

# Ankur Moitra

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CONTACT INFORMATION	Massachusetts Institute of Technology 77 Massachusetts Avenue Cambridge, MA 02139 USA	<i>Cell:</i> (607) 227-6851 <i>Offices:</i> 2-472 and 32-G594 <i>E-mail:</i> moitra@mit.edu <a href="http://people.csail.mit.edu/moitra/">http://people.csail.mit.edu/moitra/</a>
CITIZENSHIP	USA	
RESEARCH INTERESTS	theoretical computer science, machine learning	
APPOINTMENTS	University of California, Berkeley, Electrical Engineering and Computer Science <i>Chancellor's Professor</i> , Fall 2024 – present Massachusetts Institute of Technology, Department of Mathematics <i>Norbert Wiener Professor</i> , Summer 2021 – present <i>Associate Professor with Tenure</i> , Summer 2019 – Summer 2021 <i>Associate Professor</i> , Summer 2017 – Summer 2019 <i>Assistant Professor</i> , Fall 2013 – Summer 2017 Statistics and Data Science Center (SDSC) <i>Director</i> , Summer 2021 – present Computer Science and Artificial Intelligence Lab (CSAIL) <i>Principal Investigator</i> , Fall 2013 – present Institute for Advanced Study, School of Mathematics <i>NSF Computing and Innovation Fellow</i> , Fall 2011 – Summer 2013 Also: <i>Senior Postdoc</i> at Princeton University, Summer 2012 – Summer 2013	
EDUCATION	Massachusetts Institute of Technology, Electrical Engineering and Computer Science Ph.D. in Computer Science, June 2011 Thesis: <i>Vertex Sparsification and Universal Rounding Algorithms</i> Advisor: F. Thomson Leighton <b>Received the George M. Sprowls Thesis Award (best thesis)</b> Massachusetts Institute of Technology, Electrical Engineering and Computer Science S.M. in Computer Science, May 2009 Thesis: <i>A Solution to the Papadimitriou-Ratajczak Conjecture</i> Advisor: F. Thomson Leighton <b>Received the William A. Martin Memorial Thesis Award (best thesis)</b> Cornell University, Electrical and Computer Engineering B.S. <i>Summa Cum Laude</i> , May 2007 Class Rank in School of Engineering: 1 <sup>st</sup> of 714 Minor in Applied Mathematics	
HONORS AND AWARDS	Common Ground Award for Excellence in Teaching, 2024 QIP Invited Plenary, 2024 <b>AMS von Neumann Lecture</b> , 2024 Norbert Wiener Chair, 2021 – present	

Invited Paper (“Robustness Meets Algorithms”) in Communications of the ACM, Research Highlights, 2021

**School of Science Prize for Excellence in Graduate Teaching**, 2018

ONR Young Investigator Award, 2018

Rockwell International Chair, 2016 – 2019

**David and Lucile Packard Foundation Fellow**, 2016

Alfred P. Sloan Research Fellow, 2016

Edmund F. Kelly Research Award, 2015 – 2018

NSF CAREER Award, 2015

Invited Paper (“Learning Topic Models — Provably and Efficiently”) in Communications of the ACM, Research Highlights, 2015

Google Research Award, 2014

NSF Computing and Innovation Fellow, 2011 – 2013

George M. Sprowls Thesis Award, 2011

Invited Paper (“Disentangling Gaussians”) in Communications of the ACM, Research Highlights, 2011

William A. Martin Memorial Thesis Award, 2009

Siebel Scholar, Class of 2009

**Fannie and John Hertz Foundation Fellow**, 2008 – 2011

MIT Presidential Fellowship, 2007 – 2008

Barry M. Goldwater Scholar, 2006 – 2007

## PUBLICATIONS

A. Bakshi, A. Liu, A. Moitra, E. Tang. Structure Learning of Hamiltonians from Real-time Evolution. *Proceedings of the 65th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2024)*, to appear.

A. Bakshi, A. Liu, A. Moitra, E. Tang. High-Temperature Gibbs States are Unentangled and Efficiently Preparable. *Proceedings of the 65th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2024)*, to appear.

N. Golowich, A. Moitra, D. Rohatgi. Exploration is Harder than Prediction: Cryptographically Separating Reinforcement Learning from Supervised Learning. *Proceedings of the 65th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2024)*, to appear.

N. Golowich, A. Moitra. The Role of Inherent Bellman Error in Offline Reinforcement Learning with Linear Function Approximation. *Proceedings of the 1st Annual Reinforcement Learning Conference (RLC 2024)*, to appear.

N. Golowich, A. Moitra. Linear Bellman Completeness Suffices for Efficient Online Reinforcement Learning with Few Actions. *Proceedings of the 37th Annual Conference on Learning Theory (COLT 2024)*, pages 1939–1981.

B. Chin, A. Moitra. E. Mossel, C. Sandon. The Power of an Adversary in Glauber Dynamics. *Proceedings of the 37th Annual Conference on Learning Theory (COLT 2024)*, pages 1102–1124.

N. Golowich, A. Moitra, D. Rohatgi. Exploring and Learning in Sparse Linear MDPs without Computationally Intractable Oracles. *Proceedings of the 56th Annual ACM Symposium on Theory of Computing (STOC 2024)*, pages 183–193.

