

# Thomas Watson

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## CONTACT

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## EMPLOYMENT AND EDUCATION

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University of Memphis

- Associate Professor, 2022–present
- UMRF Ventures Assistant Professor, 2020–2022
- Assistant Professor, 2016–2022
- Department: Computer Science

University of Toronto

- Postdoctoral Research Scholar, 2013–2016
- Department: Computer Science
- Advisor: Professor Toniann Pitassi

University of California, Berkeley

- Doctor of Philosophy, 2008–2013
- Department: Computer Science
- Advisor: Professor Luca Trevisan
- Dissertation: The Computational Complexity of Randomness

University of Wisconsin – Madison

- Bachelor of Science, 2003–2008
- Majors: Computer Science, Mathematics, Computer Engineering
- Advisor: Professor Dieter van Melkebeek
- GPA: 4.0/4.0

## RESEARCH INTERESTS

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Computational complexity theory: communication complexity, query complexity, pseudorandomness, complexity of sampling, average-case complexity, randomness extraction, structural complexity, game complexity

## FUNDING

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- NSF grant CCF-1942742: CAREER: Structural Communication Complexity (PI, \$435,015, 10/1/2020–9/30/2025)
- NSF grant CCF-1657377: CRII: AF: Developing and Applying Connections Between Communication Complexity and Query Complexity (PI, \$182,911, 7/1/2017–6/30/2020)

## PUBLICATIONS

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33. CONFERENCE: Ramita Maharjan and Thomas Watson. Complexity of Fault Tolerant Query Complexity. In *Proceedings of the 42nd Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS)*. Schloss Dagstuhl, 2022. To appear.
32. CONFERENCE: Md Lutfar Rahman and Thomas Watson. Erdős–Selfridge Theorem for Nonmonotone CNFs. In *Proceedings of the 18th Scandinavian Symposium and Workshops on Algorithm Theory (SWAT)*, pages 31:1–31:11. Schloss Dagstuhl, 2022.
31. CONFERENCE: Md Lutfar Rahman and Thomas Watson. 6-Uniform Maker–Breaker Game Is PSPACE-Complete. In *Proceedings of the 38th International Symposium on Theoretical Aspects of Computer Science (STACS)*, pages 57:1–57:15. Schloss Dagstuhl, 2021.
30. CONFERENCE: Shalev Ben-David, Mika Göös, Robin Kothari, and Thomas Watson. When Is Amplification Necessary for Composition in Randomized Query Complexity? In *Proceedings of the 24th International Conference on Randomization and Computation (RANDOM)*, pages 28:1–28:16. Schloss Dagstuhl, 2020.
29. CONFERENCE: Md Lutfar Rahman and Thomas Watson. Tractable Unordered 3-CNF Games. In *Proceedings of the 14th Latin American Theoretical Informatics Symposium (LATIN)*, pages 360–372. Springer, 2020.
28. CONFERENCE: Mika Göös and Thomas Watson. A Lower Bound for Sampling Disjoint Sets. In *Proceedings of the 23rd International Conference on Randomization and Computation (RANDOM)*, pages 51:1–51:13. Schloss Dagstuhl, 2019.
- JOURNAL: Mika Göös and Thomas Watson. A Lower Bound for Sampling Disjoint Sets. *ACM Transactions on Computation Theory*, 12(3):20:1–20:13, 2020.
27. CONFERENCE: Toniann Pitassi, Morgan Shirley, and Thomas Watson. Nondeterministic and Randomized Boolean Hierarchies in Communication Complexity. In *Proceedings of the 47th International Colloquium on Automata, Languages, and Programming (ICALP), Track A*, pages 92:1–92:19. Schloss Dagstuhl, 2020.
- JOURNAL: Toniann Pitassi, Morgan Shirley, and Thomas Watson. Nondeterministic and Randomized Boolean Hierarchies in Communication Complexity. *Computational Complexity*, 30(2):10, 2021.
26. CONFERENCE: Thomas Watson. Amplification with One NP Oracle Query. In *Proceedings of the 46th International Colloquium on Automata, Languages, and Programming (ICALP), Track A*, pages 96:1–96:13. Schloss Dagstuhl, 2019.
- JOURNAL: Thomas Watson. Amplification with One NP Oracle Query. *Computational Complexity*, 31(1):3, 2022.
25. CONFERENCE: Md Lutfar Rahman and Thomas Watson. Complexity of Unordered CNF Games. In *Proceedings of the 29th International Symposium on Algorithms and Computation (ISAAC)*, pages 9:1–9:12. Schloss Dagstuhl, 2018.
- JOURNAL: Md Lutfar Rahman and Thomas Watson. Complexity of Unordered CNF Games. *ACM Transactions on Computation Theory*, 12(3):18:1–18:18, 2020.
24. CONFERENCE: Thomas Watson. A  $ZPP^{NP[1]}$  Lifting Theorem. In *Proceedings of the 36th International Symposium on Theoretical Aspects of Computer Science (STACS)*, pages 59:1–59:16. Schloss Dagstuhl, 2019.
- JOURNAL: Thomas Watson. A  $ZPP^{NP[1]}$  Lifting Theorem. *ACM Transactions on Computation Theory*, 12(4):27:1–27:20, 2020.

