Jonathan Michael Bloom

CONTACT

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POSITION

Massachusetts Institute of Technology, Cambridge, Massachusetts

CLE Moore Instructor and NSF Postdoctoral Fellow September 2011 - present

RESEARCH INTERESTS

Low-dimensional topology and geometry; knot theory; Morse theory; Seiberg-Witten and Heegaard Floer homology; Khovanov homology; computational biology; statistics education.

EDUCATION

Columbia University, New York, New York September 2006 - May 2011

Ph.D., Mathematics, May 2011
Advisor: Peter Ozsváth
Thesis: *Monopole Floer Homology, Link Surgery, and Odd Khovanov Homology*

M.Phil., Mathematics, May 2009
M.A., Mathematics, May 2007

Harvard University, Cambridge, Massachusetts September 2000 - June 2004

B.A., Mathematics, *magna cum laude*

POSITIONS AND FELLOWSHIPS

NSF Mathematical Sciences Postdoctoral Research Fellowship

Postdoctoral Fellow September 2011 - present
Supervisor: Tomasz S. Mrowka

Massachusetts Institute of Technology, Cambridge, Massachusetts

Exchange Scholar September 2010 - May 2011

Mathematical Sciences Research Institute, Berkeley, California

Program Associate January 2010 - May 2010
Organized weekly graduate seminar for the program *Homology Theories of Knots and Links*.

Harvard University, Cambridge, Massachusetts

Instructor and Eliot House Non-Resident Tutor September 2005 - May 2006
Taught three courses, advised students, awarded *Certificate of Distinction in Teaching*.

John Huston Finley Traveling Fellowship, Africa, Asia, Oceania, South America

Finley Fellow July 2004 - June 2005
Explored math education around the world and taught at a secondary school in Botswana.
Awarded to one graduating student each year by Eliot House, Harvard College.

PUBLICATIONS

J. Bloom. *The combinatorics of Morse theory with boundary.*
Proceedings of 19th Gokova Geometry-Topology Conference (2013), 44–88.

J. Bloom. *A link surgery spectral sequence in monopole Floer homology.*
Advances in Mathematics **226** (2011), no. 4, 3216–3281.

J. Bloom. *Odd Khovanov homology is mutation invariant.*
Mathematical Research Letters **17** (2010), no. 1, 1–10.

J. Bloom. *Monopole Floer homology, link surgery, and odd Khovanov homology.* Dissertation at: `http://math.mit.edu/~jbloom/Bloom_PhD_Thesis_2011.pdf`

Papers in preparation

J. Baldwin, J. Bloom. *The monopole category and invariants of bordered 3-manifolds.* We extend monopole Floer homology to the framework of 2+1+1 TQFT by constructing a finitely-generated A_∞-category $\mathcal{C}(\Sigma)$ for a surface Σ, a gauge-theoretic analogue of the Fukaya category of $\mathrm{Sym}^g(\Sigma)$.

J. Bloom, T. Mrowka, and P. Ozsváth. *The Künneth principle in Floer homology.* We describe the monopole Floer homology of a connected sum of 3-manifolds in terms of that of the summands.

J. Bloom. *Khovanov homology and U.* I relate Khovanov homology to the master version of monopole Floer homology with non-trivial U-action, with application to the δ-grading conjecture.

Referee

Geometria Dedicata, Journal of Differential Geometry, Journal of Geometric Analysis, Pacific Journal of Mathematics, Quantum Topology, Advances in Mathematics

Seminar

Co-organizer of the MIT Geometry and Topology Seminar — Fall 2011 - Spring 2013

Genetics

Broad Institute, Cambridge, Massachusetts — Dec 2013 - present

Amit Majithia, MD (Altshuler Group) and I are investigating the use of combinatorial pooling and NGS technology to cost-efficiently sequence genes of interest across a large population (∼30k). Our initial focus is rare variant calling for PPARG (diabetes risk). I wrote/optimized a Python simulation demonstrating dramatic efficiency gains and am preparing a protocol to leverage raw read data from the 20k exome project to realistically model PCR and sequencing error without costly wet-lab trials.