A. Bakshi, A. Liu, A. Moitra, E. Tang. Learning Quantum Hamiltonians at Any Temperature in Polynomial Time. *Proceedings of the 56th Annual ACM Symposium on Theory of Computing (STOC 2024)*, pages 1470–1477. **Invited to the SIAM Journal on Computing Special Issue.**

- C. Pabbaraju, D. Rohatgi, A. Sevekari, H. Lee, A. Moitra, A. Risteski. Provable Benefits of Score Matching. *Advances in Neural Information Processing Systems 36* (NeurIPS 2023). **Spotlight**.
- Z. Chen, K. Liu, N. Mani, A. Moitra. Strong Spatial Mixing for Colorings on Trees and its Algorithmic Applications. *Proceedings of the 64th Annual IEEE Symposium on Foundations of Computer Science* (FOCS 2023), pages 810–845.
- A. Bakshi, A. Liu, A. Moitra, M. Yau. Tensor Decompositions Meet Control Theory: Learning General Mixtures of Linear Dynamical Systems. *Proceedings of the 40th International Conference on Machine Learning* (ICML 2023), pages 1549–1563.
- A. Bakshi, A. Liu, A. Moitra, M. Yau. A New Approach to Learning Linear Dynamical Systems. *Proceedings of the 55th Annual ACM Symposium on Theory of Computing* (STOC 2023), pages 335–348.
- N. Golowich, A. Moitra, D. Rohatgi. Planning and Learning in Partially Observable Systems via Filter Stability. *Proceedings of the 55th Annual ACM Symposium on Theory of Computing* (STOC 2023), pages 349–362.
- S. Jain, H. Lawrence, A. Moitra, A. Madry. Distilling Model Failures as Directions in Latent Space. *Eleventh International Conference on Learning Representations* (ICLR 2023). **Spotlight**.
- A. Moitra, D. Rohatgi. Provably Auditing Ordinary Least Squares in Low Dimensions. *Eleventh International Conference on Learning Representations* (ICLR 2023).
- Z. Chen, N. Mani, A. Moitra. From Algorithms to Connectivity and Back: Finding a Giant Component in Random k-SAT. *Proceedings of the 34th Annual ACM-SIAM Symposium on Discrete Algorithms* (SODA 2023), pages 3437–3470.
- A. Liu, A. Moitra. Robust Voting Rules from Algorithmic Robust Statistics. *Proceedings of the 34th Annual ACM-SIAM Symposium on Discrete Algorithms* (SODA 2023), pages 3471–3512.
- N. Golowich, A. Moitra, D. Rohatgi. Learning in Observable POMDPs, without Computationally Intractable Oracles. *Advances in Neural Information Processing Systems 35* (NeurIPS 2022).
- J. Li, A. Liu, A. Moitra. Robust Model Selection and Nearly-Proper Learning for GMMs. *Advances in Neural Information Processing Systems 35* (NeurIPS 2022).
- D. Cifuentes, A. Moitra. Polynomial Time Guarantees for the Burer-Monteiro Method. *Advances in Neural Information Processing Systems 35* (NeurIPS 2022).
- A. Liu, A. Moitra. Minimax Rates for Robust Community Detection. *Proceedings of the 63rd Annual IEEE Symposium on Foundations of Computer Science* (FOCS 2022), pages 823–831.
- N. Golowich, A. Moitra. Can Q-Learning be Improved with Advice? *Proceedings of the 35th Annual Conference on Learning Theory* (COLT 2022), pages 4548–4619.
- A. Liu, A. Moitra. Learning GMMs with Nearly Optimal Robustness Guarantees. *Proceedings of the 35th Annual Conference on Learning Theory* (COLT 2022), pages 2815–2895.
- S. Chen, F. Koehler, A. Moitra, M. Yau. Kalman Filtering with Adversarial Corruptions. *Proceedings of the 54th Annual ACM Symposium on Theory of Computing* (STOC 2022), pages 832–845.

- L. Hamilton, A. Moitra. A No-go Theorem for Acceleration in the Hyperbolic Plane. *Advances in Neural Information Processing Systems 34* (NeurIPS 2021), pages 3914–3924.
- S. Chen, F. Koehler, A. Moitra, M. Yau. Online and Distribution-Free Robustness: Regression and Contextual Bandits with Huber Contamination. *Proceedings of the 62nd Annual IEEE Symposium on Foundations of Computer Science (FOCS 2021)*, pages 684–695.
- A. Moitra, E. Mossel, C. Sandon. Learning to Sample from Censored Markov Random Fields. *Proceedings of the 34th Annual Conference on Learning Theory (COLT 2021)*, pages 3419–3451.
- I. Diakonikolas, G. Kamath, D. Kane, J. Li, A. Moitra, A. Stewart. Robustness Meets Algorithms. *Communications of the ACM* May 2021, **Research Highlights**, pages 107–115.
- A. Liu, A. Moitra. Settling the Robust Learnability of Mixtures of Gaussians. *Proceedings of the 53rd Annual ACM Symposium on Theory of Computing (STOC 2021)*, pages 518–531.
- S. Chen, A. Moitra. Algorithmic Foundations for the Diffraction Limit. *Proceedings of the 53rd Annual ACM Symposium on Theory of Computing (STOC 2021)*, pages 490–503.
- S. Chen, F. Koehler, A. Moitra, M. Yau. Classification Under Misspecification: Half-spaces, Generalized Linear Models, and Connections to Evolvability. *Advances in Neural Information Processing Systems 33* (NeurIPS 2020). **Spotlight**.
- A. Liu, A. Moitra. Tensor Completion Made Practical. *Advances in Neural Information Processing Systems 33* (NeurIPS 2020).
- S. Chen, J. Li, A. Moitra. Learning Structured Distributions From Untrusted Batches: Faster and Simpler. *Advances in Neural Information Processing Systems 33* (NeurIPS 2020).
- J. Kelner, F. Koehler, R. Meka, A. Moitra. Learning Some Popular Gaussian Graphical Models without Condition Number Bounds. *Advances in Neural Information Processing Systems 33* (NeurIPS 2020). **Spotlight**.
- C. Franks, A. Moitra. Rigorous Guarantees for Tyler’s M-estimator via Quantum Expansion. *Proceedings of the 33rd Annual Conference on Learning Theory (COLT 2020)*, pages 1601–1632.
- A. Moitra, E. Mossel, C. Sandon. The Circuit Complexity of Inference. *Proceedings of the 33rd Annual Conference on Learning Theory (COLT 2020)*, pages 2910–2946.
- A. Liu, A. Moitra. Better Algorithms for Estimating Non-Parametric Models in Crowd-Sourcing and Rank Aggregation. *Proceedings of the 33rd Annual Conference on Learning Theory (COLT 2020)*, pages 2780–2829.
- S. Chen, J. Li, A. Moitra. Efficiently Learning Structured Distributions from Untrusted Batches. *Proceedings of the 52nd Annual ACM Symposium on Theory of Computing (STOC 2020)*, pages 960–973.
- A. Moitra, A. Wein. Spectral Methods from Tensor Networks. *Proceedings of the 51st Annual ACM Symposium on Theory of Computing (STOC 2019)*, pages 926–937. **Invited to the SIAM Journal on Computing Special Issue.**

