

**Noah Fleming**  
Assistant Professor  
Department of Computer Science, LTH, Lund University  
John Ericssons väg 3A, 22362 Lund  
e-mail: [nrflem@gmail.com](mailto:nrflem@gmail.com)

## Research Interests

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*Complexity Theory.* Including proof complexity, circuit complexity, TFNP, interactions between them, and similar topics.  
*Algorithm Design and Analysis.* Applications of proof complexity to the design and analysis of practical algorithms including SAT and integer programming solvers, property testing, and low-sensitivity algorithms.

## Education and Employment

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| – <b>Assistant Professor</b><br>Lund University, Lund, Sweden.  | 2025 – Present |
| – <b>Assistant Professor</b><br>Memorial University of Newfoundland and Labrador, St. John's, Canada.   | 2022 – 2025    |
| – <b>Postdoctoral Research Fellow</b><br>UC San Diego, USA.<br>Hosted by Russell Impagliazzo and Samuel Buss  | 2021 – 2022    |
| – <b>M.V. Raghunathan Research Fellow</b><br>Simons Institute, UC Berkeley, California, USA.<br>Satisfiability: Theory, Practice, and Beyond Program.                   | 2021           |
| – <b>Ph.D. in Computer Science</b><br>University of Toronto, Toronto, Canada.<br>Advisor: Toniann Pitassi<br>Title: <i>The Proof Complexity of Integer Programming.</i> | 2017 – 2021    |
| – <b>M.Sc. in Computer Science</b><br>University of Toronto, Toronto, Canada.<br>Advisor: Toniann Pitassi<br>Project Title: <i>Linear Threshold Proof Systems.</i>      | 2015 – 2017    |
| – <b>B.Sc. Double Major in Computer Science and Pure Mathematics</b><br>Memorial University of Newfoundland, St. John's, Canada.  | 2010 – 2015    |

## Visiting Positions

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|---|-------------|
| – <b>Columbia University</b> , New York, U.S.A.<br><i>Adjunct Associate Research Scientist.</i>   | 2025 – 2026 |
| – <b>Simons Institute, UC Berkeley</b> , California, U.S.A.<br><i>Visiting Researcher.</i><br>Satisfiability: Extended Reunion Program.               | Fall 2023   |
| – <b>National Institute of Informatics</b> , Tokyo, Japan<br><i>Research intern in Theoretical Computer Science.</i><br>Supervisor: Yuichi Yoshida.   | Summer 2019 |
| – <b>Simons Institute, UC Berkeley</b> , California, U.S.A.<br><i>Visiting Graduate Student.</i><br>Lower Bounds in Computational Complexity Program. | Fall 2018   |
| – <b>Institute for Advanced Study</b> , Princeton, U.S.A.<br><i>Visiting Graduate Student.</i>  | Fall 2017   |

## Research Funding

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|---|-------------|
| – Grant for Recruiting International Visiting Researchers to Sweden (\$2,000,000 SEK) | 2025 – 2026 |
| – NSERC Discovery Grant (\$205,000 CAD)   | 2023 – 2028 |

- NSERC Discovery Launch Supplement (\$12,500 CAD) 2023
- Memorial University Startup grant (\$40,000 CAD) 2022 – 2025

## Awards and Honours

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- UCSD CSE Postdoctoral Fellowship (\$124,000 USD) 2021 – 2023
- Invited special issue journal article “On the Power and Limitations of Branch and Cut” at CCC 2021. 2021  
Honour reserved for the top 5-10 papers in the conference.
- NSERC Postdoctoral Fellowship (PDF) (\$90,000 CAD) 2021 – 2023
- Graduate Completion Award (\$1,600 CAD) 2021
- Acres Productive Technologies Inc./Joseph Yonan Memorial Fellowship (\$2,000 CAD) 2020
- Ontario Graduate Scholarship (\$15,000 CAD) 2020
- Walter C. Sumner Memorial Fellowship (\$8,000 CAD) 2020
- Walter C. Sumner Memorial Fellowship (\$8,000 CAD) 2019
- Mitacs Globalink Research Award - Japan Society for the Promotion of Science (¥534,000 YEN) 2019
- NSERC Alexander Graham Bell Canada Graduate Scholarship - Doctoral (CGSD) (\$105,000 CAD) 2017 – 2020
- NSERC Alexander Graham Bell Canada Graduate Scholarship - Master’s (CGSM) (\$17,500 CAD) 2015 – 2016

## Publications

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Author order in theoretical computer science is alphabetical. The exception to this rule, below, are the papers published in *Theory and Applications of Satisfiability Testing* (SAT), in which authors are listed according to contribution. Co-authors who are students of mine are underlined.