Teaching

Massachusetts Institute of Technology, Cambridge, Massachusetts

Dr. Jeremy Orloff and I transformed MIT's introductory probability and statistics course (18.05) into a flipped, active learning class in the TEAL classroom, using the MITx platform. We created an innovative syllabus and a comprehensive set of written materials unifying Bayesian and frequentist inference, together with Matlab and R projects. Student satisfaction was very high and enrollment has grown by 80% in two years; my teaching was rated 6.2/7. Our renovation of 18.05 continues under a grant from the Davis Education Foundation (PI Haynes Miller), with presentations to the AMS Committee on Education and the HHMI / MIT Biology Education Group. The full course will be featured in OCW Educator and available on OpenCourseWare in Summer 2014. We also ran a 4-day statistics education workshop for local professors in Port-au-Prince, Haiti in March 2014.

Co-Instructor

- Intro. to Probability and Statistics (18.05) with Jeremy Orloff — Spring 2014
  `http://web.mit.edu/jorloff/www/18.05/` — Spring 2013

Recitation Instructor

- Intro. to Probability and Statistics (18.05, 2 sections), Jeremy Orloff — Spring 2012
- Differential Equations (18.03, 2 sections), David Jerison — Spring 2011

Columbia University, New York, New York

Instructor

- Knots and Dynamics, original undergraduate research seminar — Fall 2009
  `http://math.mit.edu/~jbloom/knotdyn.html`
- Calculus IV, multivariable and vector calculus — Summer 2008

Teaching Assistant

- Modern Algebra II, Dave Bayer — Fall 2009
- Calculus III, Aaron Lauda — Fall 2009
- Fixed-point Floer Homology REU, Robert Lipshitz and Tim Perutz — Summer 2009

- Algebraic Topology I (graduate), Tim Perutz — Fall 2008
- Modern Geometry II (graduate), Michael Thaddeus — Spring 2008
- Modern Geometry I (graduate), Michael Thaddeus — Fall 2007

Harvard University, Cambridge, Massachusetts

Instructor

- Calculus II (Math Xb, two classes) — Spring 2006
- Calculus I (Math Xa) — Fall 2005

Teaching Assistant

- Theory and Practice of Teaching Number Theory, John Boller — Summer 2003
- Linear Algebra and Multivariable Calculus (Math 23a), John Boller — Fall 2001

Mater Spei College, Francistown, Botswana — Summer 2004

Taught algebra and geometry in English at a secondary school.

Colegio Franco-Inglés, Viña del Mar, Chile — Summer 2002

Taught math and English, in Spanish and English, at a secondary school.

Ross Mathematics Program, Columbus, Ohio — Summer 2001

Mentored high school students in a challenging number theory program.

Public Workshops

Knots for novices. 2012 Cambridge Science Festival, MIT Museum of Science — April 22, 2012
It's knot (all) theory! MIT150: Under the Dome, MIT — May 8, 2011
No loose ends. 2011 Cambridge Science Festival, MIT Museum of Science — April 30, 2011

Consultant

Law and Order SVU, *Hothouse* (Episode 1012) — December 5, 2008
Created math visuals and coached actor playing math prodigy/murder suspect in NBC drama.
Clip available at: `http://math.mit.edu/~jbloom/blackboards.mov`

Invited Talks

HHMI Education Group Seminar, MIT — April 7, 2014
MIT-Haiti Initiative, Statistics Education Workshop, Port-au-Prince — March 24-27, 2014
Topological Data Analysis talk to Broad Institute study group — March 7, 2014
Caltech/UCLA/USC Joint Topology Seminar — February 24, 2014
Altshuler group meeting, Broad Institute (with Amit Mijithia) — January 27, 2014
Joint Meetings of the American Mathematical Society — January 18, 2014
MIT Symplectic Coffee Seminar — April 18, 2013
Workshop 13w5037, Banff International Research Station — March 26, 2013
UC Berkeley Topology Seminar — November 21, 2012
Contact and Symplectic Geometry Summer School, Budapest — July 13, 2012
Nineteenth Gökova Geometry / Topology Conference — May 28 and June 1, 2012
Princeton Topology Seminar — October 25 and 27, 2011
Notre Dame Felix Klein Seminar — October 13, 2011
Michigan State Topology Seminar — October 10, 2011
Harvard Gauge Theory and Topology Seminar — September 16, 2011
MIT Geometry and Topology Seminar — September 12, 2011
AMS 2011 Fall Eastern Sectional Meeting, Cornell University — September 10, 2011

