

# Yi Sun

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| CONTACT INFORMATION                 | Address: Department of Statistics, The University of Chicago, Chicago, IL 60637.<br>Email: <a href="mailto:yisun@statistics.uchicago.edu">yisun@statistics.uchicago.edu</a><br>Webpage: <a href="http://yisun.io">yisun.io</a>  |
| RESEARCH                            | Probability and applications to machine learning and high-dimensional statistics.   |
| EMPLOYMENT                          | <b>The University of Chicago</b> Chicago, IL<br>Assistant Professor (tenure-track), 2020–present.<br><b>Columbia University</b> New York, NY<br>Joseph F. Ritt Assistant Professor, 2019–2020; Simons Fellow, 2016–2019.  |
| EDUCATION                           | <b>Massachusetts Institute of Technology</b> Cambridge, MA<br>Ph.D., Mathematics, advised by Pavel Etingof, 2011–2016.<br><b>University of Cambridge</b> Cambridge, UK<br>M.A.St., Mathematics, with distinction, 2010–2011.<br><b>Harvard University</b> Cambridge, MA<br>A.M., Mathematics, 2006–2010.<br>A.B., Mathematics, <i>magna cum laude</i> , with secondary field in Economics, 2006–2010.<br>Phi Beta Kappa (one of 24 juniors inducted)  |
| GRANTS                              | NSF Grant DMS-2054838, 2021–2024. (\$238,603, Highly Recommended)   |
| FELLOWSHIPS                         | NSF Grant DMS-1701654/2039183, 2017–2021. (\$141,999, Highly Recommended)   |
| AND AWARDS                          | Simons Junior Fellowship, 2016–2019. (\$364,214)<br>Open Philanthropy Project Grant, 2019. (\$10,000, co-PI)<br>NSF Mathematical Sciences Postdoctoral Research Fellowship, 2016–2019 (declined).<br>Johnson Prize for best research paper by MIT graduate student in mathematics, 2016.<br>NSF Graduate Research Fellowship, 2012–2015.<br>Churchill Scholarship, 2010–2011. / MIT Praecis Presidential Fellowship, 2011–2012.<br>COMAP Math Contest in Modeling, Outstanding Winner, SIAM Prize, 2008 and 2009.<br>Intel Science Talent Search, 2 <sup>nd</sup> Place, 2006. / Putnam Competition, 10 <sup>th</sup> Place, 2009.<br>Int’l Math Olym., Silver Medal, 2006. / Asian Pacific Math Olym., Gold Medal, 2005.<br>Int’l Physics Olympiad, Gold Medal, 2004. / USA Computing Olympiad, Finalist, 2005.  |
| MATHEMATICS AND STATISTICS RESEARCH | 20. <i>Likelihood landscape and maximum likelihood estimation for the discrete orbit recovery model</i> (with Z. Fan, T. Wang, and Y. Wu), submitted, 2020. <a href="https://arxiv.org/abs/2004.00041">arXiv:2004.00041</a><br>19. <i>Probabilistic conformal blocks for Liouville CFT on the torus</i> (with P. Ghosal, G. Remy, and X. Sun), submitted, 2020. <a href="https://arxiv.org/abs/2003.03802">arXiv:2003.03802</a><br>18. <i>Principal components in linear mixed models with general bulk</i> (with Z. Fan and Z. Wang), Ann. Stat., to appear. <a href="https://arxiv.org/abs/1903.09592">arXiv:1903.09592</a><br>17. <i>Gaussian fluctuations for products of random matrices</i> (with V. Gorin), Amer. J. Math, to appear. <a href="https://arxiv.org/abs/1812.06532">arXiv:1812.06532</a><br>16. <i>Spiked covariances and principal components analysis in high-dimensional random effects models</i> (with Z. Fan and I. Johnstone), preprint, 2018. <a href="https://arxiv.org/abs/1806.09529">arXiv:1806.09529</a><br>15. <i>Affine Macdonald conjectures and special values of Felder-Varchenko functions</i> (with E. Rains and A. Varchenko), Sel. Math. N. S. <b>24</b> (2018), 1549–1591. <a href="https://arxiv.org/abs/1610.01917">arXiv:1610.01917</a><br>14. <i>Laguerre and Jacobi analogues of the Warren process</i> (single author, with an appendix by A. Sarantsev), submitted, 2017. <a href="https://arxiv.org/abs/1610.01635">arXiv:1610.01635</a><br>13. <i>Traces of intertwiners for quantum affine algebras and difference equations (after Etingof-Schiffmann-Varchenko)</i> (single author), Transform. Groups <b>23</b> (2018), 1167–1215. <a href="https://arxiv.org/abs/1609.09038">arXiv:1609.09038</a><br>12. <i>Matrix models for multilevel Heckman-Opdam and multivariate Bessel measures</i> (single author), submitted, 2016. <a href="https://arxiv.org/abs/1609.09096">arXiv:1609.09096</a><br>11. <i>Traces of intertwiners for quantum affine <math>\mathfrak{sl}_2</math> and Felder-Varchenko functions</i> (single author), Commun. Math. Phys. <b>347</b> (2016), 573–653. <a href="https://arxiv.org/abs/1508.03918">arXiv:1508.03918</a> |

