Joshua A. Grochow

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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 to present

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

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

Department of Computer Science, University of Toronto — Toronto, Canada
Postdoctoral Research Fellow — Sep 2012 to 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 to 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 to Dec 2002

Grants

AIM SQuaRE Grant: Fast matrix multiplication, additive combinatorics, and modular. 2017-2019. With J. Blasiak, T. Church, H. Cohn, and C. Umans.

NSF PHY: Thermodynamics and computation: towards a new synthesis. Co-PI. Conference proposal with PI D. H. Wolpert. $45,000. PHY-1740919

NSF INSPIRE: Tradeoffs in the thermodynamics of computation; a new paradigm for biological information-processing. 2016-2019. Consultant. PI D. Wolpert, co-PIs S. Deffner, S. Lloyd, S. Prohaska, P. Stadler. $30,000 (grant total: $999,947). CHE-1648973

NSF DMS/Computational Mathematics: Collaborative Research: New algorithms for group isomorphism. 2016-2019. PI. Collaborative proposal with PIs P. Brooksbank, J. Wilson, in collaboration with Y. Qiao. $103,727 (collaborative total: $492,133). DMS-1750319. Plus REU Supplement.

NSF DMS/Computational and Data-Enabled Science (CDS&E-MSS): Network comparison, a cornerstone of the foundations of network science. 2016-2019. Co-PI. With PI L. Hébert-Dufresne. $125,000. DMS-1622390

AIM SQuaRE Grant: Fast matrix multiplication via representation theory of finite groups and coherent configurations. 2014-2016. With J. Blasiak, T. Church, H. Cohn, and C. Umans.

Publications[†]

1. 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].
2. 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].
3. 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.
4. 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).
5. Grochow, J. A. and Moore, C., **Designing Strassen's algorithm.** arXiv:1708.09398 [cs.DS] and ECCC TR17-131, 2017.
6. †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/c19070310
7. 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.
8. 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.
9. Grochow, J. A. and Moore, C., **Matrix multiplication algorithms from group orbits**. arXiv:1612.01527 [cs.CC], 2016.
10. †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.

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

11. 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
12. 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.
13. 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**. arXiv:1604.02096 [physics.soc-ph]. In review, 2018.
14. †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
15. 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.)
16. Allender, E., Grochow, J. A., and Moore, C., **Graph isomorphism and circuit size**. ECCC TR15-162.
17. 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].)
18. †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].)
19. 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.)
20. Chan, M., Church. T., and Grochow, J. A., **Rotor-routing and spanning trees on planar graphs**. *Int. Math Research Notices*, 2014. DOI: 10.1093/imrn/rnu025 (Preprint arXiv:1308.2677 [math.CO].)
21. 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
22. 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.)
23. 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.)
24. 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].)
25. Babai, L., Codenotti, P., Grochow, J. A. and Qiao, Y., **Code equivalence and group isomorphism**. SIAM Symp. on Discrete Algorithms (SODA), 2011. http://dl.acm.org/citation.cfm?id=2133143

26. †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

27. †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

28. 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.

29. 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.

30. Grochow, J. A., **Wildness and complexity: What wildness is, and why it's important for computational complexity**. Based on author's talk given at the *SFI Workshop on Wildness in Computer Science, Physics, and Mathematics*, co-organized by the author, in preparation, 2017.

31. 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.

32. 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

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

34. Grochow, J. A., **The complexity of equivalence relations**. Master's thesis, U. Chicago, 2008. http://tuvalu.santafe.edu/~jgrochow/Grochow_UofC_Masters_08_Equivalence_Relations.pdf

35. Grochow, J. A., **On the structure and evolution of protein interaction networks**. Master's thesis, MIT, 2006. http://hdl.handle.net/1721.1/42053

Invited Talks

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. Co-presented with Ketan Mulmuley.

