

CONTACT INFORMATION

Department of Computer Science
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RESEARCH INTERESTS

Convex Optimization, Spectral Methods, Graph Algorithms, Machine Learning

PROFESSIONAL POSITIONS

The University of Chicago, Chicago, IL
Assistant Professor, Department of Computer Science 07/2019–present

Boston University, Boston, MA
Assistant Professor, Department of Computer Science 01/2015–06/2019

Additional affiliations:

Member, Center for Information & Systems Engineering 2018–2019

Junior Faculty Fellow, Hariri Institute for Computing 2015–2018

Massachusetts Institute of Technology, Cambridge, MA
Applied Mathematics Instructor, Dept. of Mathematics 09/2011–12/2014
Postdoctoral research and teaching position
Mentor: Jonathan Kelner

OTHER AFFILIATIONS

NSF TRIPODS Institute (IDEAL)
Faculty member, multi-institution transdisciplinary institute 2022–present

Simons Institute, Berkeley, CA
Visiting Scientist & Program Organizer Fall 2017

Program on *Bridging Continuous and Discrete Optimization*

Visiting Scientist Fall 2014

Program on *Algorithmic Spectral Graph Theory*

EDUCATION

University of California, Berkeley CA
Ph.D., Computer Science 05/2011

Advisor: Satish Rao

Dissertation: *Fast Approximation Algorithms for Graph Partitioning Using Spectral and Semidefinite-Programming Techniques*

Princeton University, Princeton, NJ
A.B. summa cum laude, Computer Science 05/2005

HONORS

NSF CAREER Award, 2020–2024

Boston University Hariri Institute for Computing’s Junior Faculty Fellow, 2015–2018

Co-winner of Best Paper Award, SODA 2014

Outstanding Graduate Student Instructor, UC Berkeley, Fall 2006

GRANTS

- NSF CCF CAREER Award (#1943510; Role: PI) 2020–2024
Next-Generation Design of First-Order Optimization Algorithms by the Calculus of Variations of Self-Dual Functionals
- NSF CCF Algorithmic Foundations Grant (#1718342; Role: PI) 2017–2020
Continuous Perspectives on Accelerated Methods for Combinatorial Optimization
- NSF CCF Algorithmic Foundations Grant (#1319460; Role: PI) 2013–2017
New Perspectives on Spectral Methods for Graph Algorithms
- DHS ALERT Subaward (#505035-78050; Role: co-PI) 2017–2018
Anomaly Detection in Advanced Imaging Technology Systems based on Graph Theory

PUBLICATIONS & PREPRINTS

1. L. Orecchia, J. Hu, X. He, W. Mark, X. Yang, M. Wu, X. Geng. *Training Binary Neural Networks via Gaussian Variational Inference and Low-Rank Semidefinite Programming*. **NeurIPS’24**: Proc. Neural Inf. Proc. Systems, 2024.
2. Y. Yang, A. Chen, L. Orecchia, C. Ma. *Top-K ranking with a monotone adversary*. **COLT’24**: Proc. Conf. Learning Theory, pp. 5123-5162. 2024.
3. K. Ameranis, A. Chen, A. DePavia, L. Orecchia and E. Tani. *Fast Algorithms for Hypergraph PageRank with Applications to Semi-Supervised Learning*. **ICML’24**: Proc. Intl. Conf. Machine Learning. 2024.
4. L. Orecchia, K. Ameranis, C. Tsourakakis and K. Talwar. *Practical Almost-Linear-Time Approximation Algorithms for Hybrid and Overlapping Graph Clustering*. **ICML 2022**: Proc. Intl. Conf. Machine Learning, PMLR 162:17071–17093, 2022.
5. J. Diakonikolas, M. Fazel and L. Orecchia. *Fair Packing and Covering on a Relative Scale*. **SIAM J. Optimization** 30(4):3284–3314, 2020.
6. J. Diakonikolas and L. Orecchia. *The Approximate Duality Gap Technique: A Unified Theory of First-Order Methods*. **SIAM J. Optimization**, 29(1):660–689, 2019.
7. Z. Allen-Zhu and L. Orecchia. *Nearly linear-time packing and covering LP solvers*. **Mathematical Programming** 175:307-353, 2019.
8. J. Diakonikolas and L. Orecchia. *On Acceleration with Noise-Corrupted Gradients*. **ICML 2018**: Proc. Intl. Conf. Machine Learning, PMLR 80:1019–1028, 2018.
9. J. Diakonikolas and L. Orecchia. *Alternating Randomized Block Coordinate Descent*. **ICML 2018**: Proc. Intl. Conf. Machine Learning, PMLR 80:1224–1232, 2018.
10. J. Diakonikolas and L. Orecchia. *Accelerated Extra-Gradient Descent: A Novel Accelerated First-Order Method*. **ITCS 2018**: Innovations in Theor. Comp. Sci. Conf. 94: 23:1–23:19, 2018.