23. CONFERENCE: Mika Göös, Toniann Pitassi, and Thomas Watson. Query-to-Communication Lifting for BPP. In *Proceedings of the 58th Symposium on Foundations of Computer Science (FOCS)*, pages 132–143. IEEE, 2017.
- JOURNAL: Mika Göös, Toniann Pitassi, and Thomas Watson. Query-to-Communication Lifting for BPP. *SIAM Journal on Computing*, 49(4):FOCS17-441–FOCS17-461, 2020. Special issue for selected papers from FOCS 2017.
22. CONFERENCE: Mika Göös, Pritish Kamath, Toniann Pitassi, and Thomas Watson. Query-to-Communication Lifting for  $P^{NP}$ . In *Proceedings of the 32nd Computational Complexity Conference (CCC)*, pages 12:1–12:16. Schloss Dagstuhl, 2017.
- JOURNAL: Mika Göös, Pritish Kamath, Toniann Pitassi, and Thomas Watson. Query-to-Communication Lifting for  $P^{NP}$ . *Computational Complexity*, 28(1):113–144, 2019.
21. CONFERENCE: Thomas Watson. Quadratic Simulations of Merlin–Arthur Games. In *Proceedings of the 13th Latin American Theoretical Informatics Symposium (LATIN)*, pages 864–872. Springer, 2018.
- JOURNAL: Thomas Watson. Quadratic Simulations of Merlin–Arthur Games. *ACM Transactions on Computation Theory*, 12(2):14:1–14:11, 2020.
20. CONFERENCE: Thomas Watson. Communication Complexity of Statistical Distance. In *Proceedings of the 21st International Workshop (Conference) on Randomization and Computation (RANDOM)*, pages 49:1–49:10. Schloss Dagstuhl, 2017.
- JOURNAL: Thomas Watson. Communication Complexity of Statistical Distance. *ACM Transactions on Computation Theory*, 10(1):2:1–2:11, 2018.
19. CONFERENCE: Thomas Watson. Communication Complexity with Small Advantage. In *Proceedings of the 33rd Computational Complexity Conference (CCC)*, pages 9:1–9:17. Schloss Dagstuhl, 2018.
- JOURNAL: Thomas Watson. Communication Complexity with Small Advantage. *Computational Complexity*, 29(1):2, 2020.
18. CONFERENCE: Mika Göös, Rahul Jain, and Thomas Watson. Extension Complexity of Independent Set Polytopes. In *Proceedings of the 57th Symposium on Foundations of Computer Science (FOCS)*, pages 565–572. IEEE, 2016.
- JOURNAL: Mika Göös, Rahul Jain, and Thomas Watson. Extension Complexity of Independent Set Polytopes. *SIAM Journal on Computing*, 47(1):241–269, 2018.
17. CONFERENCE: Mika Göös, T.S. Jayram, Toniann Pitassi, and Thomas Watson. Randomized Communication vs. Partition Number. In *Proceedings of the 44th International Colloquium on Automata, Languages, and Programming (ICALP), Track A*, pages 52:1–52:15. Schloss Dagstuhl, 2017.
- JOURNAL: Mika Göös, T.S. Jayram, Toniann Pitassi, and Thomas Watson. Randomized Communication vs. Partition Number. *ACM Transactions on Computation Theory*, 10(1):4:1–4:20, 2018.
16. CONFERENCE: Mika Göös, Toniann Pitassi, and Thomas Watson. Deterministic Communication vs. Partition Number. In *Proceedings of the 56th Symposium on Foundations of Computer Science (FOCS)*, pages 1077–1088. IEEE, 2015.
- JOURNAL: Mika Göös, Toniann Pitassi, and Thomas Watson. Deterministic Communication vs. Partition Number. *SIAM Journal on Computing*, 47(6):2435–2450, 2018. Special issue for selected papers from FOCS 2015.
15. CONFERENCE: Mika Göös, Toniann Pitassi, and Thomas Watson. The Landscape of Communication Complexity Classes. In *Proceedings of the 43rd International Colloquium on Automata, Languages, and Programming (ICALP), Track A*, pages 86:1–86:15. Schloss Dagstuhl, 2016.
- JOURNAL: Mika Göös, Toniann Pitassi, and Thomas Watson. The Landscape of Communication Complexity Classes. *Computational Complexity*, 27(2):245–304, 2018.

