

Richard Ryan Williams

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POSITIONS

Massachusetts Institute of Technology (Cambridge, MA)

Professor of Electrical Engineering and Computer Science, July 2020 – present.

Associate Professor (with tenure) of EECS, Jan. 2017 – Jun. 2020.

University of California, Berkeley

Visiting Professor of EECS, Aug. 2018 – Dec. 2018.

Visiting Scientist at the Simons Institute, Aug. 2014 – Dec. 2014 and Aug. 2015 – Dec. 2015.

Stanford University (Stanford, CA)

Assistant Professor of Computer Science, Sept. 2011 – Dec. 2016.

IBM Almaden Research Center (San Jose, CA)

Josef Raviv Postdoctoral Fellow, Sept. 2009 – Sept. 2011.

Managers: T. S. Jayram and Ken Clarkson.

Institute for Advanced Study (Princeton, NJ)

Member of the School of Mathematics, Sept. 2008 – Sept. 2009.

Mentor: Avi Wigderson.

Carnegie Mellon University (Pittsburgh, PA)

Postdoctoral Research Fellow, Sept. 2007 – August 2008.

Mentor: Manuel Blum.

EDUCATION

Carnegie Mellon University (Pittsburgh, PA)

Ph.D. in Computer Science, August 2007.

Thesis Title: Algorithms and Resource Requirements for Fundamental Problems

Advisor: Manuel Blum

Cornell University (Ithaca, NY)

Master of Engineering in Computer Science, 2002

Bachelor of Arts in Computer Science and Mathematics with Honors, 2001.

SELECTED HONORS

- Best Paper Award, 22nd Conference on Satisfiability Testing (SAT), 2019.
- Google Faculty Research Award, 2019.
- NSF CAREER Award, 2015.
- Invited speaker, International Congress of Mathematicians (ICM), 2014.
- Microsoft Research Faculty Fellow, 2013.
- Alfred P. Sloan Research Fellow, 2013-2015.
- *Notable Article of 2013* by ACM Computing Reviews.
- US Junior Oberwolfach Fellow, 2013.
- David Morgenthaler II Faculty Fellow, School of Engineering, Stanford, 2011.
- Best Paper Award from the IEEE Conf. on Computational Complexity (CCC), 2011.
- Carnegie Mellon SCS Distinguished Dissertation Award (Honorable Mention), 2008.
- Best Student Paper from the IEEE Conf. on Computational Complexity, 2005 and 2007.
- Highest ranked paper at SPAA 2005.
- Best Student Paper Award at ICALP (Track A), 2004.
- NSF Graduate Research Fellowship, 2001-2004.

**Special Issue
Invitations**

Invited journal articles considered to be among the top 5-10 papers in a given conference:
ICALP 2004, CCC 2005, SPAA 2005, CCC 2007, COCOON 2009, STOC 2010, CCC 2011,
PODS 2011, CCC 2012, STOC 2013, CCC 2013, STOC 2014, SODA 2016, SODA 2017,
IPEC 2017, STOC 2018, SAT 2019, STACS 2020

COURSES TAUGHT

- *CS 294-152. Lower Bounds: Beyond the Bootcamp*
UC Berkeley, Fall 2018.
- *6.S078: Fine-Grained Algorithms and Complexity*
MIT, Spring 2018.
- *6.841/18.405: Advanced Complexity Theory*
MIT, Fall 2018, Fall 2019.
- *6.045/18.400: Automata, Computability, and Complexity*
MIT, Spring 2017, Spring 2019, Spring 2020.
- *CS254: Computational Complexity Theory*
Stanford, Spring 2015 and Autumn 2016.
- *CS266: Parameterized Algorithms and Complexity*
Stanford, Spring 2013 and Autumn 2014.
- *CS154: Automata and Complexity Theory*
Stanford, Winters 2011-12, 2012-13, 2013-14, 2014-15, 2015-16.
- *CS354: Topics in Circuit Complexity*
Stanford, Autumn 2011, Spring 2014.
- *Wonderful and Crazy Ideas in TCS and Math* (with V. Vassilevska Williams)
NJ Governor's School for Engineering and Technology (for high school students), Rut-
gers University, Summer 2009.
- *15-453 Formal Languages, Automata, and Computation* (with L. Blum)
Carnegie Mellon, Spring 2008.
- *15-859P Theoretical Cryptography* (with M. Blum and S. Rudich)
Carnegie Mellon, Fall 2007.

Postdocs Mentored

Michael Forbes (2016)
Roei Tell (2020)

PhD Students

Huacheng Yu (2017)
Cody Murray (2018)
Josh Alman (2019), co-advised with Virginia Vassilevska Williams
Dylan McKay (2020)
Brynmor Chapman (2013-present)
Lijie Chen (2017-present)
Nikhil Vyas (2017-present)
Shyan Akmal (2019-present), co-advised with Virginia Vassilevska Williams
Rahul Ilango (2019-present)
Ce Jin (2020-present), co-advised with Virginia Vassilevska Williams

**Research Interns
Mentored**

Xin Lyu, undergrad at Tsinghua (2020)
Hanlin Ren, undergrad at Tsinghua (2019)
Ce Jin, undergrad at Tsinghua (2019)
Kaifeng Lyu, undergrad at Tsinghua (2018)
Alexander Golovnev, PhD student at NYU (2016)

