Joshua A. Grochow

jgrochow@colorado.edu
University of Colorado Boulder
1111 Engineering Dr., ECOT 717, 430 UCB
Boulder, CO, 80309, USA

Degrees Awarded

University of Chicago Chicago, IL
Ph.D. in Computer Science, *Advisors: Lance Fortnow and Ketan Mulmuley* Jun 2012
Master of Science in Computer Science Dec 2008

Massachusetts Institute of Technology Cambridge, MA
Master of Engineering in Electrical Engineering and Computer Science Sep 2006
Advisor: Manolis Kellis
Bachelor of Science in Computer Science and Engineering Jun 2006
Bachelor of Science in Mathematics Jun 2005

Positions

Department of Computer Science, University of Colorado – Boulder Boulder, CO
Assistant Professor Aug 2016 – Present

Department of Mathematics, University of Colorado – Boulder Boulder, CO
Assistant Professor (by courtesy) Jun 2017 – Present

Santa Fe Institute Santa Fe, NM
Omidyar Postdoctoral Fellow Jun 2014 – May 2017

Department of Computer Science, University of Toronto Toronto, Canada
Postdoctoral Research Fellow Sep 2012 – May 2014

Google, Inc. Mountain View, CA
Software Engineering Intern, AdWords Front-End Summer 2007

Computational Biology Group, MIT EE/CS Cambridge, MA
M. Eng. Student, supervised by Manolis Kellis Sep 2005 – Aug 2006

Department of Mathematics, Louisiana State University Baton Rouge, LA
Researcher, NSF Research Experience for Undergraduates, supervised by Helena Verrill Summer 2003

Amorphous Computing Group, MIT AI Lab Cambridge, MA
Undergraduate Researcher, supervised by Radhika Nagpal and Gerald J. Sussman Jun 2002 – Dec 2002

Grants

2021 **CAREER: Higher-Order Interactions in Tensors and Isomorphism Problems**
Funder: National Science Foundation, Div. Computer & Information Science & Engineering (CISE)
Role: PI

Total: $600,000
Period: 2021-2026
Co-investigators: none

2019 Workshop on Tensors: Algebra, Computation & Applications.
Funder: US National Security Agency (NSA)
Role: PI
Total: $25,000 (my portion: $12,500)
Period: 2019
Co-investigators: With P. Brooksbank (Bucknell), A. Hulpke (Colorado State Univ.), J. B. Wilson (Colorado State Univ.), Y. Qiao (Univ. Technology, Sydney)

2017 SQuaRE Grant: Fast matrix multiplication, additive combinatorics, and modular representation theory.
Funder: American Institute of Mathematics (AIM)
Role: PI
Total: Covers funding for an annual collaborative meeting at AIM headquarters
Period: 2017-2019, extended to 2022 due to pandemic
Co-investigators: J. Blasiak (Drexel), T. Church (Stanford), H. Cohn (Microsoft Research), and C. Umans (California Inst. Technology)

2017 Thermodynamics and computation: towards a new synthesis.
Funder: National Science Foundation, Division of Physics (PHY)
Role: co-PI
Total: $45,000
Period: 2017-2018
Co-investigators: D. H. Wolpert (PI, Santa Fe Inst.)

2016 INSPIRE: Tradeoffs in the thermodynamics of computation; a new paradigm for biological information-processing
Funder: National Science Foundation, Division of Chemistry (CHE)
Role: Consultant
Total: $999,947 (my portion: $30,000)
Period: 2016-2019
Co-investigators D. H. Wolpert (PI; Santa Fe Inst.), S. Deffner (Univ. Maryland, Baltimore County), S. Lloyd (Massachusetts Inst. Technology), S. Prohaska (Leipzig Univ.), P. Stadler (Leipzig Univ.).

2016 Collaborative Research: New algorithms for group isomorphism.
Funder: National Science Foundation, Division of Mathematical Sciences (DMS), Computational Mathematics
Role: PI
Total: $492,133 (my portion: $112,927, including REU supplement)
Period: 2016-2020
Co-investigators: P. Brooksbank (Bucknell), J. B. Wilson (Colorado State Univ.), Y. Qiao (Univ. Technology, Sydney)

2016 Network comparison, a cornerstone of the foundations of network science.
Funder: National Science Foundation, Division of Mathematical Sciences (DMS), Computational and Data-Enabled Science (CDS&E-MSS)

Role: co-PI
Total: $125,000, plus REU supplement
Period: 2016-2020
Co-investigators: L. Hébert-Dufresne (PI; Univ. Vermont)

2014 **SQuaRE Grant: Fast matrix multiplication via representation theory of finite groups and coherent configurations.**
Funder: American Institute of Mathematics (AIM)
Role: PI
Total: Covers funding for an annual collaborative meeting at AIM headquarters
Period: 2014-2016
Co-investigators: J. Blasiak (Drexel), T. Church (Stanford), H. Cohn (Microsoft Research), and C. Umans (California Inst. Technology)