- G. Bresler, F. Koehler, A. Moitra. Learning Restricted Boltzmann Machines via Influence Maximization. *Proceedings of the 51st Annual ACM Symposium on Theory of Computing* (STOC 2019), pages 828–839.
- S. Chen, A. Moitra. Beyond the Low-Degree Algorithm: Mixtures of Subcubes and Their Applications. *Proceedings of the 51st Annual ACM Symposium on Theory of Computing* (STOC 2019), pages 869–880.
- Y. Kim, F. Koehler, A. Moitra, E. Mossel, G. Ramnarayan. How Many Subpopulations is Too Many? Exponential Lower Bounds for Inferring Population Histories. *Proceedings of the 23rd International Conference on Research in Computational Molecular Biology* (RECOMB 2019), pages 136–157. **Invited to the Journal of Computational Biology Special Issue.**
- L. Hamilton, A. Moitra. The Paulsen Problem Made Simple. *Israel Journal of Mathematics*, to appear. *Proceedings of the 10th Annual Innovations in Theoretical Computer Science* (ITCS 2019), pages 1–6.
- S. Chen, M. Delcourt, A. Moitra, G. Perarnau, L. Postle. Improved Bounds for Sampling Colorings via Linear Programming. *Proceedings of the 30th Annual ACM-SIAM Symposium on Discrete Algorithms* (SODA 2019), pages 2216–2234.
- A. Liu, A. Moitra. Efficiently Learning Mixtures of Mallows Models. *Proceedings of the 59th Annual IEEE Symposium on Foundations of Computer Science* (FOCS 2018), pages 627–638.
- S. Arora, R. Ge, Y. Halpern, D. Mimno, A. Moitra, D. Sontag, Y. Wu, M. Zhu. Learning Topic Models — Provably and Efficiently. *Communications of the ACM* April 2018, **Research Highlights**, pages 85–93.
- A. Perry, A. Wein, A. Bandeira, A. Moitra. Optimality and Suboptimality of PCA I: Spiked Random Matrix Models. *Annals of Statistics* 46(5):2416–2451, 2018.
- I. Diakonikolas, G. Kamath, D. Kane, J. Li, A. Moitra, A. Stewart. Robustly Learning a Gaussian: Getting Optimal Error, Efficiently. *Proceedings of the 29th Annual ACM-SIAM Symposium on Discrete Algorithms* (SODA 2018), pages 2683–2702.
- L. Hamilton, F. Koehler, A. Moitra. Information Theoretic Properties of Markov Random Fields, and Their Algorithmic Applications. *Advances in Neural Information Processing Systems 30* (NIPS 2017), pages 2460–2469.
- A. Perry, A. Wein, A. Bandeira, A. Moitra. Message-passing Algorithms for Synchronization Problems over Compact Groups. *Communications on Pure and Applied Mathematics*, 11(71):2275–2322, 2018.
- J. Urschel, V. Brunel, A. Moitra, P. Rigollet. Learning Determinantal Point Processes with Moments and Cycles. *Proceedings of the 34th International Conference on Machine Learning* (ICML 2017), pages 3511–3520.
- I. Diakonikolas, G. Kamath, D. Kane, J. Li, A. Moitra, A. Stewart. Being Robust (in High Dimensions) Can Be Practical. *Proceedings of the 34th International Conference on Machine Learning* (ICML 2017), pages 999–1008.
- V. Brunel, A. Moitra, P. Rigollet, J. Urschel. Rates of Estimation for Determinantal Point Processes. *Proceedings of the 30th Annual Conference on Learning Theory* (COLT 2017), pages 343–345.

- A. Moitra. Approximate Counting, the Lovasz Local Lemma and Inference in Graphical Models. *Journal of the ACM*, 66(2):1–25, 2019. Preliminary version in *Proceedings of the 49th Annual ACM Symposium on Theory of Computing (STOC 2017)*, pages 356–369.
- B. Barak, S. Hopkins, J. Kelner, P. Kothari, A. Moitra, A. Potechin. A Nearly Tight Sum-of-Squares Lower Bound for the Planted Clique Problem. *SIAM Journal on Computing* **Special Issue** 48(2): 687-735, 2019. Preliminary version in *Proceedings of the 57th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2016)*, pages 428–437.
- I. Diakonikolas, G. Kamath, D. Kane, J. Li, A. Moitra, A. Stewart. Robust Estimators in High Dimensions without the Computational Intractability. *SIAM Journal on Computing* **Special Issue** 48(2): 742-864, 2019. Preliminary version in *Proceedings of the 57th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2016)*, pages 655–664.
- S. Arora, R. Ge, F. Koehler, T. Ma, A. Moitra. Provable Algorithms for Inference in Topic Models. *Proceedings of the 33rd International Conference on Machine Learning (ICML 2016)*, pages 2859–2867.
- A. Moitra, W. Perry, A. Wein. How Robust are Thresholds for Community Detection? *Proceedings of the 48th Annual ACM Symposium on Theory of Computing (STOC 2016)*, pages 828–841.
- B. Barak, A. Moitra. Noisy Tensor Completion via the Sum-of-Squares Hierarchy. *Proceedings of the 29th Annual Conference on Learning Theory (COLT 2016)*, pages 1–29. **Mathematical Programming, Series B Special Issue**, to appear.
- B. Barak, A. Moitra, R. O’Donnell, P. Raghavendra, O. Regev, D. Steurer, L. Trevisan, A. Vijayaraghavan, D. Witmer, J. Wright. Beating the Random Assignment on Constraint Satisfaction Problems of Bounded Degree. *19th International Workshop on Approximation, Randomization, and Combinatorial Optimization (APPROX 2015)*, pages 110–123.
- S. Arora, R. Ge, T. Ma, A. Moitra. Simple, Efficient and Neural Algorithms for Sparse Coding. *Proceedings of the 28th Annual Conference on Learning Theory (COLT 2015)*, pages 113–149.
- A. Moitra. Super-resolution, Extremal Functions and the Condition Number of Vandermonde Matrices. *Proceedings of the 47th Annual ACM Symposium on Theory of Computing (STOC 2015)*, pages 821–830.
- S. Arora, R. Ge, A. Moitra. New Algorithms for Learning Incoherent and Overcomplete Dictionaries. *Proceedings of the 27th Annual Conference on Learning Theory (COLT 2014)*, pages 779–806.
- A. Bhaskara, M. Charikar, A. Moitra, A. Vijayaraghavan. Smoothed Analysis of Tensor Decompositions. *Proceedings of the 46th Annual ACM Symposium on Theory of Computing (STOC 2014)*, pages 594–603.
- C. Daskalakis, A. De, I. Diakonikolas, A. Moitra, R. Servedio. A Polynomial Time Approximation Scheme for Fault-tolerant Distributed Storage. *Proceedings of the 25th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA 2014)*, pages 628–644.
- A. Moitra, M. Saks. A Polynomial Time Algorithm for Lossy Population Recovery. *Proceedings of the 54th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2013)*, pages 110–116.