**Undergraduate
Research Advisees**

Korina Digalaki, MIT '21
Malvika Joshi, MIT '20

Magdalen Dobson, MIT '19 (PhD CMU)
Abhijit Mudigonda, MIT '19
Rio LaVigne, Stanford '15 (PhD MIT)
Joshua Wang, Stanford '13 (PhD Stanford)
Will Monroe, Stanford '13 (PhD Stanford)
Jeremiah Blocki, CMU '09 (PhD CMU)
Brendan Meeder, CMU '07 (PhD CMU)
Brendan Juba, CMU '05 (PhD MIT)
David Charlton, CMU '04 (PhD MIT)

**Other PhD Thesis
Committees**

Jayson Lynch, MIT, August 2020
Andrea Lincoln, MIT, June 2020
Luke Schaeffer, MIT, August 2019
Daniel Grier, MIT, August 2019
Saeed Mehraban, MIT, May 2019
Alex Arkhipov, MIT, July 2017
Shalev Ben-David, MIT, June 2017
Adam Bouland, MIT, June 2017
Amir Abboud, Stanford University, May 2017
Matthew Coudron, MIT, May 2017
Alexander Golovnev, NYU, April 2017
Joe Zimmerman, Stanford University, May 2016
Kevin Lewi, Stanford University, April 2016
Mark Zhandry, Stanford University, May 2015
Peifung Eric Lam, Stanford University, December 2014
Hart Montgomery, Stanford University, August 2014
Ananth Raghunathan, Stanford University, May 2014
Qiqi Yan, Stanford University, May 2012
Serge Gaspers, University of Bergen (Norway), December 2008

**PROFESSIONAL
ACTIVITIES AND
SERVICE**

Conference Program Committees:

- AAAI 2006: 21st Conference on Artificial Intelligence
- IPEC 2010: 5th Intn'l Symposium on Parameterized and Exact Computation
- STOC 2011: 43rd ACM Symposium on Theory of Computing
- FCT 2011: 18th Intn'l Symposium on Fundamentals of Computation Theory
- MFCS 2011: 36th Intn'l Symposium on Mathematical Foundations of Computer Science
- IPEC 2011: 5th Intn'l Symposium on Parameterized and Exact Computation
- SODA 2012: 23rd ACM-SIAM Symposium on Discrete Algorithms
- PODS 2013: 32nd ACM Symposium on Principles of Database Systems
- STOC 2013: 45th ACM Symposium on Theory of Computing
- ITCS 2014: 5th Innovations in Theoretical Computer Science Conference
- CCC 2014: 29th IEEE Conference on Computational Complexity
- ICALP 2014: 40th Intn'l Colloquium on Automata, Languages, and Programming
- FOCS 2014: 55th IEEE Symposium on Foundations of Computer Science
- CSR 2016: 11th International Computer Science Symposium in Russia
- SPAA 2017: 29th ACM Symposium on Parallelism in Algorithms and Architectures
- FOCS 2018: 57th IEEE Symposium on Foundations of Computer Science
- HALG 2019: Highlights of Algorithms Conference
- CCC 2020: 35th Annual Conference on Computational Complexity

Conference Reviewing: STOC, FOCS, SODA, CCC, ICALP, STACS, IPEC, AAAI, IJCAI, LICS, PODS, LATIN, FSTTCS, ESA, CP, APPROX-RANDOM, *etc.*

Journal Reviewing: Journal of the ACM, SIAM Journal on Computing, SIAM Journal on Discrete Mathematics, Journal of Computational Complexity, ACM Transactions on Algorithms, Electronic Journal of Combinatorics, Discrete Applied Mathematics, Theoretical Computer Science, Annals of Mathematics and Artificial Intelligence, Information and Computation, Information Processing Letters, *Discussiones Mathematicae Graph Theory*, *etc.*

Grant Reviewing: National Science Foundation (NSF), Israel Science Foundation (ISF), Netherlands Organisation for Scientific Research (NWO), National Sciences and Engineering Research Council of Canada (NSERC), Royal Society (UK)

Leadership Activities:

- Co-Organizer of STOC Workshop on MCSP and Hardness Magnification, 2020.
- Awards Chair, Computational Complexity Foundation, 2019–present.
- Co-Organizer at the Simons Institute for the Theory of Computing (UC Berkeley), semester on *Lower Bounds in Computational Complexity*, Fall 2018.
- Associate Editor, ACM Transactions on Theory of Computing, 2017–present.
- STOC Theory Fest Organizing Committee, 2017–2018.
- Board of Editors, Theory of Computing (journal), 2016–present.
- Co-Organizer at the Simons Institute for the Theory of Computing (UC Berkeley), semester on *Fine-Grained Algorithms and Complexity*, Fall 2015.
- SIGACT Executive Committee, 2015–2018.
- Co-Organizer for Seminar at the Schloss Dagstuhl – Leibniz Center for Informatics, on *Theory and Practice of SAT Solving*, April 2015.
- Editor of Special Issue for CCC, Computational Complexity (journal), 2014.
- IEEE Complexity Conference Steering Committee, 2011–2014.
- Co-Organizer for Seminar at the Schloss Dagstuhl – Leibniz Center for Informatics, on *Exact Complexity of NP-hard Problems*, August 2013.
- Former moderator and frequent contributor to CSTheory.Stackexchange, a Q & A site for researchers in theoretical computer science, 2010–present.
- Co-Organizer for MSR-CMU MindSwap Workshop on Privacy, Fall 2007.
- CMU Computer Science Department Speaker’s Club, 2006–2008.
- Local Arrangements Committee: FOCS 2005 (Pittsburgh), CCC 2013 (Stanford)

BOOK CHAPTERS

1. J. Wang and R. Williams. Exact Algorithms and Strong Exponential Time Hypothesis. *Encyclopedia of Algorithms 2nd edition*, M.-Y. Kao (ed.), 657–661, 2016.
2. C. Gomes and R. Williams. Approximations and Randomization. In *Search Methodologies: Introductory Tutorials in Optimization and Decision Support Techniques*, E. Burke and G. Kendall (eds.), 2nd edition, Springer, 2014.
3. R. Williams. Maximum 2-Satisfiability. In *Encyclopedia of Algorithms*, M.-Y. Kao (ed.), Springer, 2008. Updated for 2nd Edition, 2016.
4. C. Gomes and R. Williams. Approximation Algorithms. In *Search Methodologies: Introductory Tutorials in Optimization and Decision Support Techniques*, E. Burke and G. Kendall (eds.), Springer, 2005.

