Yi Sun

CONTACT INFORMATION

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RESEARCH

Probability and applications to machine learning and high-dimensional statistics.

EMPLOYMENT

The University of Chicago Chicago, IL
Assistant Professor (tenure-track), 2020–present.

Columbia University New York, NY
Joseph F. Ritt Assistant Professor, 2019–2020; Simons Fellow, 2016–2019.

EDUCATION

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

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-2054838, 2021–2024. ($238,603, Highly Recommended)
NSF Grant DMS-1701654/2039183, 2017–2021. ($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, 2nd Place, 2006. / Putnam Competition, 10th 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 AND STATISTICS RESEARCH

22. *Maximum likelihood for high-noise group orbit estimation and single-particle cryo-EM* (with Z. Fan, R. Lederman, T. Wang, and S. Xu), submitted, 2021. arXiv:2107.01305
21. *Likelihood landscape and maximum likelihood estimation for the discrete orbit recovery model* (with Z. Fan, T. Wang, and Y. Wu), Comm. Pure Appl. Math., to appear. arXiv:2004:00041
20. *Probabilistic conformal blocks for Liouville CFT on the torus* (with P. Ghosal, G. Remy, and X. Sun), submitted, 2020. arXiv:2003.03802
19. *Principal components in linear mixed models with general bulk* (with Z. Fan and Z. Wang), Ann. Stat. **49** (2021), 1489-1513. arXiv:1903.09592
18. *Gaussian fluctuations for products of random matrices* (with V. Gorin), Amer. J. Math, to appear. arXiv:1812.06532
17. *Spiked covariances and principal components analysis in high-dimensional random effects models* (with Z. Fan and I. Johnstone), preprint, 2018. arXiv:1806.09529
16. *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
15. *Laguerre and Jacobi analogues of the Warren process* (single author, with an appendix by A. Sarantsev), submitted, 2017. arXiv:1610.01635
14. *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
13. *Matrix models for multilevel Heckman-Opdam and multivariate Bessel measures* (single

author), submitted, 2016. arXiv:1609.09096

12. *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
11. *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
10. *A representation-theoretic proof of the branching rule for Macdonald polynomials* (single author), Math. Res. Lett. **23** (2016), 887–927. arXiv:1412.0714
9. *A new integral formula for Heckman-Opdam hypergeometric functions* (single author), Adv. Math. **289** (2016), 1157–1204. arXiv:1406.3772
8. *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

7. B. Hanin* and Y. Sun*, *How data augmentation affects optimization for linear regression*, NeurIPS 2021. DeepMath 2020, OPT 2020. arXiv:2010.11171
6. D. Kang*, J. Guibas*, P. Bailis, T. Hashimoto, Y. Sun, and M. Zaharia, *Accelerating Approximate Aggregation Queries with Expensive Predicates*, VLDB 2021. arXiv:2108.06313
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. P. Y. Wang, Y. Sun, R. Axel, LF Abbott, and R. G. Yang, *Evolving the olfactory system with machine learning*, Neuron, in press, 2021. CCN 2019, NeurIPS 2019 Neuro+AI Workshop.

RESEARCH PRESENTATIONS

55. Princeton: Wilks Statistics Seminar — October 2021
Maximum likelihood for high-noise group orbit estimation and single-particle cryo-EM
54. Luminy: Modern analysis related to root systems with applications — October 2021
Gaussian fluctuations for products of random matrices
53. Simons Society of Fellows Alumni Symposium — October 2021
Maximum likelihood for high-noise group orbit estimation and single particle cryo-electron microscopy
52. Online conference on Integrability in Conformal Probability — October 2021
Probabilistic construction of conformal blocks for Liouville CFT on the torus
51. UChicago: Statistics Consulting Seminar — February 2021
Learning under a group action and the orbit recovery problem
50. UChicago: Probability Seminar — February 2021
Probabilistic conformal blocks for Liouville CFT on the torus
49. NeurIPS 2020 Workshop: OPT 2020 — December 2020
Data augmentation as stochastic optimization (poster)
48. DeepMath 2020 — November 2020
Data augmentation as stochastic optimization
47. Bernoulli-IMS One World Symposium — August 2020
Likelihood landscape and maximum likelihood estimation for the discrete orbit recovery model
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

University of Chicago 2020–present
Instructor for: Introduction to Mathematical Probability (2020), Topics in Deep Learning: Discriminative Models (2021), Statistical Theory and Methods I (2021).

Columbia University 2017–2020
Instructor for: Calculus II (2017), Graduate reading course on representation theory (2019), Calculus II (2019), Calculus II (2020).

Cyberspace Mathematical Competition Summer 2020
Problem Captain. Manage grading team for one of 8 problems for first year of international online math competition.

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 2016–2020
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

Reviewing: Communications in Mathematical Physics, Probability Theory and Related Fields, Selecta Mathematica (N.S.), SIGMA, Journal of Theoretical Probability, Europhysics Letters, Information and Inference, Algebraic Combinatorics, OPT 2021.

Qualifying Exam Committee: Ivan Danilenko (Columbia), Maithreya Sitaraman (Columbia)

Dissertation Committee: Qing Yan (UChicago)

Languages

Python, PyTorch, C++, LaTeX, Magma, Mathematica / Mandarin (native), French

Last updated: October 7, 2021.