Publications†

1. Grochow, J. A. and Levet, M., **On the descriptive complexity of groups without Abelian normal subgroups**. arXiv:2209.13725 [cs.LO]. Submitted for journal publication, 2022.
2. Blasiak, J., Cohn, H., Grochow, J. A., Pratt, K., and Umans, C., **Matrix multiplication via matrix groups**. *14th Innovations in Theoret. Comp. Sci. (ITCS)*, 2023. DOI:10.4230/LIPIcs.ITCS.2023.19. Preprint arXiv:2204.03826 [math.GR].
3. Chen, L., Grochow, J. A., Layer, R., and Levet, M., **Experience report: standards-based grading at scale in Algorithms**. *Proc. 27th ACM Conf. Innovation and Teaching in Computer Science Education (ITiCSE)*, 2022. Preprint arXiv:2204.12046 [cs.CY]. DOI: 10.1145/3502718.3524750.
4. Grochow, J. A. and Levet, M., **On the parallel complexity of Group Isomorphism via Weisfeiler-Leman**. arXiv:1905.02518 [cs.DS]. Submitted for journal publication, 2022.
5. Grochow, J. A., **Polynomial-time Axioms of Choice and polynomial-time cardinality.** To appear in *Theory of Computing Systems*, 2023. Preprint arXiv:2301.07123 [cs.CC]. In memoriam, Alan L. Selman.
6. Grochow, J. A. and Qiao, Y., **On p-group isomorphism: search-to-decision, counting-to-decision, and nilpotency class reductions via tensors**. *IEEE Conf. on Computational Complexity (CCC)*, 2021. DOI: 10.4230/LIPIcs.CCC.2021.16. Submitted for journal publication.
7. †Song, Y. and Grochow, J. A., **An improved algorithm for coarse-graining cellular automata.** arXiv:2012.12153 [nlin.CG], 2020. Submitted, in revision.
8. Grochow, J. A., Qiao, Y., and Tang, G., **On testing isomorphism of polynomials, algebras, and multilinear forms.** *Symp. Theoret. Aspects Comp. Sci.2021 (STACS '21)*. Preprint arxiv:2012.01085 [cs.DS], 2020. DOI: 10.4230/LIPIcs.STACS.2021.38.
9. Grochow, J. A. and Qiao, Y., **On the complexity of isomorphism problems for tensors, groups, and polynomials I: Tensor Isomorphism-completeness**. *Innov. Theoret. Comp. Sci. 2021 (ITCS21)*. Preprint arXiv:1907.00309 [cs.CC], 2019. Accepted to *SIAM J. Comput.*, to appear 2023.
10. Baiser, B., Gravel, D., Cirtwell, A. R., Dunne, J. A., Fahimipour, A. K. Gilarranz, L. J., Grochow, J. A., Li, D., Martinez, N., McGrew, A., Romanuk, T. N., Stouffer, D. B., Trotta, L. B., Valdovinos, F. S., Williams, R. J., Wood, S. A., Yeakel, J. D., **Ecogeographical rules and the macroecology of food webs**. *Global Ecology & Biogeography*, 28:1204-1218, 2019, concept paper. DOI: 10.1111/geb.12925.
11. Brooksbank, P. A., Grochow, J. A., Li, Y., Qiao, Y., Wilson, J.B., **Incorporating Weisfeiler-Leman into algorithms for group isomorphism**. arXiv:1905.02518 [cs.CC]. Submitted 2019.

† On papers marked with †: the author order follows the style of biology publications. All others alphabetical.