INVITED ARTICLES

1. R. R. Williams. Some Estimated Likelihoods for Computational Complexity. Lecture Notes in Computer Science 10000, Springer 2019.
2. R. R. Williams. Some Ways of Thinking Algorithmically About Impossibility. *SIGLOG News* 4(3):28–40, 2017.
3. R. R. Williams. Some Open Problems Regarding Lower Bounds For NP. *SIGACT News* 47(4), 2016.
4. R. R. Williams. Thinking Algorithmically About Impossibility (Invited Talk). In *Proceedings of 24th Annual Conference on Computer Science Logic (CSL)*, 14–23, 2015.

5. R. Williams. The Polynomial Method in Circuit Complexity Applied to Algorithm Design. *Proceedings of 34th Foundations of Software Technology and Theoretical Computer Science*, 47–60, 2014.
6. R. Williams. Algorithms for circuits and circuits for algorithms: connecting the tractable and intractable. *Proceedings of the International Congress of Mathematicians*, 2014.
7. R. Williams. Algorithms for circuits and circuits for algorithms. In *IEEE Conference on Computational Complexity*, 248–261, 2014.
8. R. Williams. Towards NEXP versus BPP? Invited article in *Proceedings of Computer Science in Russia (CSR)*, 174–182, 2013.
9. L. Hemaspaandra and R. Williams. An Atypical Survey of Typical-Case Complexity. *SIGACT News* 43(4):70–89, December 2012.
10. R. Williams. A Casual Tour Around a Circuit Complexity Bound. *SIGACT News* 42(3):54–76, September 2011.
11. R. Williams. Diagonalization Strikes Back: Some Recent Lower Bounds In Complexity Theory. Invited in *Proceedings of the 17th International Conference on Computing and Combinatorics (COCOON)*, Springer LNCS 6842, 237–239, 2011.
12. R. Williams. Connecting SAT Algorithms and Complexity Lower Bounds. Invited in *Theory of Applications of Satisfiability Testing (SAT)*, Springer LNCS 6695, 1–2, 2011.
13. R. Williams. Applying Practice to Theory. *SIGACT News* 39(4):37–52, 2008.

**JOURNAL
PUBLICATIONS**

1. C. D. Murray and R. R. Williams. Circuit Lower Bounds for Nondeterministic Quasi-Polytime From a New Easy Witness Lemma. To appear in *SIAM Journal on Computing* (special issue for STOC 2019), 2020.
2. A. Björklund, P. Kaski, and R. R. Williams. Generalized Kakeya sets for polynomial evaluation and faster computation of fermionants. *Algorithmica* 81(10): 4010–4028, 2019.
3. J. Gao, R. Impagliazzo, A. Kolokolova, and R. R. Williams. Completeness for first-order properties on sparse structures with algorithmic applications. *ACM Transactions on Algorithms*, 15(2), Article 23, 2018.
4. V. Vassilevska Williams and R. R. Williams. Subcubic Equivalences Between Path, Matrix, and Triangle Problems. *Journal of the ACM* 65(5):27:1–27:38, 2018.
5. R. R. Williams. Faster All-Pairs Shortest Paths via Circuit Complexity. *SIAM Journal on Computing* 47(5):1965–1985, 2018.
6. R. R. Williams. New Algorithms and Lower Bounds for Circuits With Linear Threshold Gates. *Theory of Computing* 14(1):1–25, 2018.
7. C. D. Murray and R. R. Williams. On the (Non) NP-Hardness of Computing Circuit Complexity. *Theory of Computing* 13(1):1–22, 2017.
8. I. Koutis and R. Williams. Algebraic Fingerprints for Faster Algorithms. *Communications of the ACM* 59(1):98–105, 2016.
9. I. Koutis and R. Williams. Limits and Applications of Group Algebras for Parameterized Problems. *ACM Transactions on Algorithms* 12(3):31, 2016.
10. R. Williams. Natural Proofs Versus Derandomization. *SIAM Journal on Computing* 45(2):497–529, 2016.
11. S. Buss and R. Williams. Limits on Alternation-Trading Proofs for Time-Space Lower Bounds. *Computational Complexity* 24(3):533–600, 2015.
12. R. Santhanam and R. Williams. On Uniformity and Circuit Lower Bounds. *Computational Complexity*, 23(2):177–205, 2014.
13. R. Williams. Non-Uniform ACC Circuit Lower Bounds. *Journal of the ACM* 61(1), article 2, January 2014.
14. R. Williams. Improving Exhaustive Search Implies Superpolynomial Lower Bounds. *SIAM Journal on Computing* 42(3):1218–1244, 2013.
15. V. Vassilevska Williams and R. Williams. Finding, Minimizing, and Counting Weighted Subgraphs. *SIAM Journal on Computing* 42(3):831–854, 2013.