### Peer Reviewed Conference Publications

1. Noah Fleming, Deniz Imrek, Christophe Marciot. Provably Total Functions in the Polynomial Hierarchy. *Proceedings of the 40th Computational Complexity Conference (CCC 2025)*.  
doi: [10.4230/LIPIcs.CCC.2025.28](https://doi.org/10.4230/LIPIcs.CCC.2025.28)
2. Susanna de Rezende, Noah Fleming, Duri Andrea Janett, Jakob Nordström, Shuo Pang. Truly Supercritical Tradeoffs for Resolution, Cutting Planes, Monotone Circuits, and Weisfeiler-Leman. *Proceedings of the 57th Annual Symposium on Theory of Computing (STOC 2025)*.  
doi: [10.1145/3717823.3718271](https://doi.org/10.1145/3717823.3718271).
3. Noah Fleming, Stefan Grosser, Toniann Pitassi, Robert Robere. Black-Box PPP is not Turing Closed. *Proceedings of the 56th Annual ACM Symposium on Theory of Computing (STOC 2024)*.  
doi: [10.1145/3618260.3649769](https://doi.org/10.1145/3618260.3649769)
4. Vipul Arora, Arnab Bhattacharyya, Noah Fleming, Esty Kelman, Yuichi Yoshida. Low Degree Testing over the Reals. *Proceedings of the 2023 Symposium on Discrete Algorithms (SODA 2023)*.  
doi: [10.1137/1.9781611977554.ch31](https://doi.org/10.1137/1.9781611977554.ch31)
5. Marc Vinyals, Chunxiao Li, Noah Fleming, Antonina Kolokolova, Vijay Ganesh. Limits of CDCL Learning via Merge Resolution. *Proceedings of the 26th International Conference on the Theory and Applications of Satisfiability Testing (SAT 2023)*.  
doi: [10.4230/LIPIcs.SAT.2023.27](https://doi.org/10.4230/LIPIcs.SAT.2023.27)
6. Sam Buss, Noah Fleming, Russell Impagliazzo. TFNP Characterizations of Proof Systems and Monotone Circuits. *Proceedings of the 14th Innovations in Theoretical Computer Science (ITCS 2023)*.  
doi: [10.4230/LIPIcs.ITCS.2023.30](https://doi.org/10.4230/LIPIcs.ITCS.2023.30)
7. Noah Fleming, Toniann Pitassi, Robert Robere. Extremely Deep Proofs. *Proceedings of the 13th Innovations in Theoretical Computer Science (ITCS 2022)*.  
doi: [10.4230/LIPIcs.ITCS.2022.70](https://doi.org/10.4230/LIPIcs.ITCS.2022.70)
8. Noah Fleming, Mika Göös, Stefan Grosser, Robert Robere. On Semi-Algebraic Proofs and Algorithms. *Proceedings of the 13th Innovations in Theoretical Computer Science (ITCS 2022)*.  
doi: [10.4230/LIPIcs.ITCS.2022.69](https://doi.org/10.4230/LIPIcs.ITCS.2022.69)
9. Noah Fleming, Mika Göös, Russell Impagliazzo, Toniann Pitassi, Li-Yang Tan, Robert Robere, Avi Wigderson. On the Power and Limitations of Branch and Cut. *Proceedings of the 36th Computational Complexity Conference (CCC 2021)*.

doi: [10.4230/LIPIcs.CCC.2021.6](https://doi.org/10.4230/LIPIcs.CCC.2021.6)