- M. Hardt, A. Moitra. Algorithms and Hardness for Robust Subspace Recovery. *Proceedings of the 26th Annual Conference on Learning Theory (COLT 2013)*, pages 354–375.
- S. Arora, R. Ge, Y. Halpern, D. Mimno, A. Moitra, D. Sontag, Y. Wu, M. Zhu. A Practical Algorithm for Topic Modeling with Provable Guarantees. *Proceedings of the 30th International Conference on Machine Learning (ICML 2013)*, pages 280–288.
- M. Braverman, A. Moitra. An Information Complexity Approach to Extended Formulations. *Proceedings of the 45th Annual ACM Symposium on Theory of Computing (STOC 2013)*, pages 161–170.
- A. Moitra. An Almost Optimal Algorithm for Computing Nonnegative Rank. *SIAM Journal on Computing* 45(1):156–173, 2016. Preliminary version in *Proceedings of the 24th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA 2013)*, pages 1454–1464.
- S. Arora, R. Ge, A. Moitra, S. Sachdeva. Provable ICA with Unknown Gaussian Noise, and Implications for Gaussian Mixtures and Autoencoders. *Algorithmica Special Issue* 72(1):215–236, 2015. Preliminary version in *Advances in Neural Information Processing Systems 25 (NIPS 2012)*, pages 2384–2392.
- S. Arora, R. Ge, A. Moitra. Learning Topic Models – Going Beyond SVD. *Proceedings of the 53rd Annual IEEE Symposium on Foundations of Computer Science (FOCS 2012)*, pages 1–10.
- A. T. Kalai, A. Moitra, G. Valiant. Disentangling Gaussians. *Communications of the ACM* February 2012, **Research Highlights**, pages 113–120.
- S. Arora, R. Ge, R. Kannan, A. Moitra. Computing a Nonnegative Matrix Factorization – Provably. *SIAM Journal on Computing Special Issue* 45(4): 1582-1611, 2016. Preliminary version in *Proceedings of the 44th Annual ACM Symposium on Theory of Computing (STOC 2012)*, pages 145–162.
- N. Alon, A. Moitra, B. Sudakov. Nearly Complete Graphs Decomposable into Large Induced Matchings and Their Applications. *Journal of the European Mathematical Society* 15(5): 1575–1596, 2013. Preliminary version in *Proceedings of the 44th Annual ACM Symposium on Theory of Computing (STOC 2012)*, pages 1079–1090.
- R. Gelles, A. Moitra, A. Sahai. Efficient and Explicit Coding for Interactive Communication. *IEEE Transactions on Information Theory* 60(3): 1899–1913, 2014. Preliminary version in *Proceedings of the 52nd Annual IEEE Symposium on Foundations of Computer Science (FOCS 2011)*, pages 768–777.
- A. Moitra, R. O’Donnell. Pareto Optimal Solutions for Smoothed Analysts. *SIAM Journal on Computing Special Issue* 41(5):1266–1284, 2012. Preliminary version in *Proceedings of the 43rd Annual ACM Symposium on Theory of Computing (STOC 2011)*, pages 225–234.
- N. Immorlica, A. Kalai, B. Lucier, A. Moitra, A. Postlewaite, and M. Tennenholtz. Dueling Algorithms. *Proceedings of the 43rd Annual ACM Symposium on Theory of Computing (STOC 2011)*, pages 215–224.
- M. Andrews, M.T. Hajiaghayi, H. Karloff, A. Moitra. Capacitated Metric Labeling. *Proceedings of the 22nd Annual ACM-SIAM Symposium on Discrete Algorithms (SODA 2011)*, pages 976–995.