16. R. Williams. Alternation-Trading Proofs, Linear Programming, and Lower Bounds. *ACM Transactions on Computation Theory*, 5(2), 2013.
17. R. J. Lipton and R. Williams. Amplifying Lower Bounds Against Polynomial Time With Applications. *Computational Complexity* 22(2):311–343, 2013.
18. B. Kimelfeld, J. Vondrák, and R. Williams. Maximizing Conjunctive Views in Deletion Propagation. *ACM Transactions on Database Systems* 37(4): 24, 2012.
19. N. Bansal and R. Williams. Regularity Lemmas and Combinatorial Algorithms. *Theory of Computing* 8(4), 2012.
20. S. Diehl, D. van Melkebeek, and R. Williams. An Improved Time-Space Lower Bound for Tautologies. *Journal of Combinatorial Optimization* 22(3):325–338, 2011.
21. R. Williams. Parallelizing Time With Polynomial Circuits. *Theory of Comp. Syst.* 48(1), 2011.
22. V. Vassilevska, R. Williams, and R. Yuster. Finding Heaviest H -Subgraphs in Real Weighted Graphs, With Applications. *ACM Transactions on Algorithms* 6(3), 2010.
23. V. Vassilevska, R. Williams, and R. Yuster. All Pairs Bottleneck Paths and Max-Min Matrix Products in Truly Subcubic Time. *Theory of Computing* 5(1):173–189, 2009.
24. R. Williams. Finding Paths of Length k in $O^*(2^k)$ Time. *Information Processing Letters* 109(6):315–318, 2009.
25. R. Williams. Time-Space Lower Bounds for Counting NP Solutions Modulo Integers. *Computational Complexity* 17(2): 179–219, 2008.
26. R. Williams. Inductive Time-Space Lower Bounds for SAT and Related Problems. *Computational Complexity* 15(4):433–470, 2006.
27. R. Williams. A New Algorithm for Optimal 2-Constraint Satisfaction and Its Implications. *Theoretical Computer Science*, 348(2-3):357–365, 2005.

CONFERENCE PUBLICATIONS

1. C. Jin, N. Vyas, and R. R. Williams. Fast Low-Space Algorithms for Subset Sum. To appear in *SODA*, 2021.
2. L. Chen, X. Lyu, and R. R. Williams. Almost-Everywhere Circuit Lower Bounds from Non-Trivial Derandomization. To appear in *FOCS*, 2020.
3. L. Chen, C. Jin, and R. R. Williams. Sharp threshold results for computational complexity. In *STOC*, 2020.
4. N. Vyas and R. R. Williams. Lower Bounds Against Sparse Symmetric Functions of ACC Circuits: Expanding the Reach of #SAT Algorithms. In *STACS*, 2020.
5. N. Vyas and R. R. Williams. Results on a Super Strong Exponential Time Hypothesis. Invited paper in *AAAI*, 2020.
6. J. Alman, T. M. Chan, and R. R. Williams. Faster Deterministic and Las Vegas Algorithms for Offline Approximate Nearest Neighbors in High Dimensions. In *SODA*, 637–649, 2020.
7. L. Chen, C. Jin, and R. R. Williams. Hardness Magnification for all Sparse NP Languages. In *FOCS*, 2019.
8. A. Björklund and R. Williams. Computing Permanents and Counting Hamiltonian Cycles by Listing Dissimilar Vectors. In *ICALP*, 2019.
9. A. Björklund, P. Kaski, and R. Williams. Solving Systems of Polynomial Equations over $\text{GF}(2)$ by a Parity-Counting Self-Reduction. In *ICALP*, 2019.
10. N. Vyas and R. R. Williams. On Super Strong ETH. In *SAT*, 2019.
11. L. Chen, D. M. McKay, C. D. Murray, R. R. Williams. Relations and Equivalences Between Circuit Lower Bounds and Karp-Lipton Theorems. In *Computational Complexity Conference*, 2019.
12. L. Chen and R. R. Williams. Stronger Connections Between Circuit Analysis and Circuit Lower Bounds, via PCPs of Proximity. In *Computational Complexity Conference*, 2019.
13. D. M. McKay, C. D. Murray, and R. R. Williams. Weak Lower Bounds on Resource-Bounded Compression Imply Strong Separations of Complexity Classes. In *ACM Symposium on Theory of Computing (STOC)*, 2019.

