Noah Fleming
Assistant Professor
Department of Computer Science, Memorial University of Newfoundland and Labrador
e-mail: nfleming@mun.ca
www: cs.utoronto.ca/~noahfleming
Google Scholar : dblp

Research Interests

Computational complexity theory: proof complexity, circuit complexity, communication complexity and interactions between them. The theory and practice of SAT solving, and property testing.

Education and Employment

- **Assistant Professor**   2022 – Present
  Memorial University of Newfoundland and Labrador, St. John's, Canada.

- **Postdoctoral Research Fellow**   2021 – 2022
  University of California, San Diego, USA.
  Hosted by Russell Impagliazzo and Samuel Buss

- **M.V. Raghunathan Research Fellow**   2021
  Simons Institute, University of California, Berkeley, California, USA.
  Satisfiability: Theory, Practice, and Beyond Program.

- **Ph.D. in Computer Science**   2017 – 2021
  University of Toronto, Toronto, Canada.
  Advisor: Toniann Pitassi
  Title: *The Proof Complexity of Integer Programming*.

- **M.Sc. in Computer Science**   2015 – Aug 25, 2017
  University of Toronto, Toronto, Canada.
  Advisor: Toniann Pitassi
  Project Title: *Linear Threshold Proof Systems*.

- **B.Sc. Double Major in Computer Science and Pure Mathematics**   2010 - 2015
  Memorial University of Newfoundland, St. John's, Canada.
  Graduated with First Class Distinction.

Visiting Positions

- **National Institute of Informatics**, Tokyo, Japan   Summer 2019
  Research intern in Theoretical Computer Science.
  Supervisor: Yuichi Yoshida.

- **Simons Institute**, Berkely, U.S.A.   Fall 2018
  Visiting Graduate Student
  Lower Bounds in Computational Complexity Program.

- **Institute for Advanced Study**, Princeton, U.S.A.   Fall 2017
  Visiting Graduate Student.

Awards and Honours

- 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

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- Mitacs Globalink Research Award - Japan Society for the Promotion of Science 2019 (¥$534,000$ YEN)

- NSERC Alexander Graham Bell Canada Graduate Scholarship - Doctoral (CGSD) 2017 - 2020
  ($105,000$ CAD)

- NSERC Alexander Graham Bell Canada Graduate Scholarship - Master's (CGSM) 2015 - 2016
  ($17,500$ CAD)

- NSERC Undergraduate Student Research Award ($4,500$ CAD)   2015

- NSERC Undergraduate Student Research Award ($4,500$ CAD)   2014

- NSERC Undergraduate Student Research Award (Declined) ($4,500$ CAD)   2014

- The Gary Bourne Memorial Scholarship ($1,090$)   2014

- The Julius and Bella Levkovitz Memorial Scholarship (700 CAD)   2014

- The Samuel, Millicent and Thomas Grandy Memorial Scholarship (925 CAD) 2014

- The Women's Association of Memorial University of Newfoundland Faculty/Staff 2014
  Scholarship (700 CAD)

- The Mrs. E.D. Matthews Memorial Scholarship in Mathematics and Statistics (500 CAD)   2013

- CUPE 1615 Scholarship (500 CAD)   2013

Publications

Peer Reviewed Conference Publications

- 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

- 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

- 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
  Invited to the special journal issue for CCC 2021.

- 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

- 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

- 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

- 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

- 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

In Submission

- Vipul Arora, Arnab Bhattacharyya, Noah Fleming, Esty Kelman, Yuichi Yoshida. Low Degree Testing over the Reals.

Peer Reviewed Journal Publications

- Noah Fleming, Denis Pankratov, Toniann Pitassi, Robert Robere. Random $\Theta(\log n)$-CNFs are Hard for Cutting Planes.
  Journal of the ACM (JACM 2022).

- 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: 10.1561/0400000086

- 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

In Submission

- Paul Beame, Noah Fleming, Russell Impagliazzo, Antonina Kolokolova, Denis Pankratov, Toniann Pitassi, Robert Robere.
  Stabbing Planes.

- Noah Fleming, Mika Göös, Russell Impgaliazzo, Toniann Pitassi, Li-Yang Tan, Robert Robere, Avi Wigderson.
  On the Power and Limitations of Branch and Cut.