- A. Moitra, G. Valiant. Settling the Polynomial Learnability of Mixtures of Gaussians. *Proceedings of the 51st Annual IEEE Symposium on Foundations of Computer Science (FOCS 2010)*, pages 93-102.
- M. Charikar, T. Leighton, S. Li, A. Moitra. Vertex Sparsifiers and Abstract Rounding Algorithms. *Proceedings of the 51st Annual IEEE Symposium on Foundations of Computer Science (FOCS 2010)*, pages 265-274.
- A.T. Kalai, A. Moitra, G. Valiant. Efficiently Learning Mixtures of Two Gaussians. *Proceedings of the 42nd Annual ACM Symposium on Theory of Computing (STOC 2010)*, pages 553-562.
- T. Leighton, A. Moitra. Extensions and Limits to Vertex Sparsification. *Proceedings of the 42nd Annual ACM Symposium on Theory of Computing (STOC 2010)*, pages 47-56.
- A. Moitra. Vertex Sparsification and Oblivious Reductions. *SIAM Journal on Computing* **Special Issue** 42(6):2400–2423, 2013. Preliminary version in *Proceedings of the 50th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2009)*, pages 3-12.
- T. Leighton, A. Moitra. Some Results on Greedy Embeddings in Metric Spaces. *Discrete and Computational Geometry* **Invited** 44(3): 686–705, 2010. Preliminary version in *Proceedings of the 49th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2008)*, pages 337-346.
- MANUSCRIPTS A. Moitra, A. Wein. Precise Error Rates for Computationally Efficient Testing. *ArXiv:2311.00289*, 2023.
- BOOK A. Moitra. *Algorithmic Aspects of Machine Learning*. Cambridge University Press, New York, 2018.
- TALKS **Learning From Dynamics**  
**AMS John von Neumann Lecture**, January 2024  
 MIT LIDS Colloquium, December 2023  
 Harvard CS Theory Seminar, October 2023  
 Institute for Advanced Study CSDM Seminar, October 2023  
 Harvard Big Data Conference, August 2023
- Reinforcement Learning without Intractable Oracles?**  
 CSAIL Computing the Future, June 2023  
 ONR Meeting, April 2023  
 Princeton Machine Learning Seminar June 2022
- Rethinking Robustness: From Classification to Contextual Bandits**  
 Boston University Algorithms and Theory Seminar, April 2022  
**UAI Keynote**, July 2021
- Tensor Methods and Their Applications**  
**IPAM Tutorial**, March 2021
- Tensor Completion and Refuting Random CSPs**  
**IPAM Tutorial**, March 2021
- Algorithmic Foundations for the Diffraction Limit**  
 Institute for Advanced Study CSDM Seminar, October 2023  
 One World Mathematics of Information, Data and Signals Seminar, February 2022  
 Georgia Tech ARC Colloquium, April 2021

UT Austin Machine Learning Lab Inaugural Lecture, November 2020

Learning with Massart Noise, and Connections to Fairness

- USC Probability and Statistics Seminar, October 2021
- Princeton ORFE Colloquium, September 2021
- Northwestern Quarterly Theory Workshop**, June 2020
- CSAIL-MSR Trustworthy and Robust AI Workshop, June 2020

Efficient Federated Learning

- Microsoft Trustworthy AI Workshop, November 2019

Robustly Learning a Signal, Under a Group Action

- Stanford Theory Seminar, October 2019
- ONR Program Review, October 2019

Learning Gaussian Graphical Models without Condition Number Bounds

- ICERM Workshop on Data Science, May 2019
- Oberwolfach Workshop on High-Dimensional Statistics, May 2019

Learning Restricted Boltzmann Machines

- Simons Institute, March 2022
- Institute for Mathematics and its Applications, September 2020
- University of Texas, Austin Theory Seminar, March 2019
- MIT MIFODS Workshop, January 2019

Sum-of-Squares, With a View Towards Average-case Complexity

- Kavli Institute Tutorial, January 2019

The Paulsen Problem Made Simple

- ICERM Workshop on Real Algebraic Geometry and Optimization, October 2018

Approximate Counting and the Lovasz Local Lemma

- MIT Probability Seminar, October 2018
- Harvard Probability and Random Matrix Theory, December 2017
- Princeton University Theory Lunch, December 2017
- Toyota Technological Institute CS Colloquium, October 2017
- STOC, June 2017
- Institute for Advanced Study CSDM Seminar, March 2017

Robustness Meets Algorithms

- UPenn Theory. Seminar, November 2019
- Stanford Statistics Seminar, October 2019
- NUS Distinguished Lecture, January 2019
- MIT Applied Math Colloquium, September 2018
- SWAT Plenary Talk**, June 2018
- HALG Tutorial**, June 2018
- Princeton Center for Theoretical Science, May 2018
- NYU Math and Data Seminar, April 2018
- Simons Math+X Symposium, January 2018
- JASON Fall Meeting**, November 2017
- DARPA Safe Machine Learning Workshop, October 2017
- Yale University Statistics Seminar, October 2017
- Packard Fellows Retreat, September 2017
- ICML Tutorial**, July 2017
- EPFL Summer Research Institute, June 2017
- Northeastern Theory Seminar, April 2017
- MIT Stochastics and Statistics Seminar, March 2017

Simons Institute, November 2016  
**Southern California Theory Day**, November 2016  
Georgia Tech ARC Colloquium, October 2016

Sum-of-Squares Proofs, with Pablo Parrilo

Simons Institute Tutorial, August 2017

How Robust are Reconstruction Threshold for Community Detection?

International Bayes Club Seminar, March 2021

Institute for Mathematics and Applications, June 2019

MIT MIFODS Workshop, June 2018

**Northwestern Quarterly Theory Workshop**, May 2017

MIT Statistics and Data Science Day, April 2017

Planted Clique, Sum-of-Squares and Pseudo-Calibration

Institute for Mathematics and Applications, May 2016

Simons Institute, May 2016

Beyond Matrix Completion

Princeton PACM Colloquium, March 2016

**FSTTCS Plenary Talk**, December 2015

Harvard Big Data Conference, August 2015

European Meeting of Statisticians, July 2015

**New England Machine Learning Day**, May 2015

MIT Stochastics and Statistics Seminar, April 2015

NYU Theory Seminar, April 2015

Harvard Probability and Random Matrix Theory, March 2015

UChicago Theory Seminar, March 2015

Simple, Efficient and Neural Algorithms for Sparse Coding

Simons Institute, March 2015

ITA, February 2015

Workshop on Algorithmic Challenges in Machine Learning (UCSD), January 2015

Symposium on Learning, Algorithms and Complexity (IISc), January 2015

Workshop on Learning Theory (FOCM), December 2014

Super-resolution, Extremal Fctns and the Condition Number of Vandermonde Matrices