12. Futorny, V., Grochow, J. A., and Sergeichuk, V. V., **Wildness for tensors**. *Lin. Alg. Appl.* 566(1):212-244, 2019. DOI: 10.1016/j.laa.2018.12.022. Preprint arXiv:1810.09219 [math.RT].
13. Grochow, J. A. and Tucker-Foltz, J., **Computational topology and the Unique Games Conjecture**. *34th Internat. Symp. Computational Geometry (SoCG)*, 43:1-43:16, 2018. DOI: 10.4230/LIPIcs.SoCG.2018.43. Preprint of full version arXiv:1803.06800 [cs.CC].
14. Blasiak, J., Church, T., Cohn, H., Grochow, J. A., Umans, C., **Which groups are amenable to proving exponent two for matrix multiplication?** arXiv:1712.02302 [math.GR], 2017. Submitted.
15. Allender, E., Grochow, J. A., van Melkebeek, D., Moore, C., Morgan, A., **Minimum circuit size, graph isomorphism, and related problems.** *SIAM J. Comput.* 47(4):1339-1372 ,2018. DOI: 10.1137/17M1157970. Prelim. version in *9th Innovations in Theoret. Comp. Sci. (ITCS)*, 2018. DOI: 10.4230/LIPIcs.ITCS.2018.20 (Preprint arXiv:1710.09806 [cs.CC] and ECCC TR-17-158).
16. Grochow, J. A. and Moore, C., **Designing Strassen's algorithm.** arXiv:1708.09398 [cs.DS] and ECCC TR17-131, 2017.
17. †Kanwal, M. S., Grochow, J. A., Ay, N., **Comparing information-theoretic measures of complexity in Boltzmann machines**. *Entropy* 19(7):310, 2017. DOI: 10.3390/e19070310
18. Berdahl, A., Bhat, U., Ferdinand, V., Garland, J., Ghazi-Zahedi, K., Grana, J. Grochow, J. A., Hobson, E. A., Kallus, Y., Kempes, C. P., Kolchinsky, A., Larremore, D. B., Libby, E., Power, E. A., Tracey, B. D., **On the records**. arXiv:1705.04353 [physics.soc-ph], 2017.
19. Grochow, J. A., Kumar, M., Saks, M., and Saraf, S., **Towards an algebraic natural proofs barrier via polynomial identity testing**. arXiv:1701.01717 [cs.CC] and ECCC TR17-009, 2017.
20. Grochow, J. A. and Moore, C., **Matrix multiplication algorithms from group orbits**. arXiv:1612.01527 [cs.CC], 2016.
21. †Libby, E., Grochow, J. A., DeDeo, S., and Wolpert, D. H., **A quantitative definition of organismality and its application to lichen**. arXiv:1612.00036 [q-bio.OT], 2016.
22. Blasiak, J., Church, T., Cohn, H., Grochow, J. A., Naslund, E, Sawin, W., and Umans, C., **On cap sets and the group-theoretic approach to matrix multiplication**. *Discrete Analysis* 2017:3, arXiv:1605.06702 [math.CO]. DOI:10.19086/da.1245
23. Grochow, J. A., Mulmuley, K. D., and Qiao, Y., **Boundaries of VP and VNP**. *43rd Internat. Colloq. Automata, Languages, and Programming (ICALP)*, 2016. (Preprint of full version arXiv:1605.02815 [cs.CC].) Submitted for journal publication.
24. Berdahl, A., Breslford, C., De Bacco, C., Dumas, M., Ferdinand, V., Grochow, J. A., Hébert-Dufresne, L., Kallus, Y., Kempes, C. P., Kolchinsky, A., Larremore, D. B., Libby, E., Power, E. A., Stern, C. A., and Tracey, B. D. (Santa Fe Institute Postdocs), **Dynamics of beneficial epidemics**. *Scientific Reports*, 9:15093, 2019. DOI: 10.1038/s41598-019-50039-w
25. †Hébert-Dufresne, L., Grochow, J. A., and Allard, A., **Multi-scale structure and topological anomaly detection via a new network statistic: The onion decomposition**. *Scientific Reports*, 6:31708, 2016. DOI:10.1038/srep31708
26. Grochow, J. A., **Monotone projection lower bounds from extended formulation lower bounds**. *Theory of Computing* 13:18, 2017. DOI: 10.4086/toc.2017.v013a018 (Preprint arXiv:1510.08417 [cs.CC] and ECCC TR15-171.)
27. Allender, E., Grochow, J. A., and Moore, C., **Graph isomorphism and circuit size**. ECCC TR15-162.
28. Grochow, J. A. and Qiao, Y., **Polynomial-time isomorphism test of groups that are tame extensions**. *26th Internat. Symp. on Algorithms & Computation (ISAAC)*, 2015. DOI: 10.1007/978-3-662-48971-0_49 (Preprint of full version arXiv:1507.01917 [cs.DS].)
29. †Wolpert, D. H., Grochow, J. A., Libby, E. and DeDeo, S., **The many faces of state-space compression.** In Walker, Davies, & Ellis (eds.), *From Matter to Life: Information and Causality*, Cambridge University Press, 2017, Chapter 10. (Preprint arXiv:1409.7403 [cs.IT].)

30. Grochow, J. A. and Pitassi, T., **Circuit complexity, proof complexity, and polynomial identity testing**. *J. ACM* 65(6) Art. No. 37, 2018. DOI: 10.1145/3230742. Prelim. version in *IEEE Symp. on Foundations of Computer Science (FOCS),* 2014. DOI: 10.1109/FOCS.2014.20 (Preprint arXiv:1404.3820 [cs.CC] and ECCC TR14-052.)

31. Chan, M., Church. T., and Grochow, J. A., **Rotor-routing and spanning trees on planar graphs**. *Int. Math Research Notices*, 11:3225-3244, 2015. DOI: 10.1093/imrn/rnu025 (Preprint arXiv:1308.2677 [math.CO].)