Book Chapters

- 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

Professional Service

- **Head Coach**, University of Toronto International Collegiate Programming Contest (ICPC) Team
  University of Toronto, Toronto, Canada   2018 – 2021

- **Seminar Organizer**, Satisfiability: Theory, Practice, and Beyond Program
  Simons Institute, Berkeley, Canada   2021

- **Lead Mentor**, Undergraduate Summer Research Program
  University of Toronto, Toronto, Canada   2016
  Held weekly meetings with for undergraduate students participating in the Undergraduate Summer Research Program to help guide them in their summer research projects.

- **External Reviewer**

  - Conferences: FOCS, STOC, CCC, ITCS, SODA, SAT, ISAAC, ICALP, LICS, ESA, STACS.

  - Journals: Theory of Computing, Information Processing Letters, TheoretiCS, Computational Complexity.

Teaching Experience

Student Supervision

- Felipe Heap. Co-supervised Research Internship with Toniann Pitassi.   2019

Course Instruction

- CSC199: Seminar Course on the Theory of SAT.   Fall 2021
  This seminar covered topics in propositional and algebraic proof systems, and algorithms for satisfiability (SAT solvers).
  Co-taught with Sam Buss, Sicun Gao, and Russell Impagliazzo.

- CSC165: Mathematical Expression and Reasoning for Computer Science.
  Co-taught with Toniann Pitassi.   Winter 2017

Teaching Assistantships

- CSC438/2404: Computability and Logic (Graduate Course).   1.5 appointments.

- CSC373: Algorithm Design and Analysis.   2 appointments.

- CSC363: Computational Complexity and Computability.   1 appointment.

- CSC263: Data Structures and Analysis.   1 appointments.

- CSC263: Data Structures and Analysis (Course Design and Preparation).   1 appointments.

- CSC165: Mathematical Expression and Reasoning for Computer Science.   12 appointments.

Selected Invited Talks and Workshops

- Satisfiability: Theory, Practice, and Beyond Reunion
  Simons Institute, Berkeley, California, USA.   2022
  Invited Speaker.
  Seminar Title: *Extremely Deep Proofs*.

- Online SAT Seminar
  Online.   2022
  Invited Speaker.
  Seminar Title: *Extremely Deep Proofs*.

- UCSD Theory Seminary, University of California, San Diego
  San Diego, California, USA.   2022
  Invited Speaker.
  Seminar Title: *Semi-Algebraic Proofs and Algorithms*.

- Oxford-Warwick Complexity Meeting
  Online.   2021
  Invited Speaker.
  Seminar Title: *Extremely Deep Proofs*.

- MIAO Video Seminar, University of Copenhagen
  Copenhagen, Denmark.   2021
  Invited Speaker.
  Seminar Title: *On the Complexity of Branch-and-Cut*.

- Simons Institute
  Berkeley, California, USA.   2021
  Invited Speaker.
  Seminar Title: *The Proof Complexity of Integer Programming Solvers*.

- Simons Institute
  Berkeley, California, USA.   2021
  Invited Speaker.
  Seminar Title: *The Proof Complexity of Practical Integer Programming*.

- Institute for Advanced Study
  Princeton, New Jersey, USA.   2020
  Invited Speaker.
  Seminar Title: *Recent Progress on Cutting Planes Proofs*.

- BIRS Proof Complexity Workshop 20w5144
  BIRS Centre, Banff, Canada.   2020
  Participant/Speaker.
  Seminar Title: *Semialgebraic Proofs and Efficient Algorithm Design*.

- Simon Fraser University Theory Seminar
  Simon Fraser University, Vancouver, Canada.   2019

Invited Speaker.
Seminar Title: *Stabbing Planes*.

- Memorial University of Newfoundland Computer Science Seminar.
  Memorial University of Newfoundland, St. John's, Canada.   2018
  Invited Speaker.
  Seminar Title: *Random CNF formulas are hard to refute in Cutting Planes*.

- Proof Complexity Workshop
  Dagstuhl, Germany.   2018
  Participant/Speaker.
  Seminar Title: *Stabbing Planes*.

- Proof Complexity and Beyond Workshop
  MFO Oberwolfach, Germany.   2017
  Participant/Speaker.
  Seminar Title: *Random $\Theta(\log n)$-CNF formulas Are Hard for Cutting Planes*.