14. D. M. Kane and R. R. Williams. The Orthogonal Vectors Conjecture for Branching Programs and Formulas. In *Conference on Innovations in Theoretical Computer Science (ITCS)*, 48:1-48:15, 2019.
15. D. M. McKay and R. R. Williams. Quadratic Time-Space Lower Bounds for Computing Natural Functions with a Random Oracle. In *Conference on Innovations in Theoretical Computer Science (ITCS)*, 56:1–56:20, 2019.
16. L. Chen and R. R. Williams. An Equivalence Class for Orthogonal Vectors. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 21–40, 2019.
17. R. R. Williams. Limits on Representing Boolean Functions by Linear Combinations of Simple Functions: Thresholds, ReLUs, and Low-Degree Polynomials. In *Computational Complexity Conference (CCC)*, 6:1-6:24, 2018.
18. C. D. Murray and R. R. Williams. Circuit Lower Bounds for Nondeterministic Quasipolytime: an Easy Witness Lemma for NP and NQP. In *ACM Symposium on Theory of Computing (STOC)*, 890–901, 2018.
19. R. R. Williams. Counting Solutions to Polynomial Systems via Reductions. In *Symposium on Simplicity in Algorithms (SOSA@SODA)*, 6:1-6:15, 2018.
20. A. Lincoln, V. Vassilevska Williams, and R. R. Williams. Tight Hardness for Shortest Cycles and Paths in Sparse Graphs. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 1236–1252, 2018.
21. R. R. Williams. On the Difference Between Closest, Furthest, and Orthogonal Pairs: Nearly-Linear vs Barely-Subquadratic Complexity. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 1207–1215, 2018.
22. A. Björklund, P. Kaski, and R. R. Williams. Generalized Kakeya Sets for Polynomial Evaluation and Faster Computation of Fermionants. *International Symposium on Parameterized and Exact Computation (IPEC)*, 6:1–6:13, 2017.
23. A. Abboud, A. Rubinfeld and R. Williams. Distributed PCP Theorems for Hardness of Approximation in P. In *IEEE Symposium on Foundations of Computer Science (FOCS)*, 25–36, 2017.
24. C. D. Murray and R. R. Williams. Easiness Amplification and Uniform Circuit Lower Bounds. In *Computational Complexity Conference (CCC)*, 8:1-8:21, 2017.
25. J. Alman and R. Williams. Probabilistic Rank and Matrix Rigidity. In *ACM Symposium on Theory of Computing (STOC)*, 641–652, 2017.
26. D. Lokshtanov, R. Paturi, S. Tamaki, R. R. Williams, and H. Yu. Beating Brute Force for Systems of Polynomial Equations over Finite Fields. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2190–2202, 2017.
27. K. G. Larsen and R. R. Williams. Faster Online Matrix-Vector Multiplication. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2182–2189, 2017.
28. J. Gao, R. Impagliazzo, A. Kolokolova, and R. R. Williams. Completeness for First-Order Properties on Sparse Structures with Algorithmic Applications. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2162–2181, 2017.
29. J. Alman, T. M. Chan, and R. R. Williams. Polynomial Representations of Threshold Functions and Algorithmic Applications. In *IEEE Symposium on Foundations of Computer Science (FOCS)*, 467–476, 2016.
30. A. Lincoln, V. Vassilevska Williams, J. R. Wang, and R. Williams. Deterministic Time-Space Tradeoffs for k-SUM. In *ICALP*, 58:1–58:14, 2016.
31. R. Williams. Strong ETH Breaks With Merlin and Arthur: Short Non-Interactive Proofs of Batch Evaluation. In *Computational Complexity Conference (CCC)*, 2:1–2:17, 2016.
32. A. Abboud, T. D. Hansen, V. Vassilevska Williams, and R. Williams. Simulating Branching Programs With Edit Distance: A Polylog Shaved is a Lower Bound Made. In *ACM Symposium on Theory of Computing (STOC)*, 275–388, 2016.
33. D. M. Kane and R. Williams. Super-Linear Gate and Super-Quadratic Wire Lower Bounds for Depth-2 and Depth-3 Threshold Circuits. In *ACM Symposium on Theory of Computing (STOC)*, 633–643, 2016.

34. T. M. Chan and R. Williams. Deterministic APSP, Orthogonal Vectors, and More: Quickly Derandomizing Razborov-Smolensky. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 126–1255, 2016.
35. J. Alman and R. Williams. Probabilistic Polynomials and Hamming Nearest Neighbors. In *IEEE Symposium on Foundations of Computer Science (FOCS)*, 136–150, 2015.
36. D. Van Gucht, R. Williams, D. Woodruff, and Q. Zhang. The Communication Complexity of Distributed Set-Joins with Applications to Matrix Multiplication. In *ACM Symposium on Principles of Database Systems (PODS)*, 199–212, 2015.
37. C. Murray and R. Williams. On the (Non) NP-Hardness of Computing Circuit Complexity. In *Computational Complexity Conference (CCC)*, 365–380, 2015.
38. B. Chapman and R. Williams. The Circuit-Input Game, Natural Proofs, and Testing Circuits With Data. In *ACM Conference on Innovations in Theoretical Computer Science (ITCS)*, 263–270, 2015.
39. R. Santhanam and R. Williams. Beating Exhaustive Search for Quantified Boolean Formulas and Connections to Circuit Complexity. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2015.
40. A. Abboud, H. Yu, and R. Williams. More Applications of the Polynomial Method in Algorithm Design. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2015.
41. V. Vassilevska Williams, J. Wang, R. Williams, and H. Yu. Finding Four-Node Subgraphs in Triangle Time. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2015.
42. A. Abboud, K. Lewi, and R. Williams. Losing Weight by Gaining Edges. In *European Symposium on Algorithms (ESA)*, 1–12, 2014.
43. R. Williams. Faster Decision of First-Order Graph Properties. In *EACSL Conference on Computer Science Logic and ACM-IEEE Symposium on Logic in Computer Science (CSL-LICS)*, article 80, 2014.
44. R. Williams. Faster All-Pairs Shortest Paths Via Circuit Complexity. In *ACM Symposium on Theory of Computing (STOC)*, 664–673, 2014.
45. R. Williams. New Algorithms and Lower Bounds for Circuits With Linear Threshold Gates. In *ACM Symposium on Theory of Computing (STOC)*, 194–202, 2014.
46. R. Williams and H. Yu. Finding Orthogonal Vectors in Discrete Structures. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 1867–1877, 2014.
47. R. Williams. Natural Proofs Versus Derandomization. In *ACM Symposium on Theory of Computing (STOC)*, 21–30, 2013.
48. R. Santhanam and R. Williams. On Medium Uniformity and Circuit Lower Bounds. In *IEEE Conference in Computational Complexity (CCC)*, 2013.
49. B. Juba and R. Williams. Massive Online Teaching To Bounded Learners. In *Innovations in Theoretical Computer Science (ITCS)*, 1–10, 2013.
50. R. J. Lipton and R. Williams. Amplifying Lower Bounds Against Polynomial Time With Applications. In *IEEE Conference on Computational Complexity (CCC)*, 1–9, 2012.
51. S. Buss and R. Williams. Limits on Alternation-Trading Proofs for Time-Space Lower Bounds. In *IEEE Conference on Computational Complexity (CCC)*, 181–191, 2012.
52. E. Kim and R. Williams. Improved Algorithms for Constraint Satisfaction Above Average. In *International Conference on Exact and Parameterized Computation (IPEC)*, 118–131, 2011.
53. R. Williams. Non-Uniform ACC Circuit Lower Bounds. In *IEEE Conference on Computational Complexity (CCC)*, 115–125, 2011.
54. B. Kimelfeld, J. Vondrák, and R. Williams. Maximizing Conjunctive Views in Deletion Propagation. In *ACM Symposium on Principles of Database Systems (PODS)*, 187–198, 2011.
55. V. Vassilevska Williams and R. Williams. Subcubic Equivalences Between Path, Matrix, and Triangle Problems. In *IEEE Symposium on Foundations of Computer Science (FOCS)*, 645–654, 2010.