32. Grochow, J. A., **Unifying known lower bounds via geometric complexity theory**. *Computational Complexity* 24(2):393-475, 2015. Open access. Special issue devoted to the top 5 papers from *IEEE Conf. on Computational Complexity (CCC)*, 2014. DOI: 10.1007/s00037-015-0103-x

33. Grochow, J. A. and Qiao, Y., **Algorithms for group isomorphism via group extensions and cohomology**. *SIAM J. Comput.* 46(4):1153-1216, 2017. Open access. DOI:10.1137/15M1009767 Preliminary version in *IEEE Conf. on Computational Complexity (CCC)*, 2014. (Also available as arXiv:1309.1776 [cs.DS] and ECCC TR13-123. Preliminary version 10.1109/CCC.2014.19.)

34. Grochow, J. A., **Matrix isomorphism of matrix Lie algebras**. *IEEE Conf. on Computational Complexity (CCC)*, June 2012. DOI: 10.1109/CCC.2012.34 (Full version arXiv:1112.2012 [cs.CC] and ECCC TR11-168.)

35. Fortnow, L. and Grochow, J. A., **Complexity classes of equivalence relations revisited**. *Information and Computation* 209(4):748-763, 2011. DOI: 10.1016/j.ic.2011.01.066 (Preprint arXiv:0907.4775 [cs.CC].)

36. Babai, L., Codenotti, P., Grochow, J. A. and Qiao, Y., **Code equivalence and group isomorphism**. SIAM Symp. on Discrete Algorithms (SODA), 2011. DOI: 10.1137/1.9781611973082.107.

37. †Jothi, R., Balaji, S., Wuster, A., Grochow, J. A., Gsponer, J., Przytycka, T. M., Aravind, L. and Madan Babu, M., **Genomic analysis reveals a tight link between transcription factor dynamics and regulatory network architecture**. *Molecular Systems Biology* 5:294, 2009. DOI:10.1038/msb.2009.52

38. †Grochow, J. A. and Kellis, M., **Network motif discovery using subgraph enumeration and symmetry-breaking**. In *RECOMB 2007*, Lecture Notes in Computer Science 4453, pp. 92-106, Springer-Verlag, 2007. DOI:10.1007/978-3-540-71681-5_7

Surveys & Expositions

39. Grochow, J. A., **Complexity in ideals of polynomials: Questions on algebraic complexity of circuits and proofs.** *Bulletin EATCS* 130, 2020.

40. Grochow, J. A., **New applications of the polynomial method: The cap set conjecture and beyond.** *Bulletin AMS* 56(1):29-64, 2019. DOI: 10.1090/bull/1648.

41. Grochow, J. A. and Wolpert, D. H., **Beyond number of bit erasures: New complexity questions raised by recently discovered thermodynamic costs of computation**. *ACM SIGACT News*, June 2018. DOI: 10.1145/3232679.3232689.

42. Grochow, J. A. **NP-complete sets are not sparse unless P=NP: An exposition of a simple proof of Mahaney's Theorem, with applications**. arXiv:1610.05825 [cs.CC] and ECCC TR16-162, 2016.

43. Grochow, J. A. & Rusek, K., **Report on "Mathematical Aspects of P vs. NP and its Variants" August 1-5, 2011 at Brown-ICERM**. Organizers J. M. Landsberg, S. Basu, and J. M. Rojas. arXiv:1203.2888 [cs.CC].

Theses

44. Grochow, J. A., **Symmetry and equivalence relations in classical and geometric complexity theory**. Ph.D. thesis, U. Chicago, 2012. http://www.cs.colorado.edu/~jgrochow/grochow-thesis.pdf

45. Grochow, J. A., **The complexity of equivalence relations**. Master's thesis, U. Chicago, 2008. http://www.cs.colorado.edu/~jgrochow/Grochow_UofC_Masters_08_Equivalence_Relations.pdf
46. Grochow, J. A., **On the structure and evolution of protein interaction networks**. Master's thesis, MIT, 2006. http://hdl.handle.net/1721.1/42053

Edited Volumes

47. Wolpert, D. H., Kempes, C., Stadler, P. F., and Grochow, J. A. (editors), *The Energetics of Computing in Life and Machines*. SFI Press, 2019.

Invited Talks

Polynomial-time Axioms of Choice and polynomial-time cardinality. U. Connecticut Logic Colloquium, Jan 27, 2023.

Polynomial Identity Testing & the Ideal Proof System. DIMACS Workshop on Meta-Complexity, Barriers, and Derandomization. Apr 26, 2022.

Circuit Compliexity, Ideals, and Proof Systems: Connections & Recent Results. Invited talk at the FOCS '21 Workshop: Reflections on Propositional Proofs in Algorithms & Complexity. Feb 7, 2022.

Geometric Complexity Theory, Characterization by Symmetries, and Natural Proofs. Two invited talks at the School & Conference on Geometric Complexity Theory, November 9 & 12, 2021.

Codes and Expansions in Algorithms for Matrix Multiplication. Codes and Expansions (CodEx) Seminar, February 2021.