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

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
Nathan Lindzey (joint with Prof. Alex Kolla)	Spring 2019 – Present
Eric Reckwerdt (joint with Prof. Alex Kolla)	Fall 2018 – Present
Ph.D. Advisor	Boulder, CO
Gabriel Andrade, Dept. of Computer Science	Fall 2018 – Present
Joel Ornstein, Dept. of Mathematics	Spring 2017 – Present
Tyler Schrock, Dept. of Mathematics	Fall 2016 – Present
Ph.D. Thesis Committee	
C. Ramya (IIT Madras CS)	Spring 2019
Paul Lessard (CU Boulder Math)	Spring 2019
Justin Wilson (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
Luke Meszar (CS)	2018-2019

Undergraduate Researcher Boulder, CO
Samuel Schlesinger, U. Massachusetts – Amherst Summer 2018
Jamie Tucker-Foltz, Amherst College Summer 2017

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 (CSCI 3104) Spring 2018 & 2019
Tensors & Computational Complexity (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)

Professional Service

Workshops and Working Groups Organized/Co-organized

- *Workshop on Limits to Understanding: Past, Present, and Future,* SFI, 2017. ~25 scientists, journalists, authors, philosophers, and more (budget: ~$50K)
- *Workshop on Thermodynamics & Computation: Towards a New Synthesis*, SFI, 2017. ~50 researchers from biology, physics, computer science (budget: ~$45K)
- *Workshop on Thermodynamics of Computation in Chemical and Biological Systems,* SFI, 2017.
- *Workshop on the Limits to Prediction,* SFI, 2016. ~25 researchers from engineering, epidemiology, ecology, biology, weather, mathematics, climate science, and other areas (budget: ~$65K).
- *Workshop on Wildness in Computer Science, Mathematics, and Physics.* SFI, Oct 12-16, 2015. ~25 computer scientists, mathematicians, and physicists (budget: ~$35K)
- *New Algorithms for Group Isomorphism*, Working Group, SFI, May 2016. Two computer scientists & two mathematicians.
- *Geometric Complexity Theory*, Working Group, SFI, Dec 2016. Nine computer scientists & mathematicians.
- *72 Hours of Science*, Working Group, SFI, April 2016. 15 postdocs from different disciplines conceived, executed, and wrote a paper in 72 hours (arXiv:1604.02096). Involved significant organization & planning.
- *Comparing Food Webs Along Gradients*, Working Group, SFI, Feb 2016. Two computer scientists & two ecologists.
- *Algorithms for Matrix Multiplication via the Representation Theory of Finite Groups and Coherent Configurations*, Working Group, SFI, Mar 25-27, 2015. Four computer scientists and mathematicians
- *Algebra, Geometry, Pseudorandomness, and Complexity*. Working Group, SFI, May 18-22, 2015. Six theoretical computer scientists.

Program Committees

- 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

Theoretical Computer Science Reviewing

- *Science Advances*
- *Nature Communications*
- *SIAM Journal on Computing (×4)*
- *Forum of Mathematics, Sigma*
- *Theoretical Computer Science* (×2)
- *Theory of Computing* (×5)
- *Computational Complexity*
- *J. Algebra*
- *ACM Transactions on Computation Theory*
- *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*
- *Bulletin of Mathematical Sciences and Applications*
- *Applied Soft Computing*
- Natural Sciences and Engineering Research Council of Canada (NSERC, grant review)
- Cambridge University Press (book referee)

- ACM Symposium on Theory of Computing (STOC) (×12)
- IEEE Foundations of Computer Science (FOCS) (×6)
- Conference on Computational Complexity (CCC) (×3)
- ACM-SIAM Symposium on Discrete Algorithms (SODA) (×6)
- Innovations in Theoretical Computer Science (ITCS) (×4)
- 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)

Active participant in cstheory.stackexchange.com, a Q&A site for research-level theoretical computer science.

References

Lance Fortnow, Professor and Chair, School of Computer Science, Georgia Tech. College of Computing
Email: fortnow@cc.gatech.edu

Toniann Pitassi, Professor of Computer Science and Mathematics, University of Toronto
Email: toni@cs.toronto.edu

Christopher Umans, Professor of Computer Science, California Institute of Technology
Email: umans@cs.caltech.edu

Scott Aaronson, David J. Bruton Centennial Professor of Computer Science & Director, Quantum Information Center, University of Texas at Austin
Email: aaronson@cs.utexas.edu

Cristopher Moore, Professor, Santa Fe Institute,
Email: moore@santafe.edu

Jerzy Weyman, Professor of Mathematics, University of Connecticut
Email: jerzy.weyman@uconn.edu

Teaching Reference

Sharon Salveter, Senior Lecturer in Computer Science (Frmr.), The University of Chicago

Email: salveter@cs.uchicago.edu