Yi Sun

Contact Information

Address: Department of Mathematics, Columbia University, New York, NY 10027.
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Research Integrable probability, random matrix theory, machine learning, representation theory.

Employment

Columbia University New York, NY
Joseph F. Ritt Assistant Professor (2019–present), Simons Fellow (2016–2019).

Education

Massachusetts Institute of Technology Cambridge, MA
Ph.D., Mathematics (2011–2016), advised by Pavel Etingof.

University of Cambridge Cambridge, UK
M.A.St., Mathematics, with distinction (2010–2011).

Harvard University Cambridge, MA
A.M., Mathematics (2006–2010).
A.B., Mathematics, *magna cum laude*, with secondary field in Economics (2006–2010).
Phi Beta Kappa (one of 24 juniors inducted)

Grants Fellowships and Awards

NSF Grant DMS-1701654, Alg. and NT, 2017–2020. ($141,999, Highly Recommended)
Simons Junior Fellowship, 2016–2019. ($364,214)
Open Philanthropy Project Grant, 2019. ($10,000, co-PI)
NSF Mathematical Sciences Postdoctoral Research Fellowship, 2016–2019 (declined).
Johnson Prize for best research paper by MIT graduate student in mathematics, 2016.
NSF Graduate Research Fellowship, 2012–2015.
Churchill Scholarship, 2010–2011. / MIT Praecis Presidential Fellowship, 2011–2012.
COMAP Math Contest in Modeling, Outstanding Winner, SIAM Prize, 2008 and 2009.
Intel Science Talent Search, 2$^{\text{nd}}$ Place, 2006. / Putnam Competition, 10$^{\text{th}}$ Place, 2009.
Int'l Math Olym., Silver Medal, 2006. / Asian Pacific Math Olym., Gold Medal, 2005.
Int'l Physics Olympiad, Gold Medal, 2004. / USA Computing Olympiad, Finalist, 2005.

Mathematics Research

18. *Probabilistic conformal blocks for Liouville CFT on the torus* (with P. Ghosal, G. Remy, and X. Sun), preprint, 2020. arXiv:2003.03802
17. *Principal components in linear mixed models with general bulk* (with Z. Fan and Z. Wang), submitted, 2019. arXiv:1903.09592
16. *Gaussian fluctuations for products of random matrices* (with V. Gorin), submitted, 2019. arXiv:1812.06532
15. *Spiked covariances and principal components analysis in high-dimensional random effects models* (with Z. Fan and I. Johnstone), preprint, 2018. arXiv:1806.09529
14. *Affine Macdonald conjectures and special values of Felder-Varchenko functions* (with E. Rains and A. Varchenko), Sel. Math. N. S. **24** (2018), 1549–1591. arXiv:1610.01917
13. *Laguerre and Jacobi analogues of the Warren process* (single author, with an appendix by A. Sarantsev), submitted, 2017. arXiv:1610.01635
12. *Traces of intertwiners for quantum affine algebras and difference equations (after Etingof-Schiffmann-Varchenko)* (single author), Transform. Groups **23** (2018), 1167–1215. arXiv:1609.09038
11. *Matrix models for multilevel Heckman-Opdam and multivariate Bessel measures* (single author), submitted, 2016. arXiv:1609.09096
10. *Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions* (single author), Commun. Math. Phys. **347** (2016), 573-653. arXiv:1508.03918
9. *The polynomial representation of the type A_{n-1} rational Cherednik algebra in characteristic $p \mid n$* (with S. Devadas), Commun. Algebra **45** (2016), 1926-1934. arXiv:1505.07891
8. *A representation-theoretic proof of the branching rule for Macdonald polynomials* (single author), Math. Res. Lett. **23** (2016), 887–927. arXiv:1412.0714

7. *A new integral formula for Heckman-Opdam hypergeometric functions* (single author), Adv. Math. **289** (2016), 1157–1204. `arXiv:1406.3772`
6. *Finite dimensional representations of the rational Cherednik algebra for G_4* (single author), J. Algebra **323** (2010), 2864–2887. `arXiv:0910.5527`

Computer Science Research

5. D. Kang*, Y. Sun*, D. Hendrycks, T. Brown, and J. Steinhardt, *Testing robustness against unforeseen adversaries*, submitted, 2019. `arXiv:1908.08016`
4. T. Hashimoto, Y. Sun, and T. Jaakkola, *From random walks to distances on unweighted graphs*, NIPS 2015. `arXiv:1511.00573`
3. T. Hashimoto, Y. Sun, and T. Jaakkola, *Metric recovery from directed unweighted graphs*, NIPS 2014 workshop (Best Student Paper), AISTATS 2015. `arXiv:1411.5720`
2. Y. Sun and M. Sundararajan, *Axiomatic attribution for multilinear functions*, ACM Conf. on Electronic Commerce 2011. `arXiv:1102.0989`