	MIT QFT Seminar	August 2, 2011
	USC Geometry and Topology Seminar	March 7, 2011
	Dartmouth Geometry and Topology Seminar	January 11, 2011
	Moscow State Knots and Representation Theory Seminar	December 14, 2010
	MSRI Graduate Seminar	April 16 and 23, 2010
	UCLA Geometry Seminar	March 5, 2010
	Distinguished Student Talk, Knots in Washington XXIX	December 6, 2009
	MIT Geometry and Topology Seminar	November 23, 2009
	Boston College Geometry and Topology Seminar	November 19, 2009
	Ohio State Topology Seminar	November 9, 2009
	UT Austin Geometry Seminar	November 5, 2009
	Princeton Topology Seminar	October 29, 2009
	Columbia Undergraduate Math Society Seminar	October 21, 2009
	Columbia Geometric Topology Seminar	January 30, 2009
	Harvard Undergraduate Mathematics Colloquium *This talk earned the Robert Fletcher Rogers Prize.*	April 27, 2004

Conferences and Workshops

MIT-Haiti Initiative, co-organizer of Statistics Education Workshop Port-au-Prince, Haiti	March 24-27, 2014
Joint Meetings of the American Mathematical Society Baltimore, Maryland	January 15-18, 2014
AMS Short Course: Geometry and Topology in Statistical Inference Baltimore, Maryland	January 13-14, 2014
BIRS Workshop 13w5037 Banff International Research Station, Alberta, Canada	March 24-29, 2013
Contact and Symplectic Geometry Summer School and Conference Alfrd Rényi Institute of Mathematics, Budapest, Hungary	July 9-20, 2012
Nineteenth Gökova Geometry / Topology Conference Gökova, Turkey	May 28 - June 2, 2012
AMS 2011 Fall Eastern Sectional Meeting Cornell University, Ithaca, NY	September 10-11, 2011
Homological Invariants in Low-Dimensional Topology Workshop Simons Center for Geometry and Physics, Stony Brook, NY	June 13-16, 2011
Geometric and Algebraic Structures in Mathematics Simons Center for Geometry and Physics, Stony Brook, NY	May 26-29, 2011
William Rowan Hamilton Geometry and Topology Workshop Trinity College, Dublin, Ireland	September 2-4, 2010
Workshop on Symplectic Geometry and Mirror Symmetry Massachusetts Institute of Technology, Cambridge, MA	July 19-23, 2010
Low-Dimensional Topology and Categorification State University of New York, Stony Brook, NY	June 21-25, 2010
Homology Theories of Knots and Links Mathematical Sciences Research Institute, Berkeley, CA	January - May, 2010
AMS Joint Mathematics Meetings 2010 San Francisco, CA	January 13-16, 2010
Knots in Washington XXIX George Washington University, Washington D.C.	December 4-6 2009

Georgia International Topology Conference University of Georgia, Athens, GA	May 18-29, 2009
Holomorphic Curves: Algebraic Structures and Geometric Applications Stanford University, Palo Alto, CA	August 18-29, 2008
Low Dimensional Topology Mathematical Sciences Research Institute, Berkeley, CA	August 11-15, 2008
XVI Oporto Meeting on Geometry, Topology, and Physics Universidade do Algarve, Faro, Portugal	July 5-8, 2007
New Perspectives and Challenges in Symplectic Field Theory Stanford University, Palo Alto, CA	June 25-29, 2007
Georgia Topology Conference University of Georgia, Athens, GA	May 14-18, 2007
Park City Mathematics Institute: Low Dimensional Topology Park City, UT	June 25 - July 15, 2006