56. J. Blocki and R. Williams. Resolving the Complexity of Some Data Privacy Problems. In *Intern'l Colloq. on Automata, Languages, and Programming (ICALP)* Vol 2, 393–404, 2010.
57. R. Impagliazzo and R. Williams. Communication Complexity With Synchronized Clocks. In *IEEE Conference on Computational Complexity (CCC)*, 259–269, 2010.
58. R. Williams. Improving Exhaustive Search Implies Superpolynomial Lower Bounds. In *ACM Symposium on Theory of Computing (STOC)*, 231–240, 2010.
59. R. Williams. Alternation-Trading Proofs, Linear Programming, and Lower Bounds. In *International Symposium on Theoretical Aspects of Computer Science (STACS)*, 669–680, 2010.
60. M. Patrascu and R. Williams. On the Possibility of Better SAT Algorithms. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 1065–1075, 2010.
61. N. Bansal and R. Williams. Regularity Lemmas and Combinatorial Algorithms. In *IEEE Symposium on Foundations of Computer Science (FOCS)*, 745–754, 2009.
62. S. Diehl, D. van Melkebeek, and R. Williams. An Improved Time-Space Lower Bound for Tautologies. *Computing and Combinatorics Conference (COCOON)*, Springer LNCS 5609, 429–438, 2009.
63. L. Fortnow, R. Santhanam, and R. Williams. Fixed-Polynomial Circuit Lower Bounds. In *IEEE Conference on Computational Complexity (CCC)*, 19–26, 2009.
64. I. Koutis and R. Williams. Limits and Applications of Group Algebra For Parameterized Problems. In *Int. Colloq. Automata, Languages, and Programming (ICALP)* Vol. 1: 653–664, 2009.
65. V. Vassilevska and R. Williams. Finding, Minimizing, and Counting Weighted Subgraphs. In *ACM Symposium on Theory of Computing (STOC)*, 455–464, 2009.
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71. V. Vassilevska and R. Williams. Finding a Maximum Weight Triangle in $n^{3-\delta}$ Time, With Applications. In *ACM Symposium on Theory of Computing (STOC)*, 225–231, 2006.
72. V. Vassilevska, R. Williams, and S. L. M. Woo. Confronting Hardness Using a Hybrid Approach. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 1–10, 2006.
73. Y. Interian, G. Corvera, B. Selman, and R. Williams. Finding small unsatisfiability cores to prove unsatisfiability of QBFs. In *Proc. Int. Symposium on Artificial Intelligence and Mathematics (ISAIM)*, 2006.
74. R. Williams. Parallelizing Time With Polynomial Circuits. In *ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)*, 171–175, 2005.
75. R. Williams. Better Time-Space Lower Bounds for SAT and Related Problems. In *IEEE Conference on Computational Complexity (CCC)*, 40–49, 2005.
76. R. Williams. A New Algorithm for Optimal 2-Constraint Satisfaction and its Implications. In *Int. Colloq. on Automata, Languages, and Programming (ICALP)*, Springer LNCS Vol. 3142, 1227–1237, 2004.
77. A. Meyerson and R. Williams. On The Complexity of Optimal K-Anonymity. In *ACM Symposium on Principles of Database Systems (PODS)*, 223–228, 2004.

78. R. Williams. On Computing k -CNF Formula Properties. In *Theory and Applications of Satisfiability Testing*, Springer LNCS Vol. 2919, 330–340, 2003.
79. R. Williams, C. Gomes, and B. Selman. Backdoors To Typical Case Complexity. In *Int. Joint Conference on Artificial Intelligence (IJCAI)*, 1173–1178, 2003.
80. R. Williams. Algorithms for Quantified Boolean Formulas. In *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 299–307, 2002.