Other Research

1. R. G. Yang*, P. Y. Wang*, Y. Sun, A. Litwin-Kumar, R. Axel, and LF Abbott, *Evolving the olfactory system*, submitted, 2019. CCN 2019, NeurIPS 2019 Neuro+AI Workshop.

Research Presentations

46. Google X — March 2020
Testing robustness against unforeseen adversaries
45. UW Madison: Mathematics Colloquium — February 2020
Fluctuations for products of random matrices
44. UChicago: Statistics Colloquium — January 2020
Fluctuations for products of random matrices
43. AMS Fall Western Sectional Meeting — November 2019
Fluctuations for products of random matrices
42. ICML 2019 Workshop: Uncertainty and Robustness in DL (poster) — June 2019
Transfer of robustness against adversarial and stochastic distortions
41. OpenAI — June 2019
Transfer of robustness against adversarial and stochastic distortions
40. Virginia: Integrable Probability Summer School — June 2019
Fluctuations for products of random matrices
39. UCSD: Probability Seminar — January 2019
Fluctuations for products of random matrices
38. Yale: Geometry, Symmetry, and Physics Seminar — April 2018
Affine Macdonald conjectures and special values of Felder-Varchenko functions
37. Simons Society of Fellows Retreat — February 2018
A probabilistic view on random covariance matrices
36. PCMI: Research Program on Random Matrices — July 2017
Algebraic structures for multilevel eigenvalue densities
35. Rochester: Probability Seminar — April 2017
Laguerre and Jacobi analogues of the Warren process
34. Perimeter Institute: Mathematical Physics Seminar — April 2017
Affine Macdonald conjectures and special values of Felder-Varchenko functions
33. Rutgers: Lie Group / Quantum Mathematics Seminar — April 2017
Affine Macdonald conjectures and special values of Felder-Varchenko functions
32. Columbia-Princeton Probability Day — March 2017
Laguerre and Jacobi analogues of the Warren process
31. ESI: Workshop on Elliptic Hypergeometric Functions — March 2017
Affine Macdonald conjectures and special values of Felder-Varchenko functions
30. Columbia: Probability Seminar — November 2016
Laguerre and Jacobi analogues of the Warren process

29. Columbia: Mathematical Physics Seminar — October 2016
Affine Macdonald conjectures and special values of Felder-Varchenko functions
28. IESC: QIS's, CFT's, and Stochastic Processes (poster) — September 2016
Laguerre and Jacobi analogues of the Warren process
27. MIT: Infinite-Dimensional Algebra Seminar — March 2016
Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions
26. MIT: Integrable Probability Seminar — February 2016
Laguerre and Jacobi analogues of the Warren process
25. HCM: Asymptotic Analysis in Strongly Coupled Systems (poster) — January 2016
Laguerre and Jacobi analogues of the Warren process
24. NIPS 2015 (poster) — December 2015
From random walks to distances on unweighted graphs
23. ETH Zurich: ITS Talks in Theoretical Sciences 2015 — November 2015
Random matrices and representation theory
22. UC Berkeley: RTGC Seminar — November 2015
Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions
21. ETH Zurich: Mathematical Physics Seminar — October 2015
Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions
20. NEU: Geometry, Physics and Representation Theory Seminar — October 2015
Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions
19. Columbia: Mathematical Physics Seminar — October 2015
Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions
18. Yale: Geometry, Symmetry, and Physics Seminar — September 2015
Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions
17. FPSAC 2015 (poster) — July 2015
A representation-theoretic proof of the branching rule for Macdonald polynomials
16. Clay Math Inst.: Random Polymers and Algebraic Combinatorics — May 2015
A representation-theoretic proof of the branching rule for Macdonald polynomials
15. AISTATS 2015 (poster) — May 2015
Metric recovery from directed unweighted graphs
14. ICERM: Workshop on Limit Shapes (poster) — April 2015
A representation-theoretic proof of the branching rule for Macdonald polynomials
13. NIPS 2014: Workshop on Networks (poster) — December 2014
Metric recovery from directed unweighted graphs
12. UC Berkeley: GRASP Seminar — November 2014
A representation-theoretic proof of the branching rule for Macdonald polynomials
11. IHP: Workshop on Macdonald Processes and Hecke Algebras — May 2014
A new integral formula for Heckman-Opdam hypergeometric functions
10. MIT: Integrable Probability Seminar — April 2014
A new integral formula for Heckman-Opdam hypergeometric functions

