 2012, 2013, 2014, 2015, 2019
Statistical Inference, APMA 1655, Fall 2015, 2016, 2018
Introduction to Discrete Structures and Probability, CS 22, Spring 2012 – 2019
Graph Theory (GISP), Fall 2015
Combinatorial Theory, APMA 2822C, Spring 2020, Fall 2022
Matroid Theory, APMA 1941F, Spring 2024

The University of Chicago
Abstract Algebra (Regular and honors sequences) Winter 2006, 2007, 2008, Spring 2008, 2011
Discrete Mathematics (Undergraduate and graduate versions) Autumn 2004, 2005, 2006, 2007, 2008
Mathematical Methods for the Physical Sciences Winter 2005
Combinatorics and Complexity in Game Theory (Topics in theoretical computer science) Spring 2005
Hyperplane Arrangements (REU program) Summer 2005
Graph Theory Spring 2011

Cornell University
Information Modeling (School of computing and information sciences) Spring 2004
Discrete Structures (Department of Computer Science) Spring 2010

MIT (Teaching Assistant)
Calculus Spring 2003
Principles of Discrete Applied Mathematics Autumn 2002

Advising

PhD thesis advisor
Yifan Guo (current, first year)
Ethan Partida (current)
Nicholas Arosemena (current)
Terresa Chambers (current)
Patrick Liscio (graduated 2022) Quantitative Researcher, Jane Street
Alexander McDonough (graduated 2021) Kresner Assistant Professor, UC Davis

Postdoctoral mentoring
Sarah Brauner, Prager Assistant Professor and NSF postdoctoral fellow, 2024 –
Andrew Vander Werf, RTG postdoctoral fellow, 2023 –
Nidhi Kaihnsa, Prager Assistant Professor, 2020 – 2023.
Chi Ho Yuen, Croucher postdoctoral fellow, 2019 – 2021.

Undergraduate research advisor - Brown University
Cassie Ding, Tropical Geometry (Fall 2023)
Tracy Chin, A Computational Commutative Algebra Approach to Tilings (2019)
Daniel Kunin, Visualizations for Statistics (Summer, Fall 2016)
Harjasleen Malvai, Chip-firing (2014-2015), UTRA (Summer 2015)
Alex St. Laurent, Simplicial Chip-firing (Summer 2012)

Masters thesis advisor
Negar Mirsattari, Properties of Degree Sequences of k-Uniform Hypergraphs
The University of Chicago, 2010.

Ph.D. thesis committee member
Andres Santamaria-Galvis, On partitionability and shellability of relative simplicial complexes
University of Primorska, Slovenia, 2022.
Chi Ho Yuen, Geometric Bijections of Graphs and regular matroids
Georgia Institute of Technology, 2018.
Ningning Ma, Tropicalization of the dimer model and cluster integrable systems
Brown University, 2015.
Elliot Krop, Enumerating Matchings in Regular Graphs
University of Illinois - Chicago, 2007.

Brown University Undergraduate Advising
Concentration advisor, APMA, APMA-CS
Sophomore advisor
Freshman advisor

Professional Activities

Organizer & co-founder, Brown Combinatorics Seminar
2019 – present.

Executive Committee, Initiative to Maximize Student Development (IMSD)
2022 – present.

Executive Committee, Association for Women in Mathematics (AWM)
Spring 2022 – Spring 2026.

Inaugural Cohort, Faculty Leadership Program, Brown University
2022 – 2023.

Campus Advisory Board, Data Science Initiative (DSI)
Fall 2021 – Fall 2024.

Editorial Board, Algebraic Combinatorics (ALCO)
2021 – present.

Scientific Program Committee, Encuentro Colombiano de Combinatoria (ECCO) 2024

Project Leader, Research Community in Algebraic Combinatorics, ICERM
Fall 2021 – Spring 2022.

Member, StemJazz Network
2020 – present.