11. C. Aksoylar, L. Orecchia and V. Saligrama, *Connected Subgraph Detection with Mirror Descent on SDPs*. **ICML 2017**: Proc. Intl. Conf. Machine Learning, PMLR 70:51–59, 2017.
12. Z. Allen-Zhu and L. Orecchia. *Linear Coupling: An Ultimate Unification of Gradient and Mirror Descent*. **ITCS 2017**: Innovations in Theor. Comp. Sci. Conf., 3:1–3:22, 2017.
13. Z. Allen-Zhu, A. Bhaskara, S. Lattanzi, V. Mirrokni and L. Orecchia. *Expanders via Local Edge Flips*. **SODA 2016**: Proc. ACM-SIAM Symp. Discrete Algorithms, 269–279, 2016.
14. Z. Allen-Zhu, Y.T. Lee and L. Orecchia. *Using Optimization to Obtain a Width-Independent, Parallel, Simpler, and Faster Positive SDP Solver*. **SODA 2016**: Proc. ACM-SIAM Symp. Discrete Algorithms, 1824–1831, 2016.
15. Z. Allen-Zhu, Z. Liao and L. Orecchia. *Linear-Sized Spectral Sparsification in Almost Quadratic Time and Regret Minimization Beyond Matrix Multiplicative Weight Updates*. **STOC 2015**: Proc. ACM Symp. Theory Computing, 237–245, 2015.
16. Z. Allen-Zhu and L. Orecchia. *Nearly-Linear Time Packing and Covering LP Solver with Faster Convergence Rate Than $O(1/\epsilon^2)$* . **STOC 2015**: Proc. ACM Symp. Theory Computing, 229–236, 2015
17. J.A. Kelner, L. Orecchia, Y.T. Lee and A. Sidford. *An Almost-Linear-Time Algorithm for Approximate Max Flow in Undirected Graphs, and its Multicommodity Generalizations*. **SODA 2014**: Proc. ACM-SIAM Symp. Discrete Algorithms, 217–226, 2014.
Co-winner of best paper award. Invited to J. ACM.
18. Z. Allen-Zhu and L. Orecchia. *Flow-Based Algorithms for Local Graph Clustering*. **SODA 2014**: Proc. ACM-SIAM Symp. Discrete Algorithms, 1267–1286, 2014.
19. Z. Allen-Zhu, J.A. Kelner, L. Orecchia and A. Sidford. *A simple, combinatorial algorithm for solving SDD systems in nearly-linear time*. **STOC 2013**: Proc. ACM Symp. Theory Computing, 911–920, 2013.
20. R.P. Smith, S.J. Riesenfeld, A.K. Holloway, Q. Li, K.K. Murphy, N.M. Feliciano, L. Orecchia, N. Oksenberg, K.S. Pollard and N. Ahituv. *A compact, in vivo screen of all 6-mers reveals drivers of tissue-specific expression and guides synthetic regulatory element design*. **Genome Biology**, 14:R72, 2013.
21. L. Orecchia, S. Sachdeva and N.K. Vishnoi. *Approximating the Exponential, the Lanczos Method and an $\tilde{O}(m)$ -Time Spectral Algorithm for Balanced Separator*. **STOC 2012**: Proc. ACM Symp. Theory Computing, 1141–1160, 2012.
22. M.W. Mahoney, L. Orecchia and N.K. Vishnoi. *Spectral Algorithms to Explore Graphs in a Local Manner*. **J. Machine Learning Research**, 13:2339–2365, 2012.
23. L. Orecchia and N.K. Vishnoi. *Towards an SDP-Based Approach to Spectral Methods: A Nearly-Linear Time Algorithm for Graph Partitioning and Decomposition*. **SODA 2011**: Proc. ACM-SIAM Symp. Discrete Algorithms, 532–545, 2011.
24. M.W. Mahoney and L. Orecchia. *Implementing Regularization Implicitly via Approximate Eigenvector Computation*. **ICML 2011**: Proc. Intl. Conf. Machine Learning, 121–128, 2011.
25. K.J. Lang, M.W. Mahoney and L. Orecchia. *Empirical Evaluation of Graph Partitioning Using Spectral Embeddings and Flow*. **SEA 2009**: Proc. Intl. Symp. Experimental Algorithms, 197–208, 2009.
26. L. Orecchia, L. Schulman, U.V. Vazirani and N.K. Vishnoi. *On Partitioning Graphs via Single Commodity Flows*. **STOC 2008**: Proc. ACM Symp. Theory Computing, 461–470, 2008.