14. CONFERENCE: Mika Göös, Shachar Lovett, Raghu Meka, Thomas Watson, and David Zuckerman. Rectangles Are Nonnegative Juntas. In *Proceedings of the 47th Symposium on Theory of Computing (STOC)*, pages 257–266. ACM, 2015.  
 JOURNAL: Mika Göös, Shachar Lovett, Raghu Meka, Thomas Watson, and David Zuckerman. Rectangles Are Nonnegative Juntas. *SIAM Journal on Computing*, 45(5):1835–1869, 2016.
13. CONFERENCE: Mika Göös, Toniann Pitassi, and Thomas Watson. Zero-Information Protocols and Unambiguity in Arthur–Merlin Communication. In *Proceedings of the 6th Innovations in Theoretical Computer Science Conference (ITCS)*, pages 113–122. ACM, 2015.  
 JOURNAL: Mika Göös, Toniann Pitassi, and Thomas Watson. Zero-Information Protocols and Unambiguity in Arthur–Merlin Communication. *Algorithmica*, 76(3):684–719, 2016. Special issue on information complexity and applications.
12. CONFERENCE: Mika Göös and Thomas Watson. Communication Complexity of Set-Disjointness for All Probabilities. In *Proceedings of the 18th International Workshop (Conference) on Randomization and Computation (RANDOM)*, pages 721–736. Schloss Dagstuhl, 2014.  
 JOURNAL: Mika Göös and Thomas Watson. Communication Complexity of Set-Disjointness for All Probabilities. *Theory of Computing*, 12(9):1–23, 2016. Special issue for selected papers from APPROX–RANDOM 2014.
11. JOURNAL: Thomas Watson. Nonnegative Rank vs. Binary Rank. *Chicago Journal of Theoretical Computer Science*, 2016(2):1–13, 2016.
10. CONFERENCE: Thomas Watson. The Complexity of Deciding Statistical Properties of Samplable Distributions. In *Proceedings of the 31st International Symposium on Theoretical Aspects of Computer Science (STACS)*, pages 663–674. Schloss Dagstuhl, 2014.  
 JOURNAL: Thomas Watson. The Complexity of Deciding Statistical Properties of Samplable Distributions. *Theory of Computing*, 11(1):1–34, 2015.
9. JOURNAL: Thomas Watson. The Complexity of Estimating Min-Entropy. *Computational Complexity*, 25(1):153–175, 2016.
8. CONFERENCE: Thomas Watson. Time Hierarchies for Sampling Distributions. In *Proceedings of the 4th Innovations in Theoretical Computer Science Conference (ITCS)*, pages 429–439. ACM, 2013.  
 JOURNAL: Thomas Watson. Time Hierarchies for Sampling Distributions. *SIAM Journal on Computing*, 43(5):1709–1727, 2014.
7. CONFERENCE: Thomas Watson. Advice Lower Bounds for the Dense Model Theorem. In *Proceedings of the 30th International Symposium on Theoretical Aspects of Computer Science (STACS)*, pages 634–645. Schloss Dagstuhl, 2013.  
 JOURNAL: Thomas Watson. Advice Lower Bounds for the Dense Model Theorem. *ACM Transactions on Computation Theory*, 7(1):1:1–1:18, 2014.
6. JOURNAL: Thomas Watson. Lift-and-Project Integrality Gaps for the Traveling Salesperson Problem. *Chicago Journal of Theoretical Computer Science*, 2014(1):1–22, 2014.
5. CONFERENCE: Anindya De and Thomas Watson. Extractors and Lower Bounds for Locally Samplable Sources. In *Proceedings of the 15th International Workshop (Conference) on Randomization and Computation (RANDOM)*, pages 483–494. Springer, 2011.  
 JOURNAL: Anindya De and Thomas Watson. Extractors and Lower Bounds for Locally Samplable Sources. *ACM Transactions on Computation Theory*, 4(1):3:1–3:21, 2012.
4. CONFERENCE: Thomas Watson. Pseudorandom Generators for Combinatorial Checkerboards. In *Proceedings of the 26th Conference on Computational Complexity (CCC)*, pages 232–242. IEEE, 2011.