BIRS Workshop on Analytic Techniques in TCS, August 2018

STOC, June 2015

MSR/MIT Reading Group, November 2014

Workshop on Sparse Fourier Transform (FOCS), October 2014

Tensor Decompositions and Their Applications

Learning at Scale (MADALGO), August 2014

New Algorithms for Dictionary Learning

Learning at Scale (MADALGO) August 2014

Curves and Surfaces, June 2014

Mathematical Foundations of Learning Theory, June 2014

COLT, June 2014

Workshop on Overcoming Intractability in Learning (STOC), May 2014

Extended Formulations and Information Complexity

Simons Institute, April 2015

**Dagstuhl Tutorial**, March 2014

A Polynomial Time Algorithm for Lossy Population Recovery

Simons Institute, September 2014

Duke University Algorithms Seminar, August 2014  
ICERM Workshop on Numerical Linear Algebra, May 2014  
ITA, February 2014  
FOCS, October 2013  
TCS+ Seminar, September 2013  
Princeton University Discrete Math Seminar, May 2013  
Princeton University Theory Lunch, April 2013

Polynomial Methods in Learning and Statistics

**UAI Tutorial**, July 2013  
**Institute for Advanced Study Members Seminar**, March 2012

An Information Complexity Approach to Extended Formulations

MIT TOC Colloquium, September 2013  
STOC, June 2013  
**NYC Theory Day**, May 2013  
Columbia University Discrete Math Seminar, April 2013  
**ARC Theory Day**, April 2013  
Center for Computational Intractability Meeting, December 2012

New Algorithms for Nonnegative Matrix Factorization and Beyond

Harvard CS Colloquium, October 2014  
Learning at Scale (MADALGO), August 2014  
University of Washington CS Colloquium, November 2014  
University of Texas, Austin CS Colloquium, April 2013  
University of California, San Diego CS Colloquium, April 2013  
Carnegie Mellon University CS/MLD Colloquium, March 2013  
Google Research NYC Theory Seminar, March 2013  
Cornell University CS Colloquium, March 2013  
Princeton University CS/PACM Colloquium, February 2013  
MIT Applied Math Special Seminar, February 2013  
Columbia University IEOR/CS Colloquium, February 2013  
IBM T.J. Watson Theory Seminar, February 2013  
Microsoft Research, Silicon Valley Theory Seminar, February 2013  
Caltech CMS Colloquium, January 2013  
Microsoft Research, New England Theory Seminar, January 2013

An Almost Optimal Algorithm for Computing Nonnegative Rank

**ISSAC Tutorial**, July 2015  
SODA, January 2013

Learning Topic Models – Going Beyond SVD

FOCS, October 2012

Computing a Nonnegative Matrix Factorization – Provably

Cornell University Theory Seminar, October 2012  
IBM T.J. Watson Theory Lunch, July 2012  
Google Research NYC Theory Seminar, June 2012  
Carnegie Mellon University Theory Seminar, December 2011  
University of Texas, Austin Theory Seminar, November 2011

Finding Structure in Big Data (popular talk)

**Institute for Advanced Study Board of Trustees Meeting**, May 2012

Nearly Complete Graphs Decomposable into Large Induced Matchings

STOC, May 2012  
Princeton University Theory Lunch, April 2012

Vertex Sparsification: An Introduction, Connections and Applications

**WoRKer Tutorial**, June 2015

Part I: Institute for Advanced Study CSDM Seminar, November 8th 2011

Part II: Institute for Advanced Study CSDM Seminar, November 15th 2011

Pareto Optimal Solutions for Smoothed Analysts

Princeton University Discrete Math Seminar, March 2012

Rutgers University Discrete Math Seminar, February 2012

University of California, Berkeley Theory Seminar, September 2011

Workshop on Beyond Worst Case Analysis (Stanford), September 2011

STOC, May 2011

Efficiently Learning Mixtures of Gaussians

International Workshop on Statistical Learning, June 2013

University of California, San Diego Theory Seminar, April 2013

Center for Computational Intractability Meeting, September 2011

Microsoft Research, New England Theory Seminar, January 2011

Institute for Advanced Study CSDM Seminar, January 2011

Microsoft Research, Redmond Theory Lunch, December 2010

Yale University Statistics Seminar, November 2010

Carnegie Mellon University Theory Seminar, September 2010

Microsoft Research, Silicon Valley Theory Seminar, August 2010

IBM T.J. Watson Theory LUnch, May 2010

Capacitated Metric Labeling

SODA, January 2011

Vertex Sparsification and Oblivious Reductions

Columbia University CS Colloquium, February 2012

Columbia University Discrete Math Seminar, November 2011

DIMACS Theory Seminar, October 2011

University of California, Los Angeles CS Colloquium, March 2011

Toyota Technological Institute CS Colloquium, March 2011

Stanford University CS Colloquium, February 2011

University of Southern California CS Colloquium, February 2011

Georgia Institute of Technology ARC Colloquium, January 2011

Microsoft Research, Silicon Valley Theory Seminar, January 2011

MIT Operations Research Seminar, December 2010

University of Washington Theory Seminar, December 2010

Extensions and Limits to Vertex Sparsification

STOC, May 2010

Approximation Algorithms for Multicommodity Type Problems

Carnegie Mellon University Theory Lunch, September 2010

China Theory Week (Tshingua), September 2010

Cornell University Theory Seminar, February 2010

Princeton University Theory Lunch, December 2009

University of California, Berkeley Theory Seminar, November 2009

Stanford Algorithms Seminar, November 2009

MIT Combinatorics Seminar, September 2009

FOCS, October 2009

ATT Research Theory Seminar, May 2009

Bell Labs Theory Seminar, May 2009

Some Results on Greedy Embeddings in Metric Spaces

Microsoft Research, Redmond, March 2009  
FOCS, October 2008

SERVICE

Associate Editor: ACM Transactions on Algorithms (TALG)