**Invited to the special journal issue for CCC 2021.**

10. Chunxiao Li, Jonathan Chung, Soham Mukherjee, Marc Vinyals, Noah Fleming, Antonina Kolokolova, Alice Mu, Vijay Ganesh. On the Hierarchical Community Structure of Practical SAT Formulas. *Proceedings of the 24th International Conference on the Theory and Applications of Satisfiability Testing (SAT 2021)*. doi: [10.1007/978-3-030-80223-3\\_25](https://doi.org/10.1007/978-3-030-80223-3_25)
11. Chunxiao Li, Noah Fleming, Marc Vinyals, Toniann Pitassi, Vijay Ganesh. Towards a Complexity-Theoretic Understanding of Restarts in SAT Solvers. *Proceedings of the 23rd International Conference on the Theory and Applications of Satisfiability Testing (SAT 2020)*. doi: [10.1007/978-3-030-51825-7\\_17](https://doi.org/10.1007/978-3-030-51825-7_17)
12. Noah Fleming, Yuichi Yoshida. Distribution-Free Testing of Linear Functions on  $\mathbb{R}^n$ . *Proceedings of the 11th Innovations in Theoretical Computer Science Conference (ITCS 2020)*. doi: [10.4230/LIPIcs.ITCS.2020.22](https://doi.org/10.4230/LIPIcs.ITCS.2020.22)
13. Paul Beame, Noah Fleming, Russell Impagliazzo, Antonina Kolokolova, Denis Pankratov, Toniann Pitassi, Robert Robere. Stabbing Planes. *Proceedings of the 9th Innovations in Theoretical Computer Science Conference (ITCS 2018)*. doi: [10.4230/LIPIcs.ITCS.2018.10](https://doi.org/10.4230/LIPIcs.ITCS.2018.10)
14. Noah Fleming, Denis Pankratov, Toniann Pitassi, Robert Robere. Random  $\Theta(\log n)$ -CNFs are Hard for Cutting Planes. *Proceedings of the 58th annual IEEE Symposium on Foundations of Computer Science (FOCS 2017)*. doi: [10.1109/FOCS.2017.19](https://doi.org/10.1109/FOCS.2017.19)

#### In Submission

1. Noah Fleming, Yuichi Yoshida. Sensitivity Lower Bounds for Approximation Algorithms.
2. Noah Fleming, Stefan Grosser, Hanlin Ren, Siddhartha Jain, Jiawei Li, Morgan Shirley, Weiqiang Yuan. Total Search Problems in ZPP.

#### Peer Reviewed Journal Publications

1. Noah Fleming, Mika Göös, Russell Impagliazzo, Toniann Pitassi, Li-Yang Tan, Robert Robere, Avi Wigderson. On the Power and Limitations of Branch and Cut. *Theory of Computing (ToC)*, CCC Special Issue, to Appear.
2. Noah Fleming, Denis Pankratov, Toniann Pitassi, Robert Robere. Random  $\Theta(\log n)$ -CNFs are Hard for Cutting Planes. *Journal of the ACM (JACM 2022)*. doi: [10.1145/3486680](https://doi.org/10.1145/3486680)
3. Noah Fleming, Pravesh Kothari, Toniann Pitassi. Semialgebraic Proofs and Efficient Algorithm Design. *Foundations and Trends® in Theoretical Computer Science*, 14 (1-2): 1-229 (2019). doi: [10.1561/04000000086](https://doi.org/10.1561/04000000086)
4. Noah Fleming, Antonina Kolokolova, Renesa Nizamee. Complexity of Alignment and Decoding Problems: Restrictions and Approximations. *Machine Translation*, 29 (3-4): 163-187 (2015). doi: [10.1007/s10590-015-9172-5](https://doi.org/10.1007/s10590-015-9172-5)

#### In Submission

1. Vipul Arora, Arnab Bhattacharyya, Noah Fleming, Esty Kelman, Yuichi Yoshida. Low Degree Testing over the Reals. In submission to *Algorithmica*.

#### Book Chapters

1. Noah Fleming, Toniann Pitassi. Reflections on Proof Complexity and Counting Principles. In Ivo Düntsch and Edwin Mares, editors, *Alasdair Urquhart on Nonclassical and Algebraic Logic and Complexity of Proofs*, Outstanding Contributions to Logic. Springer International Publishing (2022). doi: [10.1007/978-3-030-71430-7](https://doi.org/10.1007/978-3-030-71430-7)

## Supervision

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### Graduate Students

- Christophe Marciot (Memorial University, Ph.D.) 2023 – Present
- [Deniz Imrek](#) (University of Austin, Ph.D., co-supervised with Anna Gal) 2023 – Present
- Jordan Kilfoy (Memorial University, MSc., co-supervised with Antonina Kolokolova) 2024 – Present

### Undergraduate Students

- Michael Gregory. Honours Thesis, Memorial University. Now a MSc student at University of Waterloo. 2024 – 2025
- Grey Seaward. Honours Thesis, Memorial University. 2023 – 2025
- Parsa Esmkhani. Research Assistant, Memorial University, co-supervised with Antonina Kolokolova. 2023 – 2025
- Gavin Hull. Research Assistant, Memorial University. Winter 2023
- Felipe Heap. Research Assistant, University of Toronto, co-supervised with Toniann Pitassi. 2019

### Postdocs and Researcher Scientists

- [Marc Vinyals](#). Researcher Scientist, Memorial University, co-hosted with Antonina Kolokolova. 2022

