

# Ankur Moitra

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CONTACT INFORMATION	Department of Mathematics Computer Science and Artificial Intelligence Lab Massachusetts Institute of Technology Cambridge, MA 02139 USA	<i>Cell:</i> (607) 227-6851 <i>Office:</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	algorithms and learning	
APPOINTMENTS	<b>Rockwell International Chair</b> , Summer 2016-Present <i>Assistant Professor</i> of Applied Mathematics, Massachusetts Institute of Technology Fall 2013-present Research in various aspects of theoretical computer science  <i>Principal Investigator</i> , Computer Science and Artificial Intelligence Lab (CSAIL) Fall 2013-present  <i>Postdoc</i> in School of Mathematics, Institute for Advanced Study Fall 2011-Spring 2013 Supported by an NSF Computing and Innovation Fellowship Also: <b>Senior Postdoc</b> at Princeton University, Summer 2012-Spring 2013	
EDUCATION	Massachusetts Institute of Technology, Cambridge, MA USA  Ph.D., Computer Science, June 2011 <ul style="list-style-type: none"><li>• Thesis Title: <i>Vertex Sparsification and Universal Rounding Algorithms</i></li><li>• <b>Received the George M. Sprowls Thesis Award (best thesis)</b></li><li>• Adviser: Professor F. Thomson Leighton</li><li>• Area of Study: Theoretical Computer Science</li></ul> S.M., Computer Science, May 2009 <ul style="list-style-type: none"><li>• Thesis Title: <i>A Solution to the Papadimitriou-Ratajczak Conjecture</i></li><li>• <b>Received the William A. Martin Memorial Thesis Award (best thesis)</b></li><li>• Adviser: Professor F. Thomson Leighton</li><li>• Area of Study: Theoretical Computer Science</li></ul> Cornell University, Ithaca, NY USA  B.S., Electrical and Computer Engineering, May 2007 <ul style="list-style-type: none"><li>• Class Rank in School of Engineering: 1<sup>st</sup> of 714</li><li>• <i>Summa Cum Laude</i></li><li>• Minor in <a href="#">Applied Mathematics</a></li></ul>	
HONORS AND AWARDS	<b>David and Lucile Packard Foundation Fellow</b> , 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

- 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)*, to appear.
- 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)*, to appear.
- V. Brunel, A. Moitra, P. Rigollet, J. Urschel. Maximum Likelihood Estimation for Determinantal Point Processes. *Proceedings of the 30th Annual Conference on Learning Theory (COLT 2017)*, to appear.
- A. Moitra. Approximate Counting, the Lovasz Local Lemma and Inference in Graphical Models. *Proceedings of the 49th Annual ACM Symposium on Theory of Computing (STOC 2017)*, to appear.
- 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. *Proceedings of the 57th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2016)*, pages 428–437. Invited to SIAM Journal on Computing **Special Issue**.
- I. Diakonikolas, G. Kamath, D. Kane, J. Li, A. Moitra, A. Stewart. Robust Estimators in High Dimensions without the Computational Intractability. *Proceedings of the 57th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2016)*, pages 655–664. Invited to SIAM Journal on Computing **Special Issue**.
- 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.
- 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. Invited to Communications of the ACM, **Research Highlights**.
- 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* (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**.
- 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. Perry, A. Wein, A. Bandeira, A. Moitra. Message-passing Algorithms for Synchronization Problems over Compact Groups. *ArXiv:1610.04583*, 2016.
- A. Perry, A. Wein, A. Bandeira, A. Moitra. Optimality and Suboptimality of PCA for Spiked Random Matrices and Synchronization. *ArXiv:1609.05573*, 2016.

TALKS

- How Robust are Reconstruction Threshold for Community Detection?  
**MIT Statistics and Data Science Day**, April 2017
- Approximate Counting and the Lovasz Local Lemma  
 Institute for Advanced Study CSDM Seminar, March 2017
- Robust Statistics, Revisited  
 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

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

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, 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

**WorkKer 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: 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 Sci-

ences, Foundations of Computational Mathematics, SIAM Journal on Computing, Israel Journal of Math, 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: ESA 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, Special Issue for FOCS 2011, ESA 2010, COLT 2010, STOC 2010, SODA 2010, SPAA 2009, Special Issue for SODA 2008

ADVISING Sitan Chen (EECS), Linus Hamilton (Math, Hertz Fellow), Frederic Koehler (Math), Jerry Li (EECS, NSF Fellow), Amelia Perry (Math, co-advised with Jon Kelner), Madalina Persu (EECS), Alex Wein (Math, NDSEG Fellow, co-advised with Michel Goemans)

THESIS COMMITTEE Adrian Vladu (Math), Ben Yang (Math), Mohammad Bavarian (Math), Brian Cleary (CSBi), 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, Cambridge, MA USA

<i>Lecturer</i> for 6.042/18.062:Mathematics for Computer Science	Fall 2016
Undergraduate course on discrete math co-taught with Tom Leighton	
<i>Lecturer</i> for 6.854/18.415:Advanced Algorithms	Spring 2016
Redesigned core graduate course on algorithm design	
<i>Lecturer</i> for 18.200:Principles of Discrete Applied Mathematics	Fall 2015
Undergraduate course on discrete math co-taught with Peter Shor	
<i>Lecturer</i> for 18.409:Algorithmic Aspects of Machine Learning	Spring 2015
Updated graduate course on recent progress in machine learning	
<i>Lecturer</i> for 6.042/18.062:Mathematics for Computer Science	Fall 2014
Undergraduate course on discrete math co-taught with Tom Leighton	
<i>Lecturer</i> for 18.434:Topics in Theoretical Computer Science	Spring 2014
Undergraduate seminar on polytopes and optimization	
<i>Lecturer</i> for 18.S996:Algorithmic Aspects of Machine Learning	Fall 2013
New graduate course on modern algorithmic approaches in machine learning	

SUMMER PROGRAMS Massachusetts Institute of Technology, Cambridge, MA USA

<i>Faculty Supervisor</i> for SPUR/RSI	Summer 2015, Summer 2016
Six week intensive math research experience for 40+ students at all levels (high school, undergraduate, graduate) both as advisees and mentors, co-supervised with David Jerison	



**Project Awards: Out of eleven eligible student projects, one was a finalist and six were semifinalists in the prestigious Siemens Competition**

Rutgers University, New Brunswick, NJ USA

*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)

Associate Professor, Cornell University

Tom Leighton (ftl@akamai.com)

CEO, Akamai Technologies

Professor, MIT

Avi Wigderson (avi@math.ias.edu)

Herbert H. Maass Professor, Institute for Advanced Study