

# Benjamin Lovitz

benjamin.lovitz@gmail.com  
www.benjaminlovitz.com

---

## Employment

*Fall 2022*— **Department of Mathematics, Northeastern University**  
–NSF postdoctoral fellow  
–Zelevinsky postdoctoral fellow  
–Mentor: Harm Derksen

## Education

*Spring 2018* **Institute for Quantum Computing, University of Waterloo**  
—*Winter 2022* –PhD in Applied Math (Quantum Information)  
–Advisors: William Slofstra and John Watrous  
–Thesis: *Tensors: Entanglement, Geometry, and Combinatorics*

*Fall 2015* **Institute for Quantum Computing, University of Waterloo**  
—*Fall 2018* –MSc in Physics (Quantum Information)  
–Advisor: Norbert Lütkenhaus  
–Thesis: *Practical quantum fingerprinting and appointment scheduling*

*Fall 2011* **Bates College**  
—*Winter 2015* –BA double degree in Math and Physics (Honors)  
–Magna Cum Laude

## Research Interests

Tensors, quantum information theory, optimization, applied algebraic geometry, representation theory, combinatorics, entanglement theory, matroid theory.

## Publications and preprints

*Nearly tight bounds for testing tree tensor network states*

Benjamin Lovitz and Angus Lowe  
Submitted, 2024

*X-arability of mixed quantum states*

Harm Derksen, Nathaniel Johnston, Benjamin Lovitz, and Aravindan Vijayaraghavan  
arXiv preprint, 2024

*Linear preservers of secant varieties and other varieties of tensors*

Fulvio Gesmundo, Young In Han, and Benjamin Lovitz  
Submitted, 2024

*A hierarchy of eigencomputations for polynomial optimization on the sphere*  
Benjamin Lovitz and Nathaniel Johnston  
arXiv preprint, 2023

*Computing linear sections of varieties: quantum entanglement, tensor decompositions and beyond*  
Nathaniel Johnston, Benjamin Lovitz, and Aravindan Vijayaraghavan  
FOCS 2023

*A generalization of Kruskal's theorem on tensor decomposition*  
Benjamin Lovitz and Fedor Petrov  
Forum of Mathematics, Sigma, 2023

*A complete hierarchy of linear systems for certifying quantum entanglement of subspaces*  
Nathaniel Johnston, Benjamin Lovitz, and Aravindan Vijayaraghavan  
Physical Review A, 2022 and QIP 2023

*Entangled subspaces and generic local state discrimination with pre-shared entanglement*  
Benjamin Lovitz and Nathaniel Johnston  
Quantum, 2022

*New techniques for bounding stabilizer rank*  
Benjamin Lovitz and Vincent Steffan  
Quantum, 2022 and QIP 2022

*On decomposable correlation matrices*  
Benjamin Lovitz  
Linear and Multilinear Algebra, 2021

*Toward a generalization of Kruskal's theorem on tensor decomposition*  
Benjamin Lovitz  
arXiv preprint, 2020

*The non- $m$ -positive dimension of a positive linear map*  
Nathaniel Johnston, Benjamin Lovitz, and Daniel Puzzuoli  
Quantum, 2019

*Families of quantum fingerprinting protocols*  
Benjamin Lovitz and Norbert Lütkenhaus  
Physical Review A, 2018

*Practical quantum appointment scheduling*  
Dave Touchette, Benjamin Lovitz, and Norbert Lütkenhaus  
Physical Review A, 2018

*Perfect state transfer in Laplacian quantum walk*  
Rachael Alvir, Sophia Dever, Benjamin Lovitz, James Myer, Christino Tamon, Yan Xu, and Han-  
meng Zhan  
Journal of Algebraic Combinatorics, 2016

## Awards

- September 2022*— NSF Mathematical Sciences Postdoctoral Research Fellowship (MSPRF)  
*National Science Foundation*  
150,000 USD
- September 2021* Ontario Graduate Scholarship (international competition)  
—*April 2022* *Government of Ontario, Canada*  
10,000 CAD

## Talks

- August 2024* Effective methods in algebraic geometry (MEGA) 2024  
*A hierarchy of eigencomputations for polynomial optimization on the sphere*
- May 2024* University of Toulouse geometry seminar  
*Computing linear sections of varieties: quantum entanglement, tensor decompositions and beyond*
- May 2024* SIAM conference on applied linear algebra  
*Algorithms and uniqueness of tensor decompositions*
- April 2024* Georgia Tech algebra seminar  
*Computing linear sections of varieties: quantum entanglement, tensor decompositions and beyond*
- January 2024* Tel Aviv University applied math seminar  
*Old dog, new tricks: Tensor decompositions in quantum information and machine learning*
- January 2024* Northwestern University TCS seminar  
*Old dog, new tricks: Tensor decompositions and applications*
- November 2023* FOCS 2023  
*Computing linear sections of varieties: quantum entanglement, tensor decompositions and beyond*
- November 2023* UMASS Boston math seminar  
*Algorithms and uniqueness of tensor decompositions*
- August 2023* IWOTA 2023  
*A complete hierarchy of linear systems for certifying quantum entanglement of subspaces*
- July 2023* SIAM conference on applied algebraic geometry 2023  
*Computing linear sections of varieties: quantum entanglement, tensor decompositions and beyond*
- June 2023* ILAS 2023  
*A complete hierarchy of linear systems for certifying quantum entanglement of subspaces*