## Professional Service

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- *Program Committee Member*
  - 17th Innovations in Theoretical Computer Science (ITCS 2026).
  - 28th International Conference on Theory and Applications of Satisfiability Testing (SAT 2025).
- *External Reviewer*
  - Conferences: FOCS, STOC, CCC, ITCS, SODA, SAT, ISAAC, ICALP, LICS, ESA, STACS, Random.
  - Journals: Journal of the ACM, Theory of Computing, Information Processing Letters, TheoretCS, Computational Complexity, Logical Methods in Computer Science, Journal of Artificial Intelligence.
  - Grants: German Research Foundation (DFG).
- *Selection Committee for the University Research Professor*. Memorial University.
  - 2025.
- *Thesis Examiner*
  - Omran Khalifa. MSc. Title: A Study in Orthogonal Latin Squares and Strong Starters. Department of Computer Science, Memorial University.
- *Faculty Search Committee*. Department of Computer Science, Memorial University.
  - 2022 – 2023, 2023 – 2024, 2024 – 2025.
- *Graduate Student Admissions Committee*. Department of Computer Science, Memorial University.
  - 2022 – 2023.
- *Faculty of Science representative to the Faculty of Business Faculty Council*. Memorial University.
  - 2022 – 2023.
- *Head Coach, University of Toronto International Collegiate Programming Contest (ICPC) Team*. University of Toronto. 2018 – 2021
  - Organized and ran programming competitions, problem sessions, and practices for the three University of Toronto ICPC teams. Organized logistics and transportation to regional championships. Secured funding to run the teams from the University of Toronto.
- *Teaching Assistant*. University of Toronto. 2015 – 2021
  - CSC438/2404 (1 appt.), CSC165 (9 appt.), CSC373 (1 appt.), CSC363 (1 appt.), CSC263 (1 appt.)
- *Lead Mentor, Undergraduate Summer Research Program*. University of Toronto 2016
  - Held weekly mentoring sessions for undergraduate students participating in the Department of Computer Science Undergraduate Summer Research Program to guide them on their research project.

## Teaching

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In the following I list the courses which I have been an instructor for. In all of the courses below, the instruction was in the form of standard lecture-based classroom teaching, and the language of instruction was in English.

- Comp 3602: *Introduction to the Theory of Computing*. Memorial University.  
Third year undergraduate course which gives students a formal introduction to theoretical computer science, with a focus on computational complexity theory. This includes automata theory, Turing Machines, the P versus NP problem, and related topics. Not required for BSc in Computer Science.
  - Fall 2024. Class size: 24.
  - Fall 2023. Class size: 27.
- Comp 6901: *Applied Algorithms*. Memorial University.  
Graduate-level course providing students with an introduction to the formal study of algorithms. This includes standard algorithmic paradigms such as greedy algorithms, graph algorithms, dynamic programming, network flows, and linear programming. Required for MSc/PhD in Computer Science.
  - Fall 2024. Class size: 67.
  - Fall 2023. Class size: 79.
  - Fall 2022. Class size: 49.
- Comp 6902/COMP 4742: *Theory of Computation*. Memorial University.  
Cross-listed fourth-year undergraduate/graduate course covering topics in complexity theory. Not required for degrees in Computer Science.
  - Winter 2025. Class size: 18.
  - Winter 2023. Class size: 10.
- CSC165: *Mathematical Expression and Reasoning*. University of Toronto.  
First-year undergraduate course, which introduces students to formal mathematical reasoning. Topics include formalizing mathematical ideas, structuring proofs, and proof techniques such as induction. As well, it covers the analysis of algorithms including asymptotic notation.
  - Winter 2017. Co-taught with Toniann Pitassi. Class size: >200.

## Seminars and Reading Series

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- *Theory Reading Group*. Memorial University 2022 – 2025  
Weekly seminar series on topics in theoretical computer science.
- CSC199: *Special topics in Computer Science*. University of California, San-Diego. Fall 2021  
Seminar on the Theory of SAT. Covering topics in propositional and algebraic proof systems, and SAT Solvers. Co-organized with Sam Buss, Sicun Gao, and Russell Impagliazzo.

## Invited Talks

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These *do not* include presentations for accepted papers at conferences.

1. MAIO Seminar 2025  
Lund University, Lund, Sweden.  
Seminar Title: *Proofs and Search Problems*
2. Computer Science Colloquium 2025  
Southern Denmark University, Odense, Denmark.  
Seminar Title: *Connecting Proofs and Algorithms*.
3. Computer Science Colloquium 2025  
University of Montreal, Montreal, Canada.  
Seminar Title: *Connecting Proofs and Algorithms*.
4. Theory Seminar 2025  
Columbia University, New York, USA.  
Seminar Title: *Supercritical Trade-offs*.