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| COMPUTER<br>SCIENCE<br>RESEARCH | 10. | <i>The polynomial representation of the type <math>A_{n-1}</math> rational Cherednik algebra in characteristic <math>p \mid n</math></i> (with S. Devadas), Commun. Algebra <b>45</b> (2016), 1926-1934. <a href="#">arXiv:1505.07891</a> |               |
|                                 | 9.  | <i>A representation-theoretic proof of the branching rule for Macdonald polynomials</i> (single author), Math. Res. Lett. <b>23</b> (2016), 887-927. <a href="#">arXiv:1412.0714</a>  |               |
|                                 | 8.  | <i>A new integral formula for Heckman-Opdam hypergeometric functions</i> (single author), Adv. Math. <b>289</b> (2016), 1157-1204. <a href="#">arXiv:1406.3772</a>  |               |
|                                 | 7.  | <i>Finite dimensional representations of the rational Cherednik algebra for <math>G_4</math></i> (single author), J. Algebra <b>323</b> (2010), 2864-2887. <a href="#">arXiv:0910.5527</a>  |               |
|                                 | 6.  | B. Hanin* and Y. Sun*, <i>Data augmentation as stochastic optimization</i> , submitted, 2020. DeepMath 2020, OPT 2020. <a href="#">arXiv:2010.11171</a>   |               |
|                                 | 5.  | D. Kang*, Y. Sun*, D. Hendrycks, T. Brown, and J. Steinhardt, <i>Testing robustness against unforeseen adversaries</i> , submitted, 2019. <a href="#">arXiv:1908.08016</a>  |               |
|                                 | 4.  | T. Hashimoto, Y. Sun, and T. Jaakkola, <i>From random walks to distances on unweighted graphs</i> , NIPS 2015. <a href="#">arXiv:1511.00573</a>   |               |
|                                 | 3.  | T. Hashimoto, Y. Sun, and T. Jaakkola, <i>Metric recovery from directed unweighted graphs</i> , NIPS 2014 workshop (Best Student Paper), AISTATS 2015. <a href="#">arXiv:1411.5720</a>  |               |
|                                 | 2.  | Y. Sun and M. Sundararajan, <i>Axiomatic attribution for multilinear functions</i> , ACM Conf. on Electronic Commerce 2011. <a href="#">arXiv:1102.0989</a>   |               |
|                                 | 1.  | R. G. Yang*, P. Y. Wang*, Y. Sun, A. Litwin-Kumar, R. Axel, and LF Abbott, <i>Evolving the olfactory system</i> , submitted, 2019. CCN 2019, NeurIPS 2019 Neuro+AI Workshop.  |               |
| OTHER<br>RESEARCH               | 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  |               |
| RESEARCH<br>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