Understanding large systems from their small parts: Algorithms & theory.

- Clarkson Univ. Center for Complex Systems Science, September 24, 2020, Potsdam, NY (online).
- Univ. Colorado Boulder Computer Science Colloquium, September 10, 2020, Boulder, CO.

Multi-way interactions. Invited panelist. Santa Fe Institute-National Science Foundation Workshop on Convergent Paths Towards Universality in Complex Systems, December 2019, Alexandria, VA.

Tensor Isomorphism: completeness, graph-theoretic methods, and consequences for Group Isomorphism.

- IPAM Semester on Tensor Methods & Emerging Applications to the Physical and Data Sciences, May 25, 2021.
- TU Berlin Kolloquium on Algorithmic Mathematics & Complexity Theory, April 28, 2021
- Johns Hopkins Univ. Computer Science Theory Seminar, October 28, 2020, Baltimore, MD.
- Rocky Mountain Algebraic Combinatorics Seminar, November 2019, Fort Collins, CO.
- Banff (BIRS) Workshop on Algebraic Techniques in Computational Complexity, July 2019, Banff, Canada.

Tutorial: Tensors & Complexity. Workshops on Tensors: Algebra, Computation, and Applications (TACA), June 2019.

Complexity in ideals of polynomials. Clay Mathematics Institute / Oxford Workshop on Complexity Theory, July 2018.

Computational complexity, dynamical systems, and non-convex optimization. CU Boulder Dept. of Applied Mathematics Colloquium, March 2018.

Combinatorial polytopes in algebraic and geometric complexity theory.

- Rocky Mountain Algebraic Combinatorics Seminar, March 2018.
- U. Washington CS Theory Seminar, March 2016.

The Ideal Proof System(s). Dagstuhl Workshop on Proof Complexity, January 2018.

The Cap Set Conjecture, the polynomial method, and applications (after Croot-Lev-Pach, Ellenberg-Gijswijt, and others). AMS Current Events Bulletin, January 2018.

Wildness & geometry in representation theory & computational complexity. CU Boulder Dept. of Mathematics Kempner Colloquium, November 2017.

Representation theory and additive combinatorics in algorithms for matrix multiplication.

- Rocky Mountain Algebraic Combinatorics Seminar, October 2017.
- CU Boulder Dept. of Mathematics Lie Theory Seminar, December 2017.

Proof, intuition, and understanding. SFI Workshop on Limits to Understanding, November 2017.

Tutorial: Computational complexity. SFI Workshop on Thermodynamics and Computation in Chemical and Biological Systems, August 2017.

Wildness at the heart of complexity. U.T. Austin CS Theory Seminar, October 2016.

Newton polytopes of quiver semi-invariants in geometric complexity theory. Philadelphia Area Combinatorics and Algebraic Geometry (CAGE) Seminar, May 2016.

What makes individual problem instances hard? Computational complexity and complex systems. C. U. Boulder CS Colloquium, April 2016.

Network structure at multiple scales via a new statistic: The onion decomposition. SFI Workshop on Inference on Networks: Algorithms, Phase Transitions, New Models and New Data, December 2015.

Wildness in computational complexity. SFI Workshop on Wildness in Computer Science, Physics, and Mathematics, October 2015. 90-minute opening talk of the workshop, followed by another 90 minutes by request.

The role of symmetry (or the lack thereof) in algorithms and computational complexity. U. New Mexico CS Colloquium, April 2015.

New connections between lower bounds on algorithms, circuits, and proofs. Rutgers/DIMACS Theory of Computing Seminar, February 2014.

Satellite Mini-Workshop on Geometric Complexity. Tokyo ELC Complexity Workshop, March 2013.

Unifying and generalizing known lower bounds via geometric complexity theory.

- Institute for Advanced Study, Princeton, Theoretical CS and Discrete Math Seminar, February 2014.
- Stanford CS Theory Seminar, May 2013.

- MIT CS Theory Seminar, April 2013.
- Penn. State University, Mathematics Dept. Algebra and Number Theory Seminar, December 2013.
- Exploring the Limits of Computation Tokyo Complexity Workshop, March 2013.

Algorithms for group isomorphism via group extensions and cohomology. Penn. State University, CS Theory Seminar, December 2013.

New examples of orbit closures via computational complexity. Texas A&M Geometry Seminar, Feb 2013.

Symmetry-characterization in Geometric Complexity Theory: representation theory and matrix Lie algebra isomorphism. AMS Joint Mathematics Meetings Special Session on Geometric Complexity Theory, January 2013.

An Introduction to Geometric Complexity Theory.
- York University, Mathematics Dept. Applied Algebra Seminar, November 2012.
- Dagstuhl Workshop on Algebraic and Combinatorial Methods in Complexity, October 2012.
- U. Toronto Mathematics Dept. Geometric Representation Theory Seminar, October 2012.
- U. Toronto CS Theory Seminar, October 2012.
- Stanford Mathematics Dept. Topology Seminar, January 2012.
- Brown-ICERM Workshop on "Mathematical Aspects of P vs. NP and its Variants," August 2011. Video available at http://icerm.brown.edu/video_archive.