27. D. Dubhashi, O. Häggström, L. Orecchia, A. Panconesi, C. Petrioli and A. Vitaletti. *Localized Techniques for Broadcasting in Wireless Sensor Networks*. **Algorithmica**, 49(4):412–446, 2007.
28. L. Orecchia, A. Panconesi, C. Petrioli and A. Vitaletti. *Localized Techniques for Broadcasting in Wireless Sensor Networks*. **DIALM-POMC’04: Joint Workshop Found. Mobile Computing**, 41–51, 2004.
29. A. Cavalcanti, T. Doak, L. Landweber, L. Orecchia and N. Stover. *Coding Properties of *Oxytricha trifallax* (Sterkiella histriomuscorum) Macronuclear Chromosomes: Analysis of a Pilot Genome Project*. **Chromosoma**, 113(2):69–76, 2004.

INVITED TALKS

- Theory Seminar, Northwestern University 2024
“Local Formulations Lead to Global Approximations for Hypergraph Partitioning Problems”
- IDEAL (multi-institution virtual meeting) 2022
“Spectral Algorithms Without a Spectrum: Efficient Hypergraph Diffusions and Applications”
- Theory Seminar, University of Chicago 2022
“Spectral Algorithms Beyond the Laplacian Framework”
- Theory Seminar, Università La Sapienza, Rome, Italy 2022
“Fast Diffusion-based Algorithms for Vertex-based & Hypergraph Partitioning”
- Theory/ML Seminar, Carnegie Mellon University (CMU), Pittsburgh, PA 2019
“First-Order Optimization and the Calculus of Variations”
- TTIC Colloquium, Toyota Technical Institute at Chicago (TTIC), Chicago, IL 2019
“First-order optimization and the calculus of variations”
- Program Boot Camp, Simons Institute, Berkeley, CA 2017
“Continuous Methods”, *Bridging Discrete and Continuous Optimization* program
- Workshop, Simons Institute, Berkeley, CA 2017
“Width-independent Iterative Algorithms for Packing and Covering Programs”,
for the *Fast Iterative Methods in Optimization* workshop
- Symp. Theory of Computing (STOC), Montreal, Canada 2017
“A User-Friendly Primal-Dual View of First-Order Methods”
- ICERM Workshop on Electrical Flows, Graph Laplacians, and Algorithms 2014
“Random Walks as a Stable Analogue of Eigenvectors”
- TCS+ (community-wide virtual meeting) 2013
“A Simple, Combinatorial Algorithm for Solving SDD Systems in Nearly-Linear Time”
- MIT TOC Colloquium, MIT, Cambridge, MA 2013
“A Nearly-linear-time Spectral Algorithm for Balanced Graph Partitioning”
- Breakthroughs in Theoretical Computer Science, IIT Guwahati, Guwahati, India 2013
“A Simple, Combinatorial Algorithm for Solving SDD Systems in Nearly-Linear Time ”
- Breakthroughs in Theoretical Computer Science, IIT Guwahati, Guwahati, India 2013
“An Almost-Linear-Time Algorithm for Approximate Max Flow in Undirected Graphs, and its Multicommodity Generalizations ”