5. Theory Seminar  
University of Chicago, Chicago, IL, USA. 2025  
Seminar Title: *Proofs, Circuits, and Total Functions.*
6. Theory Seminar  
University of Toronto, Toronto, Canada. 2024  
Seminar Title: *Supercritical Trade-offs.*
7. MIAO Seminar  
University of Copenhagen, Copenhagen, Denmark. 2024  
Seminar Title: *PPP is not Turing Closed in the Black-Box Setting.*
8. Proof Complexity and Beyond Workshop  
MFO Oberwolfach, Germany. 2024  
Seminar Title: *PPP is not Closed for Turing Reductions.*
9. Theory Seminar  
National Institute of Informatics, Tokyo, Japan. 2024  
Seminar Title: *Black-Box PPP is not Turing Closed.*
10. Math Colloquium  
Memorial University, Newfoundland, Canada. 2023  
Seminar Title: *A Logical Approach to P vs. NP.*
11. Theory Seminar  
University of Toronto, Toronto, Canada. 2023  
Invited Speaker.  
Seminar Title: *Proofs, Circuits, and Total Functions.*
12. Extended Reunion: Satisfiability Program  
Simons Institute, Berkeley, California, USA. 2023  
Seminar Title: *The Proof Complexity of Integer Programming.*
13. Meta-Complexity Program  
Simons Institute, Berkeley, California, USA. 2023  
Seminar Title: *TFNP, Proof Complexity and Monotone Circuit Complexity.*
14. North American Annual Meeting of the Association for Symbolic Logic  
University of California, Irvine, California, USA. 2023  
Seminar Title: *The Proof Complexity of Integer Programming.*
15. Satisfiability: Theory, Practice, and Beyond Reunion Program  
Simons Institute, Berkeley, California, USA. 2022  
Seminar Title: *Extremely Deep Proofs.*
16. Online SAT Seminar  
Online. 2022  
Seminar Title: *Extremely Deep Proofs.*
17. UCSD Theory Seminary, University of California, San Diego  
San Diego, California, USA. 2022  
Seminar Title: *Semi-Algebraic Proofs and Algorithms.*
18. Oxford-Warwick Complexity Meeting  
Online. 2021  
Seminar Title: *Extremely Deep Proofs.*
19. MIAO Video Seminar, University of Copenhagen  
Copenhagen, Denmark. 2021  
Seminar Title: *On the Complexity of Branch-and-Cut.*
20. Simons Institute  
Berkeley, California, USA. 2021  
Seminar Title: *The Proof Complexity of Integer Programming Solvers.*
21. Simons Institute  
Berkeley, California, USA. 2021  
Seminar Title: *The Proof Complexity of Practical Integer Programming.*
22. Institute for Advanced Study

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| Princeton, New Jersey, USA.<br>Invited Speaker.<br>Seminar Title: <i>Recent Progress on Cutting Planes Proofs</i> .   | 2020 |
| 23. BIRS Proof Complexity Workshop 20w5144<br>BIRS Centre, Banff, Canada.<br>Seminar Title: <i>Semialgebraic Proofs and Efficient Algorithm Design</i> .  | 2020 |
| 24. Simon Fraser University Theory Seminar<br>Simon Fraser University, Vancouver, Canada.<br>Seminar Title: <i>Stabbing Planes</i> .  | 2019 |
| 25. Memorial University of Newfoundland Computer Science Seminar.<br>Memorial University of Newfoundland, St. John's, Canada.<br>Seminar Title: <i>Random CNF formulas are hard to refute in Cutting Planes</i> . | 2018 |
| 26. Proof Complexity Workshop<br>Dagstuhl, Germany.<br>Seminar Title: <i>Stabbing Planes</i> .  | 2018 |
| 27. Proof Complexity and Beyond Workshop<br>MFO Oberwolfach, Germany.<br>Seminar Title: <i>Random <math>\Theta(\log n)</math>-CNF formulas Are Hard for Cutting Planes</i> .                                      | 2017 |

### Short-Term Visiting Researchers

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| – Ben Davis.  | Fall 2025   |
| – Stefan Grosser. (Co-hosted with Antonina Kolokolova). | Fall 2024   |
| – Morgan Shirley.                                       | Fall 2024   |
| – Jiawei Li.  | Summer 2024 |
| – Ian Mertz.  | Winter 2024 |
| – Chunxiao Li. (Co-hosted with Antonina Kolokolova).    | Fall 2022   |
| – Vijay Ganesh. (Co-hosted with Antonina Kolokolova).   | Fall 2022   |