Program Committees: SODA 2025, FOCS 2023, STOC 2023, ITCS 2023, NeurIPS 2022 (area chair), COLT 2022 (area chair), ICLR 2022 (area chair), NeurIPS 2021 (area chair), COLT 2021 (area chair), ICLR 2021 (area chair), COLT 2020 (senior pc), NeurIPS 2019 (area chair), ICML 2019 (area chair), COLT 2019, NeurIPS 2018 (area chair), COLT 2018, ICALP 2018, STOC 2018, RANDOM 2017, ICML 2016, SODA 2015, FOCS 2014, ICML 2013, APPROX 2013

Journal Reviewer: Journal of the ACM, Proceedings of the National Academy of Sciences, Duke Math Journal, Journal of the European Mathematical Society, Foundations of Computational Mathematics, SIAM Journal on Computing, Israel Journal of Math, Annals of Statistics, Mathematical Statistics and Learning, Journal of Machine Learning Research, Mathematical Programming, Machine Learning, Journal of Combinatorial Theory Series B, Mathematics of Operations Research, Computational Complexity, Information and Computation, IEEE Transactions on Information Theory, IEEE Transactions on Computers, SIAM Journal on Matrix Analysis, SIAM Journal on Optimization, ACM Transactions on Algorithms, Algorithmica

Conference Reviewer: FOCS 2022, STOC 2022, ISIT 2022, STOC 2021, SODA 2021, ITCS 2021, FOCS 2020, STOC 2020, SODA 2020, FOCS 2019, STOC 2019, SODA 2019, FOCS 2018, ITCS 2018, SODA 2018, APPROX 2017, FOCS 2017, COLT 2017, ISIT 2017, STOC 2017, ITCS 2017, SODA 2017, FOCS 2016, IPCO 2016, STOC 2016, SODA 2016, NIPS 2015, ESA 2015, FOCS 2015, COLT 2015, ICALP 2015, STOC 2015, ESA 2014, RANDOM 2014, COLT 2014, STOC 2014, SODA 2014, FOCS 2013, NIPS 2013, COLT 2013, STOC 2013, ICML 2013, STACS 2013, ITCS 2013, SODA 2013, ESA 2012, FOCS 2012, COLT 2012, STOC 2012, SWAT 2012, SODA 2012, ICS 2011, SODA 2011, ESA 2010, COLT 2010, STOC 2010, SODA 2010, SPAA 2009

ADVISING

Dhruv Rohatgi, EECS, 2021 – present

**National Defense Science and Engineering Graduate Fellow**

Hannah Lawrence, EECS, 2020 – present

**Fannie and John Hertz Foundation Fellow**

**National Science Foundation Fellow**

Allen Liu, EECS, 2020 – present

**Fannie and John Hertz Foundation Fellow**

**National Science Foundation Fellow**

Noah Golowich, EECS, 2019 – present

**Fannie and John Hertz Foundation Fellow**

**National Science Foundation Fellow**

Linus Hamilton, Math, 2016 – 2022

Now at Two Sigma

Thesis: *Applications and Limits of Convex Optimization*

**Fannie and John Hertz Foundation Fellow**

Sitan Chen, EECS, 2016 – 2021

Next an **Assistant Professor** in Computer Science at Harvard

Now a **NSF Postdoctoral Fellow** at UC Berkeley

Thesis: *Rethinking Algorithm Design for Modern Challenges in Data Science*  
**Paul and Daisy Soros Fellow**

Frederic Koehler, Math, 2016 – 2021

Next an **Assistant Professor** in Statistics at the University of Chicago

Now a **Rajeev Motwani Fellow** at Stanford

Thesis: *Provable Algorithms for Learning and Variational Inference in Undirected Graphical Models*

Jerry Li, EECS, 2013 – 2018

Next an **Assistant Professor** in Computer Science at University of Washington

Thesis: *Principled Approaches to Robust Machine Learning and Beyond*

**George M. Sprowls Thesis Award**

**National Science Foundation Fellow**

Madalina Persu, EECS, 2013 – 2018

Thesis: *Tensors, Sparse Problems and Conditional Hardness*

Now at Two Sigma

Amelia Perry, Math, 2013 – 2018, deceased

Thesis (unsubmitted): *Message Passing Algorithms and Invariant Theory*

**Charles M. Johnson Paper Prize**

Alex Wein, Math, 2013 – 2018

Now an **Assistant Professor** in Mathematics at UC Davis

Thesis: *Statistical Estimation in the Presence of Group Actions*

**Charles M. Johnson Paper Prize**

**National Defense Science and Engineering Graduate Fellow**

#### POSTDOCS

Ainesh Bakshi, 2022 – present

Kuikui Liu, 2022 – 2023

Now an **Assistant Professor** in Computer Science at MIT

Zongchen Chen, 2021 – 2023

Now an **Assistant Professor** in Computer Science at Georgia Tech

Vatsal Sharan, 2020 – 2021

Now an **Assistant Professor** in Computer Science at USC

Diego Cifuentes, 2018 – 2021

Now an **Assistant Professor** in Industrial Engineering at Georgia Tech

Colin Sandon, 2018 – 2022

Now a **Research Scientist** at EPFL

Tselil Schramm, 2018 – 2020

Now an **Assistant Professor** in Statistics at Stanford

Andrej Risteski, 2017 – 2019

Now an **Assistant Professor** in Machine Learning at CMU

THESIS  
COMMITTEE

Sam Park (EECS), Adam Block (Math), Alex Po-Yen Wu (CSBi), Sinho Chewi (Math), Yuval Dagan (EECS), Chenyang Yuan (EECS), Paxton Turner (Math), Matthew Brennan (EECS), Manolis Zampetakis (EECS), Brandon Tran (Math), Vishesh Jain (Math), Julia Gaudio (Sloan), Sarah Nyquist (CSBi), Jonathan Weed (Math), Haihao Lu (Math/ORC), Francisco Unda (Math), Themistoklis Gouleakis (EECS), Gautam Kamath (EECS), David Rolnick (Math), Cheng Mao (Math), Brian Cleary (CSBi), Adrian Vladu (Math), Ben Yang (Math), Mohammad Bavarian (Math), Hilary Finucane (Math), Hamza Fawzi (EECS), Oren Rippel (Math), Aaron Potechin (Math), Dimiter Ostrev (Math), Mark Lipson (Math), Alan Deckelbaum (Math)