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|               | 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      | 9. Math Olympiad Program 2018   | June 2018         |
| PRESENTATIONS | 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         | 6. <i>54<sup>th</sup> International Mathematical Olympiad</i> (with J. Berman and Z. Feng), Mathematics Magazine <b>86</b> (2013), 309–313.                 |                   |
| PUBLICATIONS  | 5. <i>53<sup>rd</sup> International Mathematical Olympiad</i> (with Z. Feng), Mathematics Magazine <b>85</b> (2012), 312–317.                               |                   |
|               | 4. <i>52<sup>nd</sup> International Mathematical Olympiad</i> (with Z. Feng), Mathematics Magazine <b>84</b> (2011), 316–319.                               |                   |
|               | 3. <i>51<sup>st</sup> International Mathematical Olympiad</i> (with Z. Feng and P. Loh), Mathematics Magazine <b>83</b> (2010), 320–323.                    |                   |
|               | 2. <i>A simulation based model of traffic circles</i> (with C. Chang and Z. Fan), The UMAP Journal <b>30</b> (2009), 225–244.                               |                   |
|               | 1. <i>hsolve: A difficulty metric and puzzle generator for Sudoku</i> (with C. Chang and Z. Fan), The UMAP Journal <b>29</b> (2008), 303–324.               |                   |
| TEACHING      | <b>University of Chicago</b>  | 2020–present      |
|               | Instructor. Autumn 2020: Introduction to Mathematical Probability. Winter 2021: Topics in Deep Learning: Discriminative Models                              |                   |
|               | <b>Columbia University</b>  | 2017–2020         |
|               | Instructor. Fall 2017: Calculus II. Spring 2019: Graduate reading course on representation theory. Fall 2019: Calculus II. Spring 2020: Calculus II.        |                   |
|               | <b>Cyberspace Mathematical Competition</b>  | Summer 2020       |
|               | Problem Captain. Manage grading team for one of 8 problems for first year of international online math competition.   |                   |
|               | <b>US National Math Olympiad Summer Program</b>   | Summers 2007–2018 |
|               | Instructor (2010, 2012–2018); Assistant (2007–2009). Design curriculum, give lectures, and personally coach US team to International Mathematical Olympiad. |                   |
|               | <b>MIT MathROOTS</b>  | Summers 2015–2016 |

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|                            | 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. |
|                            | <b>MIT Undergraduate Research Opportunities Program</b> Fall 2012–2015   |
|                            | Mentor two undergraduate research projects, leading to published research paper.   |
|                            | <ul style="list-style-type: none"> <li>• Sheela Devadas (rational Cherednik algebras in char <math>p \leq n</math>), 2014–2015.</li> <li>• Ryan Yoo (characters of rational Cherednik algebras in char <math>p &gt; n</math>), 2012–2014.</li> </ul>             |
|                            | <b>Massachusetts Institute of Technology</b> Spring 2015   |
|                            | Teaching Assistant for Differential Equations. Evaluations: 6.2 (7.0)  |
|                            | <b>MIT Directed Reading Program</b> January 2011   |
|                            | Mentor reading project on representation theory of the symmetric group.  |
|                            | <b>Harvard University</b> Spring 2009  |
|                            | Course Assistant for Probability Theory. Evaluations: 4.3 (5.0)  |
| PROFESSIONAL<br>ACTIVITIES | <b>Columbia Probability Seminar</b> 2016–2020  |
|                            | Co-organize weekly probability seminar.  |
|                            | <b>Summer School in Probability</b> Summer 2017  |
|                            | Co-organize graduate summer school “Dyson-Schwinger equations, topological expansions, and random matrices” at Columbia.   |
|                            | <b>MIT Interacting Particle Systems Learning Seminar</b> 2012–2013   |
|                            | Organize learning seminar on recent developments in interacting particle systems.  |
|                            | <b>Google Research</b> 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, Algebraic Combinatorics.   |
|                            | Qualifying Exam Committee: Ivan Danilenko (Columbia), Maithreya Sitaraman (Columbia)   |
|                            | Dissertation Committee: Qing Yan (UChicago)  |
| LANGUAGES                  | Python, PyTorch, C++, L <sup>A</sup> T <sub>E</sub> X, Magma, Mathematica / Mandarin (native), French  |