Chair: American Mathematical Society (AMS) David P. Robbins Prize Committee.
Appointed 2021, had to step down after one of my own papers was nominated.

Co-organizer: Special Session on Applied Combinatorics
AMS Regional Meeting, Boston, MA, March 2020 (virtual)

Co-organizer: Special Session on Algebraic, Geometric and Topological Combinatorics
AMS Regional Meeting, UT El Paso, September 2020 (virtual) and September 2022 (in-person)

Participant: MSRI African Diaspora Joint Mathematics Workshop 2019

Committee Member: AWM Policy and Advocacy Committee (2019 – 2022)

Co-organizer: Special Session on Chip-firing and Divisor Theory
AMS Regional Meeting, Hartford, CT, April 2019

Program Co-Chair: Formal Power Series and Algebraic Combinatorics, FPSAC 2018

Co-organizer: Special Session on Chip-firing and Divisors on Graphs and Complexes
AMS Regional Meeting, Minneapolis, MN, October 2016

Organizing Committee Member:
Formal Power Series and Algebraic Combinatorics, FPSAC 2014
Stanley@70: A Celebration of Combinatorics in honor of Richard Stanley 2014

Program Committee Member:
Formal Power Series and Algebraic Combinatorics, FPSAC 2010 & 2014

AWM Selection Committee Member for the Alice T. Schafer Prize

Panelist and Participant for various women and URM in STEM events

Co-organizer: Special Session on Geometric Combinatorics
AMS Regional Meeting, DePaul University, October 2007

Member of The Women in the Physical Sciences Dean's Committee
University of Chicago (2005 – 2011)

Faculty Sponsor: AWM Student Chapter
University of Chicago (2005 – 2011)

Organizer, Zeilberger Miniconference, MIT 2003

Reviewer for many mathematical journals and the National Science Foundation

Awards and Honors

Brown University Mid-Career Research Achievement Award, 2024.
One awardee in the physical sciences every two years.

National Institute of Health (NIH) NIGMS grant 1T32GM144926-01A1, Initiative to Maximize Student Development (IMSD) Role: Committee member, Dates: February 1, 2023 – January 31, 2028, Award Amount: $3,297,130.

National Science Foundation Research and Training Grant (NSF RTG Grant) Mathematics of Information, Data, and Applications to Science (MIDAS) Role: co-PI, Dates: September 1, 2021 – August 31, 2026, Award Amount: $2,491,556.

Top Influential Mathematicians of 2010-2020, ranked #11, Academic Influence, 2020.

National Science Foundation Mathematics Institutes Award, Institute for Computational and Experimental Research in Mathematics (ICERM) Role: co-I, Dates: September 1, 2020 – August 31, 2025, Award Amount: $23,532,919.

National Science Foundation (NSF) Conference Grant, Celebration of Combinatorics Stanley(at)70, Role: Co-PI, Dates: June 23-27 2014, Award Amount: $25,000.

Brown University Brazil Initiative Grant, Collaborations in Applied Mathematics. Role: PI, Dates: November 2013 – November 2016, Award amount: $19,576.

Association for Women in Mathematics, National Science Foundation (AWM-NSF) Travel Grant. Role: PI, Date: 2013, Award amount $1,742.

Association for Women in Mathematics, National Science Foundation (AWM-NSF) Travel Grant. Role: PI, Date: 2009, Award amount $1,010.

National Science Foundation VIGRE Postdoctoral Fellowship, 2004 – 2008.

National Science Foundation Graduate Fellowship, 1999 – 2002.

Alice T. Schafer AWM National Mathematics Prize, 1999.

Summer Research Assistant, DIMACS 1999
(Center for Discrete Math and Theoretical Computer Science)
Project: Mobile Robotics Navigation, Advisor: Sven Dickinson

REU Student, DIMACS 1998
Advisors: Sven Dickinson and Diane Souvaine

President, Undergraduate Math Club, Cornell University (1997-1999);
Rensselaer Medal Award 1995;
Andrew's Leaper, Carnegie Mellon University 1994.