Wildness, Geometry and Complexity. Texas A&M Mathematics Dept. Geometry Seminar, May 2011.

The Complexity of Equivalence Relations. Boston University CS Theory Seminar, September 2009.

Awards

Outstanding Faculty Mentor Award, Univ. Colorado Boulder, 2021-2022.

Graduate Student Advising, honorable mention, Univ. Colorado Boulder, Spring 2021.

Dean's Faculty Fellowship, Univ. Colorado Boulder, Spring 2021

Teaching Assistant Prize, University of Chicago, Department of Computer Science, 2009

Charles and Jennifer Johnson Outstanding M. Eng. Thesis Award, MIT, Department of EE/CS, 2007

Finalist, Hertz Foundation Graduate Fellowship, 2007

Research Supervision

Postdoctoral Supervisor	Boulder, CO
Abhiram Natarajan	Summer 2020 – Spring 2021
Nathan Lindzey (joint with Alex Kolla)	Spring 2019 – Fall 2022
Eric Reckwerdt (joint with Alex Kolla)	Fall 2018 – Summer 2020

Ph.D. Advisor	Boulder, CO

Elise Tate, Dept. of Computer Science	Spring 2021 – Present
Robert Green, Dept. of Computer Science	Fall 2018 – Present
Tzu-Chi Yen, Dept. of Computer Science (co-advised with Dan Larremore)	Fall 2018 – Present
Maya Ornstein, Dept. of Mathematics	Spring 2017 – Present
Michael Levet, Dept. of Computer Science	Ph.D. expected May 2023
Gabriel Andrade, Dept. of Computer Science (co-advised with Raf Frongillo)	Ph.D. May 2022
Tyler Schrock, Dept. of Mathematics	Ph.D. Dec 2019

Ph.D. Thesis Committee

Charlie Carlson (CU Boulder CS)	Spring 2023
Jonathan Quartin (CU Boulder Math)	Spring 2023
Burl Amsbury (CU Boulder Economics)	Spring 2022
Abhranil Chatterjee (Inst. Math. Sci., Chennai, India)	Spring 2022
Katharine Adaymk (CU Boulder Math)	Spring 2020
C. Ramya (IIT Madras CS)	Spring 2019
Paul Lessard (CU Boulder Math)	Spring 2019
Jonathan Paul Lamar (CU Boulder Math)	Spring 2018
Jeffrey Alan Shriner (CU Boulder Math)	Spring 2018
Nora Connor (CU Boulder CS)	Spring 2017

Undergraduate Thesis	Boulder, CO
Nathaniel Collins (CU Boulder Math)	2022-2023
Luke Meszar (CU Boulder CS)	2018-2019

Undergraduate Thesis Committee

Saurabh Totey (CU Boulder CS)	Spring 2023
Zachary Jorquera (CU Boulder CS)	Spring 2022
Michael Walker (CU Boulder Math)	Spring 2022
Justin Cai (CU Boulder CS)	Spring 2020
Henry Fontana (CU Boulder Math)	Spring 2020
Justin Wilson (CU Boulder Math)	Spring 2019

Undergraduate Researcher	Boulder, CO
Nicole Dong (CU Boulder)	Fall 2020 – Summer 2021
Ezzeddine El Sai (CU Boulder)	Fall 2020 – Present
Samuel Serra (CU Boulder)	Winter 2020 – Spring 2021
Tarek Tohme (American U. Beirut)	Summer 2019, Summer 2020
Arthur Pellegrino (CU Boulder)	Summer 2019
Samuel Schlesinger (U. Massachusetts – Amherst)	Summer 2018
Jamie Tucker-Foltz (Amherst College)	Summer 2017

High School Researcher	Boulder, CO
Michael Klyachman	Summer 2020
Yerim Song	Summer 2020

Senior Thesis in Mathematics, Reed College	Portland, OR
Sarah Brauner (internal advisor: Prof. A. Osorno)	2015-2016

NSF Research Experience for Undergraduates (REU), Santa Fe Institute	Santa Fe, NM

Ian Klasky, Algorithmic coarsening of computationally irreducible complex systems Summer 2016
Roujia Wen, Applying novelty search to the SAT problem Summer 2016
Sarah Brauner, Sorting and the information-theoretic bound: a structural analysis Summer 2015
Maxinder Kanwal, Quantifying complexity (co-supervisor: Prof. N. Ay) Summer 2015

NSF Research Experience for Undergraduates (REU) Dept. of Math., U. Chicago Chicago, IL
Elan Bechor, Statistical group theory Summer 2008
Alexander Staples-Moore, Equitable partitions in graph theory Summer 2008
Alex Rosenfeld, Understanding irreducible representations Summer 2008
Isaac Ottoni Wilhelm, Packing triangles on a sphere Summer 2008
Angelica Wong, Primes and quadratic reciprocity Summer 2008