TEACHING

Massachusetts Institute of Technology

*Lecturer* for 18.200: Principles of Discrete Applied Mathematics Spring 2024  
Undergraduate course on discrete math co-taught with Peter Shor

*Lecturer* for 6.C06/18.C06: Linear Algebra and Optimization Fall 2023  
Undergraduate course on linear algebra co-taught with Pablo Parrilo

*Lecturer* for 18.408: Algorithmic Aspects of Machine Learning Spring 2023  
Revised graduate course on theoretical foundations for deep learning

*Lecturer* for 6.C06/18.C06: Linear Algebra and Optimization Fall 2022  
Undergraduate course on linear algebra co-taught with Pablo Parrilo

*Lecturer* for 18.200: Principles of Discrete Applied Mathematics Spring 2022  
Undergraduate course on discrete math co-taught with Michel Goemans

*Lecturer* for 6.S084/18.S096: Linear Algebra and Optimization Fall 2021  
Undergraduate course on linear algebra co-taught with Pablo Parrilo

*Lecturer* for 18.408: Theoretical Foundations for Deep Learning Spring 2021  
New graduate course on theoretical foundations for deep learning

*Lecturer* for 6.S084/18.S096: Linear Algebra and Optimization Fall 2020  
Pilot undergraduate course for College of Computing co-taught with Pablo Parrilo

*Lecturer* for 6.042/18.062: Mathematics for Computer Science Fall 2019  
Undergraduate course on discrete math co-taught with Zachary Abel and Ronitt Rubinfeld

*Lecturer* for 6.042/18.062: Mathematics for Computer Science Fall 2018  
Undergraduate course on discrete math co-taught with Tom Leighton

*Lecturer* for 18.200: Principles of Discrete Applied Mathematics Spring 2018  
Undergraduate course on discrete math co-taught with Michel Goemans

*Lecturer* for 18.408: Algorithmic Aspects of Machine Learning Fall 2017  
Graduate course on recent progress in machine learning

*Lecturer* for 6.042/18.062: Mathematics for Computer Science Fall 2016  
Undergraduate course on discrete math co-taught with Tom Leighton

*Lecturer* for 6.854/18.415: Advanced Algorithms Spring 2016  
Redesigned core graduate course on algorithm design

*Lecturer* for 18.200: Principles of Discrete Applied Mathematics Fall 2015  
Undergraduate course on discrete math co-taught with Peter Shor

*Lecturer* for 18.409: Algorithmic Aspects of Machine Learning      Spring 2015  
 Updated graduate course on recent progress in machine learning

*Lecturer* for 6.042/18.062: Mathematics for Computer Science      Fall 2014  
 Undergraduate course on discrete math co-taught with Tom Leighton

*Lecturer* for 18.434: Topics in Theoretical Computer Science      Spring 2014  
 Undergraduate seminar on polytopes and optimization

*Lecturer* for 18.S996: Algorithmic Aspects of Machine Learning      Fall 2013  
 New graduate course on modern algorithmic approaches in machine learning

GRANTS

Microsoft Research Award. *Trustworthy AI*. \$250,000, 7/18 – indeterminate.

Office of Naval Research, Young Investigator Program. *An Algorithmic Theory of Robustness*. \$510,000, 7/18 – 7/21

David and Lucile Packard Foundation. *Machine Learning with Provable Guarantees*. \$875,000, 10/16 – 10/21.

National Science Foundation, Algorithmic Foundations. *Algebraic Proof Systems, Convexity, and Algorithms*, co-PIs Boaz Barak (Harvard), Jonathan Kelner (MIT) and Pablo Parrilo (MIT). \$3,000,000 (PI portion: \$750,000), 9/16 – 9/21.

Alfred P. Sloan Foundation. *Machine Learning with Provable Guarantees*. \$55,000, 9/16 – 9/18.

National Science Foundation, Algorithmic Foundations. *CAREER: Algorithmic Aspects of Machine Learning*. \$500,000, 9/15 – 9/20.

NEC Corporation Fund Award. *Algorithms for Discovering Sparse Representations*. \$75,000, 7/14 – 1/17,

Google Research Award. *New Theoretical Challenges in Dictionary Learning*. \$63,732, 9/14 – 9/16.

SUMMER PROGRAMS

Massachusetts Institute of Technology  
*Faculty Supervisor* for SPUR/RSI      Summers 2015 – 2022  
 Six week intensive math research experience for 20+ students each year at all levels (high school, undergraduate, graduate) both as advisees and mentors, co-supervised with David Jerison (2015-2017, 2019-2020) and Davesch Maulik (2018)

**Project Awards: Fourteen semifinalists and one finalist in the Siemens competition, seven Regeneron STS scholars, three finalists and one third-place overall in the International Science and Engineering Fair and one outstanding presentation award at the 2016 MAA undergraduate poster session.**

Rutgers University  
*Lecturer* for The Math Behind the Machine      Summer 2013  
 Summer course for high school students, aimed at introducing them to theoretical computer science

REFERENCES

Sanjeev Arora (arora@cs.princeton.edu)  
 Charles C. Fitzmorris Professor, Princeton University

Robert Kleinberg (rdk@cs.cornell.edu)

Professor, Cornell University

Tom Leighton ([ftl@akamai.com](mailto:ftl@akamai.com))

CEO, Akamai Technologies

Professor, MIT

Madhu Sudan ([madhu@cs.harvard.edu](mailto:madhu@cs.harvard.edu))

Gordon McKay Professor, Harvard University

Avi Wigderson ([avi@math.ias.edu](mailto:avi@math.ias.edu))

Herbert H. Maass Professor, Institute for Advanced Study