Accepted Invited Talks

2024 BIRS workshop, Algebraic and Enumerative Combinatorics, Banff, Canada

The Marden Lectures, University of Wisconsin-Milwaukee (public Lecture and colloquium)

IPAM workshop, Statistical Mechanics Beyond 2D, UCLA, CA

AMS-UMI Joint Meeting, Discrete and Combinatorial Homotopy, Palermo, Italy

2023 Matroids and Tropical Combinatorics, London, UK (series of 4 lectures)

BIRS workshop, Algebraic aspects of matroid theory, Banff, Canada

Triangle Lectures, Raleigh, NC (plenary speaker)

EDGE Colloquium, Brown University

2022 Combinatorics Seminar, Michigan State University

AMS Invited address, El Paso, Texas

ECCO, Encuentro Colombiano de Combinatoria, Bogota, Colombia (series of 4 lectures)

2021 Research Communities in Algebraic Combinatorics, ICERM

MPS Conference on High-Dimensional Expanders, Simons Foundation, NYC, NY

2020 Discrete Math Seminar, UMass, Amherst, MA **postponed**

Combinatorics Seminar, University of Miami, Miami FL

ECCO 2020, Bogota, Colombia **postponed** (plenary speaker)

AMS Invited address, El Paso, Texas **postponed**

2019 Dynamical Systems Seminar, PUC-Rio, Rio de Janeiro, Brazil

Colloquium, Math department, Providence College, Providence, RI

FPSAC 2019, Ljubljana, Slovenia (plenary speaker)

Combinatorics Seminar, MIT/Harvard, Cambridge, MA

JMM special session, Baltimore, MD

2018 Discrete Math Days of the Northeast, University of New England, Biddeford, ME

AMS Special Session Algebraic, Geometric, and Topological Methods in Combinatorics, Boston MA

Combinatorics Seminar, Brandeis, MA

CombinaTexas 2018, Texas A&M University, College Station, TX

2017 Colloquium, Math department, UC-Berkeley, Berkeley, CA

Combinatorics Seminar, UC-Davis, Davis, CA

Combinatorics Seminar, UC-Berkeley, Berkeley, CA

MSRI workshop, Geometric and topological combinatorics: Modern techniques, Berkeley, CA

Combinatorics Seminar, University of Washington, Seattle, WA

MSRI workshop, Connections for Women: Geometric and Topological Combinatorics, Berkeley, CA

Theoretical Biology Seminar, Penn State University, State College, PA

Discrete Geometry and Combinatorics Seminar, Cornell University, Ithaca, NY

Combinatorics & Geometry/Topology Seminar, Binghamton University, Binghamton, NY

2106 ICERM workshop, Stochastic Topology and Thermodynamic Limits, Providence, RI

Workshop and Special Session, Combinatorics, at the crossroads of Algebra, Geometry, and Topology, Northeastern University, Boston, MA

FPSAC 2016 (28th International Conference), Vancouver, BC

Combinatorial algebra meets algebraic combinatorics, University of Western Ontario, London, ON

Applied Algebra Seminar, York University, Toronto, ON

2015 CRM, Perspectives in Lie Theory, Combinatorics & Algebraic Topology of Configurations, Pisa, Italy

Discrete Math Seminar, Brown University / ICERM

AMS Special Session on Enumerative, Algebraic and Geometric Combinatorics, Chicago IL

Colloquium, Mathematics Department, Dartmouth College

Applied Math DUG, Brown University

BIRS Workshop, Sandpile Groups, Oaxaca, Mexico

Combinatorics Seminar, MIT

2014 Mathematics Department Seminar, PUC-Rio, Rio de Janeiro, Brazil

Stanley@70, Conference in honor of Richard P. Stanley's 70th birthday, MIT

Colloquium, Mathematics Department, George Mason University

AMS Special Session on Topological Combinatorics, Washington University, St. Louis