RECENT CONTRIBUTED TALKS

- INFORMS Conference, Seattle, WA 2019
“A Variational Approach to the Design of First-order Methods Via Self-dual Convex Functionals Over Path Space”
- Intl. Symp. Mathematical Programming (ISMP), Bordeaux, France 2018
“First-order Methods From Dynamical Systems to Discrete Optimization”
- Graph Exploitation Symposium, MIT Lincoln Laboratory 2017
“Graph Partitioning Using Random Walks: A Convex Optimization Perspective”

TEACHING

Course Designer and Instructor, University of Chicago

CMSC 27200: *Theory of Algorithms* Spring 2023, 2022; Winter 2021, 2020
Undergraduate course. Enrollment: 95–150. I redesigned the course in 2022, after co-teaching it with Aaron Potechin in 2020 and Andrew Drucker in 2020 and 2021.

CMSC 35480: *Topics in Optimization: Hypergraph Algorithms* Autumn 2022
Graduate seminar. Enrollment: 12.

CMSC 25460: *Introduction to Optimization* Spring 2021, 2020
Undergraduate course I designed. Enrollment: ~10.

CMSC 35480: *Topics in Optimization: Calculus of Variations* Autumn 2021
Graduate Seminar. Enrollment: 6

CMSC 35480: Autumn 2020
Topics in Optimization: Current Research in First-Order Methods
Graduate seminar. Enrollment: 19.

CMSC 35410: Autumn 2019, Autumn 2023
Spectral Methods for Machine Learning and Network Analysis
Graduate course I designed. Enrollments: 19,7.

Tutorial Designer and Instructor, University of Chicago

Principal Component Analysis and Dimensionality Reduction Spring 2021
Mini-course I designed for researchers in Immunology and Immunoengineering.

Mathematical Writing for CS PhD Students Spring 2023
Two guest lectures I gave for CMSC 30100: *Technical Writing and Presentation*.

Course Designer and Instructor, Boston University

CS507: *Convex Optimization Algorithms* Spring 2018, Spring 2019
Graduate course I designed.

CS591: *Iterative Methods for Graph Algorithms* Spring 2015, Fall 2016
Graduate course I designed.

CS131: *Combinatoric Structures* Fall 2015, Spring 2017
Undergraduate course.

CS330: *Introduction to Algorithms* Fall 2018
Undergraduate course.

Course Designer and Instructor, MIT

18.434: *Undergraduate Seminar in Theor. Comput. Sci.* Spring 2013, 2014
Undergraduate seminar course I designed.

18.310C: *Principles of Discrete Applied Mathematics* Fall 2012, 2013
Communication-intensive course I developed with M.X. Goemans, S. Ruff, P. Shor.

18.02: *Multivariable Calculus* Spring 2012

18.01: *Calculus* Fall 2011

ADVISING AND MENTORING

Postdoctoral Trainees, University of Chicago

- Jeffrey Negrea, *Data Science Institute Postdoctoral Research Scholar*, 2022–2023
Next position: Assistant Professor, Statistics, University of Waterloo.

Postdoctoral Trainees, Boston University

- Jelena Diakonikolas, née Maragević, 2016–2018
Next position: Assistant Professor, Computer Sciences, U. Wisconsin–Madison.

PhD Students, University of Chicago

- Devin Mithal, Computer Science 2022–present
- Adela De Pavia, Computational and Applied Mathematics 2021–present
Expected graduation: 2025. NSF Graduate Research Fellowship (GRF) awarded 2022.
- Antares Chen, Computer Science 2020–present
Expected graduation: 2025. NSF GRF awarded in 2021.
- Ruimin Zhang, Computer Science 2020–present
Expected graduation: 2026. Co-advised with Haifeng Xu.
- Ryan Robinett, Computer Science 2020–present
Expected graduation: 2025. NSF GRF awarded in 2019. Co-advised with Samantha Riesenfeld.
- Konstantinos Ameranis, Computer Science 2019–present
Expected graduation: 2024. Also my PhD advisee, Boston University, 2018–2019.
- Erasmo Tani, Computer Science 2019–present
Expected graduation: 2025. Also my Masters degree advisee, Boston University, 2017–2019.
- Zixin Ding, Computer Science 2019–2022
Switched PhD advisor to Yuxin Chen.