**PLENARY
LECTURES AND
INVITED TALKS**

1. *Circuit Lower Bounds from Algorithm Design: A Progress Report*
 - Plenary Lecture at 69th Midwest Theory Day, Purdue University, April 2019.
 - Invited Lecture at Clay Mathematics Institute Workshop on Complexity Theory, Oxford (England), July 2018.
 - Plenary Lecture at International Colloquium on Automata, Languages, and Computation (ICALP), Prague (Czech Republic), July 2018.
2. *Weak Lower Bounds on Resource-Bounded Compression Imply Strong Separations of Complexity Classes.*
 - Princeton Theory Seminar, March 2019.
3. *Fine-Grained Complexity of Solving Polynomial Systems of Equations*
 - Simons Institute workshop on “Algebraic Methods”, December 2018.
4. *Circuit Lower Bounds for Nondeterministic Quasi-Polynomial Time*
 - Theory Seminar, UC Berkeley, November 2018.
 - Mathematisches Forschungsinstitut Oberwolfach (Germany), November 2018.
 - Theory Seminar, Northeastern University, March 2018.
 - Theory Seminar, University of Texas at Austin, January 2018.
5. *Circuit Lower Bounds from Algorithm Design: An Overview*
 - Simons Institute Boot Camp on Lower Bounds, UC Berkeley, August 2018.
6. *Thinking Algorithmically About Impossibility*
 - Logic Colloquium, UC Berkeley, November 2018.
 - Theory Seminar, University of Massachusetts at Amherst, December 2017.
 - Very Informal Gathering of Logicians, UCLA Institute for Pure and Applied Mathematics, February 2017.
7. *Strong ETH Breaks With Merlin and Arthur: Proof Systems for UNSAT That Beat 2^n (With Randomness)*
 - Invited Lecture at “Proof Complexity and Beyond”, Mathematisches Forschungsinstitut Oberwolfach (Germany), August 2017.
 - Workshop on “Theoretical Foundations of SAT Solving”, Fields Institute, Toronto, August 2016.
8. *Algorithms and Lower Bounds: A Love Story.*
 - 15 Lectures at the Swedish Summer School in Computer Science, Stockholm, July 2017.
9. *Sam and Me versus P versus NP.*
 - OMNI BUSS Celebration of Samuel Buss’s 60th Birthday, UC San Diego, July 2017.
10. *Approximately Counting Solutions to Systems of Quadratic Equations.*
 - Simons Symposium on New Directions in Approximation Algorithms, Schloss Elmau (Germany), April 2017.
 - Simons Institute Workshop on “Proving and Using Pseudorandomness”, UC Berkeley, March 2017.
11. *Polynomial Representations of Threshold Functions and Algorithmic Applications*
 - Banff International Research Station, September 2016.
12. *New applications of the polynomial method to algorithm design*
 - Highlights of Algorithms (HALG), Paris, June 2016.
13. *Super-Linear Gate Lower Bounds and Super-Quadratic Wire Lower Bounds for Depth-2 and Depth-3 Threshold Circuits*
 - Theory Seminar, Caltech, January 2016.

- Theory Seminar, Harvard, March 2016.
- Combinatorics Seminar, Stanford, April 2016.
- 14. *Recent Work in Fine-Grained Complexity*
 - Invited Lecture at Computational Complexity Workshop, Mathematisches Forschungsinstitut Oberwolfach (Germany), November 2015.
- 15. *Deterministic APSP, Orthogonal Vectors, and More*
 - Invited Talk at Simons Institute, UC Berkeley, October 2015.
- 16. *Thinking Algorithmically About Impossibility*
 - EECS Colloquium, MIT, January 2016.
 - Invited Lecture at the 24th Annual Conference on Computer Science Logic, Berlin (Germany), September 2015.
 - Simons Institute Open Lecture, UC Berkeley, October 2015.
 - <https://youtu.be/7uplycLvraw>
- 17. *“Boot Camp” on Algorithms and Lower Bounds: Some Basic Connections*
 - Simons Institute, UC Berkeley, August 2015.
 - <https://youtu.be/adJvi7tL-qM?list=PLgKuh-lKre10C3b4qfGF5cdgYzbHqoRBA>
- 18. *Four Lectures on Algorithms as Lower Bounds (and Vice-Versa)*
 - Summer School on Lower Bounds, Prague (Czech Republic), June 28–July 1, 2015.
- 19. *SAT Solving and Complexity Theory*
 - Invited Tutorial at Schloss Dagstuhl workshop (Germany), April 2015.
 - Invited Lecture at the 1st Annual SAT/SMT Summer School, MIT, Cambridge, MA, June 2011.
- 20. *The Polynomial Method in Circuit Complexity, Applied to Algorithm Design*
 - Princeton Theory Seminar, February 2015.
 - Invited Lecture at 35th Annual Conference on Foundations of Software Technology and Theoretical Computer Science, New Delhi (India), December 2014.
- 21. *On the Strong Exponential Time Hypothesis*
 - Exact Algorithms and Lower Bounds Workshop, IIT Delhi, December 2014.
- 22. *Algorithms for Circuits and Circuits for Algorithms*
 - Rajeev Motwani Memorial Workshop, IIT Kanpur, December 2014.
 - Southern California Theory Day, San Diego, October 2014.
 - Invited Lecture at International Congress of Mathematicians, Seoul (Korea), August 2014.
 - Invited Survey at 29th IEEE Conference on Computational Complexity, June 2014.
 - Clay Mathematics Research Conference, Oxford (England), September 2013.
- 23. *Faster All-Pairs Shortest Paths via Circuit Complexity*
 - Microsoft Research (Silicon Valley), July 2014.
 - TCS+ Online Seminar, <https://sites.google.com/site/plustcs/>, March 2014.
- 24. *On Medium Uniformity and Circuit Lower Bounds*
 - Workshop on Computational Complexity, Banff International Research Station, July 2013.
- 25. *Connections Between Algorithms and Lower Bounds*
 - Two lectures at CSEDays Summer School on Algorithms and Complexity, Ekaterinburg (Russia), June 2013.
- 26. *Non-Uniform ACC Circuit Lower Bounds*
 - Invited Lecture at the Conference on Computer Science in Russia, Ekaterinburg (Russia), June 2013
 - Israel CS Theory Day, March 2012 <https://youtu.be/MIqsRsZacws>
 - Univ. of Michigan, August 2011
 - UPC Barcelona, July 2011
 - CS Department Colloquium, Dartmouth, May 2011
 - Mathematics Department Colloquium, UC San Diego, March 2011
 - EECS Distinguished Lecture, UC Berkeley, February 2011
 - Theory Seminar, Univ. of Washington, February 2011