2013 AIM workshop, Generalizations of Chip-Firing and The Critical Group, Palo Alto

CIRM workshop, Combinatorial Geometries: matroids, oriented matroids and applications, Luminy, France

Applied mathematics seminar, Wentworth Institute of Technology, Boston, MA

Discrete Math Seminar, Brown University, Providence, RI

2012 Applied Math & Math DUG, Brown University, Providence, RI

Lefschetz Center for Dynamical Systems Seminar, Brown University, Providence, RI

Combinatorics Seminar, MIT, Cambridge, MA

2011 Discrete Math Seminar, Brown University

Mathematics Department Colloquium, Wellesley University

AMS Special Session on Species and Hopf Algebraic Combinatorics, Cornell University

Geometry/Topology Seminar, University of Chicago

Computer Science Theory Seminar, University of Chicago

Mathematics Department Colloquium, University of Nebraska

Algebraic Combinatorixx, Banff

Special Session on Polyhedra, MAA Mathfest, Lexington KY

2010 Discrete Geometry and Combinatorics Seminar, Cornell University

Combinatorics and Computer Science Seminar, University of Illinois -Chicago

Workshop on Quasisymmetric Functions, Banff

2009 Combinatorics Seminar, SUNY-Binghamton

Combinatorial Geometry Workshop, IPAM

Mathematics Department Colloquium (Oliver Club), Cornell University

Discrete Geometry and Combinatorics Seminar, Cornell University

Special Session on Matroids in Algebra and Geometry, AMS regional meeting, SFSU

Algebra Seminar, IMPA, Rio de Janeiro

Analysis Seminar, PUC-Rio, Rio de Janeiro

Theoretical Computer Science Seminar, University of Chicago

2008 Special Session on Combinatorial Representation Theory, AMS regional meeting, Vancouver, BC

Lou Billera's Birthday Conference, Cornell University

Special Session on Combinatorial Representation Theory, Topological Combinatorics, and Interactions between them, AMS regional meeting, Indiana University

Combinatorics Seminar, University of Washington

2007 Combinatorics Seminar, University of Illinois - Chicago

Combinatorics Seminar, MIT

Combinatorics Seminar, SUNY - Binghamton

Discrete Geometry and Combinatorics Seminar, Cornell

2006 Special Session on Geometric Combinatorics, AMS regional meeting, University of Cincinnati

Applied Mathematics Seminar, Illinois Institute of Technology

Combinatorics Seminar, University of Minnesota

Combinatorics Seminar, University of Kansas

2005 Special Session on Algebraic and Geometric Combinatorics, AMS regional meeting, Bard College

Combinatorics Seminar, University of Illinois - Chicago

Special Session on Curvature in Group Theory and Combinatorics, AMS regional meeting, UCSB

Combinatorics Seminar, Indiana University

Topology Seminar, University of Chicago

2004 Combinatorics Seminar, University of Illinois - Chicago

Richard Stanley's Birthday Conference, MIT

Combinatorics Seminar, MIT

Combinatorics Seminar, University of Michigan

Geometry Seminar, Courant Institute

Discrete Geometry and Combinatorics Seminar, Cornell University

Combinatorics Seminar, SUNY - Binghamton

2003 Combinatorics Seminar, University of California - Davis

Bay Area Discrete Math Day, San Francisco State University

Special Session on Topological Combinatorics, AMS regional meeting, SUNY - Binghamton

Combinatorics Seminar, University of California - Berkeley

Combinatorics Seminar, SUNY - Binghamton

Combinatorics Seminar, University of Washington - Seattle

1998-2003 Applied Mathematics Student Seminar (SPAMS) (4 talks), MIT

Pure Mathematics Student Seminar (Puma Grass), MIT

Graph Theoretic Methods in Computer Vision, DIMACS Workshop

Graph Theory and Combinatorial Optimization, DREI 98, DIMACS

Cornell Math Club