- JOURNAL: Thomas Watson. Pseudorandom Generators for Combinatorial Checkerboards. *Computational Complexity*, 22(4):727–769, 2013.
3. CONFERENCE: Thomas Watson. Query Complexity in Errorless Hardness Amplification. In *Proceedings of the 15th International Workshop (Conference) on Randomization and Computation (RANDOM)*, pages 688–699. Springer, 2011.
- JOURNAL: Thomas Watson. Query Complexity in Errorless Hardness Amplification. *Computational Complexity*, 24(4):823–850, 2015.
2. CONFERENCE: Thomas Watson. Relativized Worlds Without Worst-Case to Average-Case Reductions for NP. In *Proceedings of the 14th International Workshop (Conference) on Randomization and Computation (RANDOM)*, pages 752–765. Springer, 2010.
- JOURNAL: Thomas Watson. Relativized Worlds Without Worst-Case to Average-Case Reductions for NP. *ACM Transactions on Computation Theory*, 4(3):8:1–8:30, 2012.
1. JOURNAL: Dieter van Melkebeek and Thomas Watson. Time-Space Efficient Simulations of Quantum Computations. *Theory of Computing*, 8(1):1–51, 2012.

## TEACHING

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University of Memphis

- COMP 8613: Computational Complexity (Fall 2020, Fall 2017)
- COMP 7612: Foundations of Computing (Fall 2022, Spring 2017)
- COMP 4601: Models of Computation (Spring 2022, Fall 2021, Fall 2020, Spring 2020, Fall 2019, Spring 2019, Fall 2018, Spring 2018, Fall 2016)
- COMP 4030: Design and Analysis of Algorithms (Spring 2019, Fall 2018)
- COMP 4019: Competitive Programming and Technical Interviews (Fall 2022, Fall 2021, Fall 2020, Fall 2019, Fall 2018, Fall 2017)
- COMP 3150: Programming in C/C++ (Fall 2021)

Earlier teaching

- University of Toronto: CSC 2401: Computational Complexity Theory (Fall 2015 teaching assistant)
- University of California, Berkeley: CS 70: Discrete Mathematics and Probability Theory (Summer 2013 primary instructor, Spring 2012 head graduate student instructor)
- University of California, Berkeley: CS 170: Efficient Algorithms and Intractable Problems (Fall 2011 graduate student instructor)

## GRADUATE STUDENTS

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- Md Lutfar Rahman, Ph.D. 2021. Dissertation: Unordered CNF Games
- Ramita Maharjan, M.S. 2022.
- Aashis Ghimire, M.S. 2019.