- Microsoft Research (Silicon Valley), December 2010
- Princeton, December 2010
- Microsoft Research (New England), December 2010
- MIT, November 2010
- UC Berkeley, November 2010
- IBM Almaden, November 2010
- 27. *Recent Progress in Non-Uniform Circuit Complexity*
 - 85th Mathematical Colloquium, Computer Science Institute of Charles University, Prague (Czech Republic), June 2013.
- 28. *Algorithm Design and Circuit Complexity*
 - 6th Bertinoro Workshop on Algorithms and Data Structures (ADS), June 2013.
- 29. *Duality between Circuit Analysis and Circuit Lower Bounds*
 - Stanford CSLI Workshop on Logic, Rationality and Intelligent Interaction, June 2013.
- 30. *Substructure in SAT*
 - Symposium on Structure in Combinatorial Problems, Vienna (Austria), May 2013.
- 31. *New Lower Bounds in Complexity Theory via Diagonalization*
 - Stanford Logic Colloquium, April 2013.
 - UCSD Math Department, April 2012.
 - UCLA Logic Colloquium, April 2012.
 - Plenary Lecture, North Amer. Annual Meeting of the Association for Symbolic Logic, Berkeley, CA, March 2011.
- 32. *Parameterized Algorithms and Circuit Lower Bounds*
 - Special Session at Joint Mathematics Meetings, San Diego, CA, January 2013.
- 33. *Lower Bounds Against ACC*
 - Invited Lecture at Mathematisches Forschungsinstitut Oberwolfach (Germany), November 2012.
- 34. *Algorithms for Circuits and Circuits for Algorithms*
 - Kyoto University (Japan), January 2012.
 - Georgia Tech ARC Theory Day, Atlanta, GA, November 2011.
 - Keynote Lecture at China Theory Week, Aarhus (Denmark), October 2011.
- 35. *Backdoors to Typical Case Complexity*
 - Beyond Worst-Case Analysis Workshop, Stanford, August 2011.
- 36. *Diagonalization Strikes Back*
 - Keynote Lecture at the International Computing and Combinatorics Conference (COCON), Dallas, TX, August 2011.
- 37. *Connecting SAT Algorithms and Complexity Lower Bounds*
 - Plenary Lecture at the International Conference on Theory and Applications of Satisfiability Testing (SAT), Ann Arbor, MI, June 2011.
- 38. *Algorithms, Obstructions, and Beating Exhaustive Search*
 - Univ. of Michigan, January 2011; Univ. of Chicago, February 2011; Harvard, February 2011; Stanford, February 2011; UC San Diego, March 2011; IBM Almaden, March 2011; Cornell, March 2011; Microsoft Research (Silicon Valley), March 2011; Caltech, April 2011.
- 39. *What's all this about P not equaling NP?* (with Ken Clarkson and Ron Fagin)
 - IBM Almaden, August 2010.
- 40. *Communication Complexity With Clocks*
 - Theory Seminar, UC Berkeley, March 2010.
- 41. *Improving Exhaustive Search Implies Superpolynomial Lower Bounds*
 - Schloss Dagstuhl (Germany), November 2010.
 - Georgia Tech, May 2010
 - Microsoft Research (Silicon Valley), April 2010
 - IBM Almaden, February 2010
- 42. *Time-Space Lower Bounds for NP-Hard Problems*
 - North Amer. Ann. Meeting of the Association for Symbolic Logic, D.C., March 2010

- UC San Diego, May 2009
- 43. *Applying Practice to Theory: Time Lower Bounds for Fundamental Problems*
 - Univ. of Toronto, February 2009
 - DIMACS, November 2008
 - TTI Chicago, March 2008
- 44. *Graph Algorithms From Group Algebra*
 - IBM T.J. Watson (Yorktown), February 2009
 - Schloss Dagstuhl (Germany), October 2009.
- 45. *Finding a k -Path in $O^*(2^k)$ Time*
 - Schloss Dagstuhl (Germany), October 2008.
- 46. *A Survey of Time Lower Bounds by Algorithmic Arguments*
 - Institute for Advanced Study, September 2008.
- 47. *Clique Problems and Applications*
 - Computer Science Colloquium, Univ. of Rochester, February 2008.
- 48. *Automated Proofs of Time Lower Bounds*
 - China Theory Week, Tsinghua Univ. (China), September 2007.
- 49. *A Hybrid Approach to Coping With Hard Problems*
 - Georgia Tech, April 2007
 - Schloss Dagstuhl (Germany), July 2005.
- 50. *Exact 2-CSP Optimization Using Matrix Multiplication*
 - Microsoft Research (Redmond), June 2005.
- 51. *On the Complexity of Optimal K -Anonymity*
 - Privacy in D.A.T.A. Workshop, Carnegie Mellon, March 2003.