Graduated PhD Students, Boston University

- Cem Aksoylar, Electrical and Computer Engineering, 2015–2016. PhD, 2016
Co-advised student. Next position: Applied Scientist, Microsoft, Sunnyvale, CA.
- Zhenyu Liao, PhD, Computer Science, 2015–2019. PhD, 2019
Next position: Research Scientist, ByteDance AI Lab, Menlo Park, CA.

Masters Students, University of Chicago

- Jiawei Hu, *Pre-doctoral MS in Computer Science*, 2022–2023. Masters, 2023
Next position: PhD student, Computer Science, GeorgiaTech.
- Andrew Eckart, *Computer Science, Research Intern*, 2020–2021. Masters, 2021
Next position: Software engineer, SpaceX.

Undergraduate Research Advisees, University of Chicago

- William Hu 2023-present
- Siqi (Clover) Zheng 2021–2022
Next position: PhD student, Mathematics, Princeton University.
- Yiqiao Bao 2021–2022
Next position: PhD student, Computer Science, University of Pennsylvania.
- Xifan Yu 2020–2022
Next position: PhD student, Computer Science, Yale University.
- Yueheng Zhang 2020–2022
For our work, Zhang received the College Research Fellowship in Summer 2020.
Next position: PhD student, Computer Science, University of Waterloo.
- Isabella Declue, *Center for Data and Computing Research Intern*, 2020–2021
For our work, Declue received the College Research Fellowship in Fall 2020.
Next position: Software engineer, Microsoft Search, Assistant and Intelligence.

Undergraduate Research Advisees, Boston University

- Zixin Ding 2017–2019
Next position: PhD student, Computer Science, University of Chicago.

High-School Student Research Advisees, University of Chicago

- Andrew Razborov 2020–2021
Next position: Undergraduate, University of Chicago.

PROFESSIONAL SERVICE AND OUTREACH

Special Program Organizer, IDEAL Institute 2023-2024
One of 12 organizers for the Special Semester Program on Networks and Inference. Organizer for two workshops within the program: “Workshop on Learning in Networks: Discovering Hidden Structure” (April 2024) and “Workshop on Graph Representation Learning” (May 2024).

Program Committee Member

Served on program committees for numerous conferences: NeurIPS 2021, FOCS 2021, ITCS 2021, SODA 2020, SODA 2017, and ICALP 2016.

NSF Panelist

Served as a panelist for the NSF CISE Division of Computing and Communication Foundations (CCF) in 2014, 2017, 2020 and 2021.

Action Editor, Transactions of Machine Learning Research (TMLR) 2023–present
Coordinating the review process for submissions to TMLR in my area.

TCS Visioning Workshop 2020
Contributed to and participated in this SIGACT workshop aiming to highlight achievements in theoretical computer science and call for robust funding support.

CIFellows Reviewer 2020
Reviewed postdoctoral applicants to the CIFellows program sponsored by the CRA, CCC and NSF.

Program Organizer, Simons Institute for Theoretical Computer Science 2017
Organized a semester-long program, *Bridging Continuous and Discrete Optimization*, which included developing a program proposal, inviting speakers, planning talks, organizing logistics, and managing fellowship applications.

Workshop Organizer 2017
Organized and taught at the conference workshop *User-Friendly Tools from Continuous Optimization*, affiliated with STOC 2017.

Summer School Outreach 2013
Developed and co-taught a 2-week summer school on *Geometry, Graphs and Optimization*, as part of the government program *Messaggeri della Conoscenza 2013*, which aims to expose undergraduates in underdeveloped regions of Italy to instructors from internationally recognized universities.

UNIVERSITY AND DEPARTMENTAL SERVICE

Rising Stars in Data Science Faculty Committee 2021,2022,2023
Helped select candidates and organize talks for UChicago Data Science Institute’s annual national workshop *Rising Stars in Data Science*, for graduating PhD students and postdoctoral trainees entering the academic job market.

Departmental Committees

Graduate Affairs Committee	2022–present
Computer Science PhD Admissions Committee	2019–present
Undergraduate Affairs Committee	2020–2022

Large-scale Collaborative Grant Proposals

Institute for AI and the Rules of Life (AIROL), PI: R. Willett	2020
NSF/VMware Next Gen. Sustain. Digital Infra. (NGSDI), PI: A. Chien	2020