## INVITED TALKS

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- “Query-to-Communication Lifting for BPP”, KTH Royal Institute of Technology Seminar, 2017
- “Introduction to Query-to-Communication Lifting”, Workshop Tutorial for FOCS, 2017
- “Communication Complexity with Small Advantage”, Banff Workshop on Communication Complexity and Applications II, 2017
- “Computational Complexity Theory”, Honors Math Seminar, University of Memphis, 2016
- “Computational Complexity Theory”, Lecture Series for Undergraduate Theory Group / Math Union, University of Toronto, 2015
- “Zero-Information Protocols and Unambiguity in Arthur–Merlin Communication”, Banff Workshop on Communication Complexity and Applications, 2014
- “Pseudorandom Generators for Combinatorial Checkerboards”, Dagstuhl Seminar on Computational Complexity of Discrete Problems, 2011

## AWARDS

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Invitations to special journal issues for selected conference papers

- FOCS 2017: Query-to-Communication Lifting for BPP
- FOCS 2015: Deterministic Communication vs. Partition Number
- RANDOM 2014: Communication Complexity of Set-Disjointness for All Probabilities
- STACS 2014 (declined): The Complexity of Deciding Statistical Properties of Samplable Distributions

Other awards

- Finalist for University of Memphis Alumni Association Distinguished Teaching Award, 2019: one of 20 faculty members to receive the most nominations from students, alumni, and other faculty
- Early Career Research Award, University of Memphis College of Arts and Sciences, 2018
- Best Student Paper Award co-recipient, ITCS 2013: Time Hierarchies for Sampling Distributions
- Nominated for department Outstanding GSI Award, UC Berkeley EECS, 2011: top 10% of Graduate Student Instructors
- First place at 2006 ACM International Collegiate Programming Contest NCNA Regionals, advanced to World Finals

## SERVICE

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- Program Committee member: 22nd International Conference on Randomization and Computation (RANDOM), 2018.
- NSF grant panelist, 2018
- Coach for ACM International Collegiate Programming Contest, University of Memphis, 2016–present
- Faculty advisor for ACM student chapter, University of Memphis, 2016–present
- Conference reviewing: FOCS'21, STOC'21, ITCS'21, FOCS'20, CCC'20, STOC'20, STACS'20, QIP'20, FSTTCS'19, STOC'19, SODA'19, FOCS'18, CCC'18, SODA'18, FOCS'17, CCC'17, SODA'17, ISAAC'16, ESA'16, RANDOM'16, ICALP'16, CCC'16, STACS'16, TCC'16, SODA'16, ISAAC'15, RANDOM'15, FOCS'15, CSR'15, CCC'15, RANDOM'14, ICALP'14, ICALP'13, ITCS'13, MFCS'12, STOC'11
- Journal reviewing: Journal of the ACM, SIAM Journal on Computing, Theory of Computing, Computational Complexity, ACM Transactions on Computation Theory, ACM Transactions on Algorithms, Algorithmica, Random Structures and Algorithms, Journal of Cryptology, Discrete Mathematics and Theoretical Computer Science, Linear Algebra and Its Applications, Chicago Journal of Theoretical Computer Science
- Grant reviewing: U.S.–Israel Binational Science Foundation
- Volunteer for UC Berkeley Computer Science Education Day (for high school students): 2010, 2011

## FELLOWSHIPS AND SCHOLARSHIPS

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- National Science Foundation Graduate Research Fellowship, 2009
- DeWitt Undergraduate Scholarship (UW–Madison Computer Science Department), 2008
- Barry M. Goldwater Scholarship, 2007
- Undergraduate Summer Research Assistantship (UW–Madison Computer Science Department), 2007
- Violet Higgitt Frank Scholarship (UW–Madison Mathematics Department), 2007
- Hilldale Fellowship for Undergraduate/Faculty Collaborative Research (UW–Madison), 2006
- Richard H. Thomas Family Distinguished Scholarship (UW–Madison Electrical and Computer Engineering Department), 2005
- Claude I. and Dora D. Richardson Memorial Fund for Excellence in Electrical and Computer Engineering Scholarship (UW–Madison Electrical and Computer Engineering Department), 2004, 2005, 2006, 2007
- National Merit Scholarship, 2003
- Freshman Engineering Scholarship (UW–Madison College of Engineering), 2003
- Kemper K. Knapp Scholarship (UW–Madison), 2003