Teaching

Department of Computer Science, University of Colorado – Boulder Boulder, CO
Algorithms (undergrad, CSCI 3104) Spring 2018, 2019, 2020, Fall 2021,2022
Computational Complexity Theory (grad, CSCI 6114) Fall 2021
Practical Algorithmic Complexity (undergrad/grad CSCI 4114/5114) Fall 2019, 2020, 2022
Tensors & Computational Complexity (grad, CSCI 7000-014) Fall 2017

Santa Fe Institute Santa Fe, NM
Lecturer, Tutorial on Computation Theory, complexityexplorer.org (online) Fall 2017
Lecturer, Complex Systems Summer School Summer 2015
Lecturer, SFI REU Program Summer 2015

Department of Computer Science, University of Toronto Toronto, Canada
Lectures on Geometric Complexity Theory Fall 2012 to Spring 2013

Department of Computer Science, University of Chicago Chicago, IL
Lecturer, Lab Instructor, and Teaching Assistant Fall 2006 to Spring 2012

Department of Mathematics, University of Chicago Chicago, IL
Mentor, Directed Reading Program Winter 2008 to Spring 2008
Mentor, NSF Research Experience for Undergraduates Summer 2008

Department of Mathematics, MIT Cambridge, MA
Teaching Assistant (Fall 2004), Tutor (Spring 2004), Grader (Fall 2003)

Referee Work

Grant Reviewing

- U. S. A. National Science Foundation (NSF)
- European Research Council (ERC)
- Natural Sciences and Engineering Research Council of Canada (NSERC)
- Israel Science Foundation (ISF)
- Dutch Research Council (NWO)

Theoretical Computer Science Reviewing

- *Science Advances* (×2)
- *Nature Communications*
- *Journal of the American Mathematical Society (J. AMS)* (×3)
- *SIAM Journal on Computing (×5)*
- *Forum of Mathematics, Sigma*
- *Theoretical Computer Science* (×2)
- *Theory of Computing* (×7)
- *Theory of Computing Systems*
- *Computational Complexity* (×2)
- *J. Algebra*
- *ACM Transactions on Computation Theory* (×2)
- *SIAM Journal on Discrete Mathematics*
- *Journal of Symbolic Logic*
- *Journal of Algebraic Combinatorics* (×2)
- *Journal of Statistical Physics*
- *Foundations of Computational Mathematics* (×2)
- *Chicago Journal of Theoretical Computer Science*
- *Linear and Multilinear Algebra*
- *European Journal of Combinatorics*
- *Bulletin of Mathematical Sciences and Applications*
- *Computing*
- *Applied Soft Computing*
- Natural Sciences and Engineering Research Council of Canada (NSERC, grant review)
- Dutch Research Council (NWO, grant review)
- Cambridge University Press (book referee)
- ACM Symposium on Theory of Computing (STOC) (×19)
- IEEE Foundations of Computer Science (FOCS) (×12)
- Conference on Computational Complexity (CCC) (×7)
- ACM-SIAM Symposium on Discrete Algorithms (SODA) (×7)
- Innovations in Theoretical Computer Science (ITCS) (×4)
- International Colloquium on Automata, Languages, and Programming (ICALP) (×3)
- Theory of Cryptography Conference (TCC)
- Mathematical Foundations of Computer Science (MFCS)
- Symposium on Theoretical Aspects of Computer Science (STACS)
- International Computer Science Symposium in Russia (CSR)
- ACM-IEEE Symposium on Logic in Computer Science (LICS)
- Joint Workshop on Linearity & TLLA (Linearity/TLLA)

Other Complex Systems Reviewing

- *Information Systems*
- *Transactions on Computational Biology and Bioinformatics*
- *Scientific Reports* (×2)
- *Genome Research*
- *Genes & Genetic Systems*
- *IET Systems Biology*
- Workshop on Algorithms in Bioinformatics (WABI)

- RECOMB joint conference on Systems Biology, Regulatory Genomics, and Reverse Engineering Challenges (SB-RG-DREAM)

Professional Service

Program Committees

- International School and Conference on Network Science (NetSci), 2023
- International School and Conference on Network Science (NetSci), 2022
- IEEE Symposium on the Foundations of Computer Science (FOCS), 2020. Also co-editor SICOMP special issue.
- International School and Conference on Network Science (NetSci), 2020
- International School and Conference on Network Science (NetSci), 2019
- International School and Conference on Network Science (NetSci), 2017
- IEEE Symposium on the Foundations of Computer Science (FOCS), 2017
- Computational Complexity Conference (CCC), 2017
- FQXi Essay Contest Judge (year omitted for confidentiality)