Outreach Presentations

9. Math Olympiad Program 2018 — June 2018
Threshold signatures
8. MIT "Meta-Math" Meetup 2017 — May 2017
How to do a Literature Search
7. Summer Program in Applied Rationality and Cognition 2016 — August 2016
Problem Solving: Contests vs. Real Life
6. Math Olympiad Summer Program 2016 — June 2016
Distribution Testing: Is this die fair?
5. MIT Open House 2016 — April 2016
Universality: Mathematics in the real world

4. Math Olympiad Summer Program 2015 — June 2015
   Fair coin flips from unfair coins
3. Math Olympiad Summer Program 2014 — June 2014
   The Ising model
2. Math Olympiad Summer Program 2013 — June 2013
   Random matrices
1. Math Olympiad Summer Program 2012 — June 2012
   Random partitions and Fock space

Other Publications

6. 54^{th} *International Mathematical Olympiad* (with J. Berman and Z. Feng), Mathematics Magazine **86** (2013), 309–313.
5. 53^{nd} *International Mathematical Olympiad* (with Z. Feng), Mathematics Magazine **85** (2012), 312–317.
4. 52^{nd} *International Mathematical Olympiad* (with Z. Feng), Mathematics Magazine **84** (2011), 316–319.
3. 51^{st} *International Mathematical Olympiad* (with Z. Feng and P. Loh), Mathematics Magazine **83** (2010), 320–323.
2. *A simulation based model of traffic circles* (with C. Chang and Z. Fan), The UMAP Journal **30** (2009), 225–244.
1. *`hsolve`: A difficulty metric and puzzle generator for Sudoku* (with C. Chang and Z. Fan), The UMAP Journal **29** (2008), 303–324.

Teaching

Columbia University — Fall 2017-2020
Instructor. Fall 2017: Calculus II, eval 3.9 (5.0). Spring 2019: Graduate reading course on representation theory. Fall 2019: Calculus II, eval 3.7 (5.0). Spring 2020: Calculus II.

US National Math Olympiad Summer Program — Summers 2007–2018
Instructor (2010, 2012–2018); Assistant (2007–2009). Design curriculum, give lectures, and personally coach US team to International Mathematical Olympiad.

MIT MathROOTS — Summers 2015–2016
Academic Coordinator. Design curriculum, give lectures, and manage academic team, guest lectures, and website for first two years of outreach program in problem solving for underrepresented minority students. Covered on MIT homepage and Notices of the AMS.

MIT Undergraduate Research Opportunities Program — Fall 2012–2015
Mentor two undergraduate research projects, leading to published research paper.

- Sheela Devadas (rational Cherednik algebras in char $p \leq n$), 2014–2015.
- Ryan Yoo (characters of rational Cherednik algebras in char $p > n$), 2012–2014.

Massachusetts Institute of Technology — Spring 2015
Teaching Assistant for Differential Equations. Evaluations: 6.2 (7.0)

MIT Directed Reading Program — January 2011
Mentor reading project on representation theory of the symmetric group.

Harvard University — Spring 2009
Course Assistant for Probability Theory. Evaluations: 4.3 (5.0)

Professional Activities

Columbia Probability Seminar — Fall 2016–Present
Co-organize weekly probability seminar.

Summer School in Probability — Summer 2017
Co-organize graduate summer school "Dyson-Schwinger equations, topological expansions, and random matrices" at Columbia.

MIT Interacting Particle Systems Learning Seminar — 2012–2013
Organize learning seminar on recent developments in interacting particle systems.

Google Research — Summer 2010
Research intern. Research attribution and cost-sharing methods, leading to paper published in EC 2010. Mentor: Mukund Sundararajan

Service	Reviewer: Probability Theory and Related Fields, Selecta Mathematica (N.S.), SIGMA, Journal of Theoretical Probability, Europhysics Letters, Information and Inference.
	Qualifying Exam Committee: Ivan Danilenko (Columbia), Maithreya Sitaraman (Columbia)
Languages	Python, PyTorch, C++, LaTeX, Magma, Mathematica / Mandarin (native), French

Last updated: March 10, 2020.