<i>June 2023</i>	NESS 2023 <i>Algorithms and uniqueness of tensor decompositions</i>
<i>March 2023</i>	WACT 2023 <i>Computing linear sections of varieties: quantum entanglement, tensor decompositions and beyond</i>
<i>February 2023</i>	QIP 2023 <i>A complete hierarchy of linear systems for certifying quantum entanglement of subspaces</i>
<i>December 2022</i>	IPAM Tensor Methods Reunion Conference <i>Computing linear sections of varieties: quantum entanglement, tensor decompositions and beyond</i>
<i>November 2022</i>	University of Western Ontario mathematics seminar <i>Nullstellensatz-inspired algorithms for certifying entanglement of subspaces</i>
<i>November 2022</i>	Tensors: Quantum Information, Complexity and Combinatorics conference held at the Centre de Recherches Mathématiques in Montréal <i>Nullstellensatz-inspired algorithms for certifying entanglement of subspaces</i>
<i>November 2022</i>	Portland State University Computer Science seminar <i>New techniques for bounding stabilizer rank</i>
<i>October 2022</i>	Northeastern University GASC seminar <i>New techniques for bounding stabilizer rank</i>
<i>September 2022</i>	Algebraic Geometry with Applications to Tensors and Secants (AGATES) Plenary talk: <i>New techniques for bounding stabilizer rank</i>
<i>September 2022</i>	SIAM Conference on Mathematics of Data Science <i>Tensor Decompositions: Algorithms and Uniqueness</i>
<i>May 2022</i>	QLunch Seminar at QMATH, University of Copenhagen <i>A splitting theorem for product tensors</i>
<i>March 2022</i>	QIP 2022 <i>New techniques for bounding stabilizer rank</i>
<i>March 2022</i>	AMS Special Session on Nonlinear Algebra with Applications to Statistics <i>A generalization of Kruskal's theorem</i>
<i>March 2022</i>	Random Tensors at CIRM <i>New techniques for bounding stabilizer rank</i>

- January 2022* GIC seminar at the Universitat Autònoma de Barcelona  
*Entangled subspaces and generic local state discrimination with pre-shared entanglement*
- December 2021* Theory Lunch Seminar at Northeastern University  
*A generalization of Kruskal's theorem*
- November 2021* IDEAL Seminar at Northwestern University  
*A generalization of Kruskal's theorem*
- November 2021* Algebra Seminar at Auburn University  
*A generalization of Kruskal's theorem*
- April 2021* IPAM Tensor Methods weekly seminar  
*A generalization of Kruskal's theorem*
- March 2021* Copenhagen QIT group meeting  
*Entangled subspaces and generic local state discrimination with pre-shared entanglement*
- February 2021* IQST seminar at the University of Calgary  
*Entangled subspaces and generic local state discrimination with pre-shared entanglement*
- January 2021* Quantum information seminar at the Perimeter Institute  
*Entangled subspaces and generic local state discrimination with pre-shared entanglement*
- October 2014* Bates College  
*Laplacian quantum walk on graphs*
- August 2014* Mathematical Association of America (MAA) Mathfest  
*Laplacian quantum walk on graphs*

## **Teaching**

- Winter 2024* Graduate course: Geometry and Applications of Tensors  
*Instructor, Northeastern University*
- Fall 2023* MATH 2331: Linear Algebra (two sections)  
*Instructor, Northeastern University*
- Fall 2021* QIC 820: Theory of Quantum Information  
*Teaching Assistant, University of Waterloo*
- Fall 2019* Math 127: Calculus 1 for the sciences  
*Instructor, University of Waterloo*

## Advising

*Fall 2021* Mentor to undergraduate student Daniel Han, in collaboration with William Slofstra  
*Undergraduate Research Assistantship program, University of Waterloo*

## Service

- Co-organized JMM 2023 special session “Applications of tensors in computer science” with Harm Derksen and Neriman Tokcan
- Co-organized SIAM AG 2023 minisymposium “Geometric and algebraic structures in quantum information” with Eliana Duarte and Luke Oeding
- Reviewer for *Mathematical Reviews*, American Mathematical Society
- Referee for:
  - *Journal of Physics A: Mathematical and Theoretical*, IOP Publishing
  - *Machine Learning: Science and Technology*, IOP Publishing
  - *Quantum Information and Computation*, Rinton Press
  - *Linear and Multilinear Algebra*, Taylor and Francis
  - *Linear Algebra and its Applications*, Elsevier
  - *Foundations of Computer Science (FOCS)*, IEEE
  - *Symposium on the Theory of Computing (STOC)*, ACM
  - *SIAM Journal on Computing (SICOMP)*, SIAM
  - *Asian Quantum Information Science Conference (AQIS)*

## Further education

*March 2021* Tensor Methods and Emerging Applications to the Physical and Data  
—*June 2021* Sciences  
*Industry for Pure and Applied Mathematics, UCLA*

*2018—2020* Fundamentals of University Teaching Program  
*Centre for Teaching Excellence, University of Waterloo*

## References

Harm Derksen  
*Northeastern University*  
ha.derksen@northeastern.edu

William Slofstra  
*Institute for Quantum Computing, University of Waterloo*  
william.slofstra@uwaterloo.ca

John Watrous  
*IBM*  
john.watrous@ibm.com

Lek-Heng Lim  
*University of Chicago*  
lekheng@statistics.uchicago.edu

Nathaniel Johnston  
*Mount Allison University*  
njohnston@mta.ca

Aravindan Vijayaraghavan  
*Northwestern University*  
aravindv@northwestern.edu

Oana Veliche (teaching reference)  
*Northeastern University*  
o.veliche@northeastern.edu

Owen Woody (teaching reference)  
*University of Waterloo*  
owood@uwaterloo.ca