Institutional Committees

- Univ. Colorado Boulder, Computer Science, Tenure-Track Theory Faculty Search, Chair 2021-2022
- Univ. Colorado Boulder, Computer Science, Pedagogy Committee, Chair 2020 – Present
- Univ. Colorado Boulder, Teaching Circle Leader Spring 2021, Fall 2021
- Univ. Colorado Boulder, Computer Science, Dept. Action Team 2019 – 2020
- Univ. Colorado Boulder, Computer Science, Quantum Faculty Hiring Committee 2018 – 2019
- Univ. Colorado Boulder, Computer Science, Undergraduate Curriculum Committee 2017 – 2018

Larger Workshops Organized

2021 *Santa Fe Institute-National Science Foundation Conference on the Future of Thermodynamics of Computation*
Location: online
Participants: ~30 physicists, biologists, and computer scientists
Co-organizers: D. Wolpert (Santa Fe Inst.), C. Lynn (Princeton), J. Korbel (Medical Univ. Vienna)

2019 *Workshop on Tensors: Algebra, Computation, & Applications (TACA)*
Location: Univ. Colorado Boulder and Colorado State Univ.
Participants: ~30 mathematicians, computer scientists, data scientists, and physicists
Budget: ~$35,000
Co-organizers: J. B. Wilson (Colorado State Univ.), A. Hulpke (Colorado State Univ.),
P. Brooksbank (Bucknell)

2017 *Workshop on Limits to Understanding: Past, Present, and Future*
Location: Santa Fe Institute
Participants: ~25 scientists, journalists, authors, philosophers, and more
Budget: ~$50,000
Co-organizers: D. Krakauer (President, Santa Fe Inst.), B. D. Tracey (Santa Fe Inst.)

2017 *Workshop on Thermodynamics & Computation: Towards a New Synthesis*,

Location: Santa Fe Institute
Participants: ~50 researchers from biology, physics, computer science
Budget: ~$45,000
Co-organizers: D. H. Wolpert (Santa Fe Inst.), C. Kempes (Santa Fe Inst.), P. F. Stadler (Leipzig Univ.)

2017 *Workshop on Thermodynamics of Computation in Chemical and Biological Systems*
Location: Santa Fe Institute
Budget: ~$45,000
Co-organizers: D. H. Wolpert (Santa Fe Inst.), C. Kempes (Santa Fe Inst.), P. F. Stadler (Leipzig Univ.)

2016 *Workshop on the Limits to Prediction*
Location: Santa Fe Institute
Participants: ~25 researchers from engineering, epidemiology, ecology, biology, weather, mathematics, climate science, and other areas
Budget: ~$65,000
Co-organizer: D. Krakauer (President, Santa Fe Inst.)

2015 *Workshop on Wildness in Computer Science, Mathematics, and Physics.*
Location: Santa Fe Institute
Participants: ~25 computer scientists, mathematicians, and physicists
Budget: ~$35,000
Co-organizers: C. Moore (Santa Fe Inst.), V. Vedral (Univ. Oxford), J. Weyman (Univ. Connecticut)

Working Groups Organized (Santa Fe Institute)

2016 *New Algorithms for Group Isomorphism*
Participants: 2 computer scientists & 2 mathematicians

2016 *Geometric Complexity Theory*
Participants: 9 computer scientists & mathematicians

2016 *72 Hours of Science*
Participants: 15 postdocs from different disciplines
Note: conceived, executed, and wrote a paper in 72 hours (arXiv:1604.02096).
Involved much more significant organization & planning than most workshops.

2016 *Comparing Food Webs Along Gradients*
Participants: 2 computer scientists & 2 ecologists

2015 *Algorithms for Matrix Multiplication via the Representation Theory of Finite Groups and Coherent Configurations*
Participants: 4 computer scientists and mathematicians

2015 *Algebra, Geometry, Pseudorandomness, and Complexity*
Participants: 6 theoretical computer scientists.

Synergistic Activities

- Active participant on cstheory.stackexchange.com, a Q&A site for research-level theoretical computer science, contributing to worldwide graduate and researcher education
  - #2 all-time score
- Science, education, and equality microblogger on Twitter @joshuagrochow
  - 1900+ followers (top 2% of all users)
- Wikipedia contributor (various science and mathematics articles)
- Ran an invited workshop for the Univ. Colorado Boulder Center for Teaching and Learning on mastery-based grading
- Helping 7+ other Univ. Colorado faculty/instructors implement mastery-based grading in their courses
- Improving organization leadership skills through DAT Project Facilitator Network
- Improved personal pedagogy through several university and department activities
  - Faculty Teaching Excellence Program (FTEP) "Leading Class Discussions: Increasing Student Engagement," 2017
  - FTEP "Preparing a Syllabus Encourages Cooperation in the Classroom," 2017
  - FTEP video consultation and 35-item in-class survey, 2018
  - Dept. of Computer Science Teaching Circles pilot program, 2019-2021

References

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