

# Jonathan Leake

Combinatorics and Optimization, University of Waterloo

☎ +1 (713) 906-6860 • ✉ jonathan@jleake.com • 🌐 jleake.com

My research generally centers around log-concave polynomials and, broadly speaking, their various applications and connections in combinatorics and theoretical computer science.

## Positions

---

- **University of Waterloo** **Waterloo, ON, Canada**  
*Assistant Professor, Department of Combinatorics and Optimization*  
2022–present
- **TU Berlin / WIAS / BMS** **Berlin, Germany**  
*Dirichlet Postdoc Fellowship, under Peter Bürgisser*  
2020–2022
- **Institut Mittag-Leffler** **Stockholm, Sweden**  
*Postdoc Fellowship, Algebraic and Enumerative Combinatorics semester*  
Spring 2020
- **KTH** **Stockholm, Sweden**  
*Postdoc, under Petter Brändén*  
Fall 2019
- **Simons Insitute** **Berkeley, CA, USA**  
*James H. Simons Fellowship, Geometry of Polynomials semester*  
Spring 2019
- **UC Berkeley** **Berkeley, CA, USA**  
*PhD Mathematics, advised by Olga Holtz*  
Dissertation: Analytic and Combinatorial Features of Stable Polynomials  
2014–2019
- **Teacher Retirement System of Texas** **Austin, TX, USA**  
*Developer, financial and statistical modeling*  
2012–2014
- **Texas A&M University** **College Station, TX, USA**  
*MS Mathematics, advised by Roger Smith*  
2010–2012
- **Texas A&M University** **College Station, TX, USA**  
*BS Applied Mathematics and Computer Engineering*  
Summa Cum Laude with University Honors  
2006–2010

## Publications and Preprints

---

1. **Optimal Trickle-Down Theorems for Path Complexes via C-Lorentzian Polynomials with Applications to Sampling and Log-Concave Sequences** (with K. Lindberg and S. Oveis Gharan), preprint (2025). [arXiv]
2. **Inequalities Characterizing Distinguished Unipotent Orbits** (with A. Bertoloni Meli and T. Koshikawa), preprint (2024). [arXiv]
3. **Compatibility of Real-Rooted Polynomials with Mixed Signs** (with N. Ryder), 2024. [arXiv]
4. **Capacity Bounds on Integral Flows and the Kostant Partition Function** (with A. Morales), preprint (2024). [arXiv]
5. **From Trees to Polynomials and Back Again: New Capacity Bounds with Applications to TSP** (with L. Gurvits and N. Klein), *ICALP* (2024). [arXiv]
6. **Lorentzian Polynomials on Cones** (with P. Brändén), preprint (2023). [arXiv]
7. **Lower Bounds for Contingency Tables via Lorentzian Polynomials** (with P. Brändén and I. Pak), *Israel Journal of Mathematics* (2023). [arXiv]
8. **Deterministic Approximation Algorithms for Volumes of Spectrahedra** (with M. L. Doğan and M. Ravichandran), preprint (2022). [arXiv]

9. **Lorentzian Polynomials on Cones and the Heron-Rota-Welsh Conjecture** (with P. Brändén), 2021. [arXiv]
10. **A Representation-Theoretic Interpretation of the Borcea-Brändén Characterization**, *Mathematische Zeitschrift* (2021). [arXiv]
11. **Capacity Lower Bounds via Productization** (with L. Gurvits), *STOC* (2021). [arXiv]
12. **Sampling Matrices from Harish-Chandra-Itzykson-Zuber Densities with Applications to Quantum Inference and Differential Privacy** (with C. McSwiggen and N. Vishnoi), *STOC* (2021). [arXiv]
13. **Counting Matchings via Capacity Preserving Operators** (with L. Gurvits), *Combinatorics, Probability, and Computing* (2021). [arXiv]
14. **Optimization and Sampling Under Continuous Symmetry: Examples and Lie Theory** (with N. Vishnoi), 2021. [arXiv]
15. **Connecting the q-Multiplicative Convolution and the Finite Difference Convolution** (with N. Ryder), *Advances in Mathematics* (2020). [arXiv]
16. **On the Computability of Continuous Maximum Entropy Distributions: Adjoint Orbits of Lie Groups** (with N. Vishnoi), preprint (2020). [arXiv]
17. **On the Computability of Continuous Maximum Entropy Distributions with Applications** (with N. Vishnoi), *STOC* (2020), *SIAM Journal on Computing* (2022). [arXiv]
18. **Mixed Determinants and the Kadison-Singer Problem** (with M. Ravichandran), *Mathematische Annalen* (2020). [arXiv]
19. **Generalizations of the Matching Polynomial to the Multivariate Independence Polynomial** (with N. Ryder), *Algebraic Combinatorics* (2019). [arXiv]
20. **On the Further Structure of the Finite Free Convolutions** (with N. Ryder), preprint (2018). [arXiv]

## Selected Invitations

---

- **FPSAC 2026** **Seattle, WA, USA**  
Program Committee Member July 2026
- **CanADAM 2025** **Ottawa, ON, Canada**  
Minisymposium organizer: *Log-concave Polynomials* May 2025
- **American Institute of Mathematics** **Pasadena, CA, USA**  
*Geometry of Polynomials in Combinatorics and Sampling*  
Invited speaker March 2025
- **IPAM, UCLA** **Los Angeles, CA, USA**  
*Integrability and Algebraic Combinatorics* April 2024  
Title: *Log-concave polynomials, lattice point counting, and the traveling salesperson problem*
- **Institute for Advanced Study** **Princeton, NJ, USA**  
*Computer Science/Discrete Mathematics Seminar* April 2024  
Title: *Polynomial Capacity and its Applications: To TSP and Beyond*
- **CanADAM 2023** **Winnipeg, MB, Canada**  
*Random matrix theory and connections* June 2023  
Title: *Sampling Matrices from HCIZ Densities*
- **Oberwolfach** **Oberwolfach, Germany**  
*New Directions in Real Algebraic Geometry* March 2023  
Invited participant
- **MATRIX Institute** **Melbourne, Australia**  
*Keynote speaker: Theory and Applications of Stable Polynomials* August 2022  
Title: *Approximate Counting using Stable and Lorentzian Polynomials*

- Oberwolfach** **Oberwolfach, Germany**  
*The Laguerre-Pólya Class and Combinatorics* March 2022  
 Title: *Lorentzian polynomials on cones and the Heron-Rota-Welsh conjecture*
- Frontiers of Statistical Mechanics and Theoretical Computer Science** **Online**  
*Sampling Matrices from HCIZ Densities* December 2021
- Simons Institute, UC Berkeley** **Berkeley, CA, USA**  
*Geometric Methods in Optimization and Sampling Bootcamp* September 2021  
 Title: *Optimization and Sampling under Symmetry*
- SIAM Conference on Applied Algebraic Geometry** **College Station, TX, USA**  
*Optimization and Invariant Theory* August 2021  
 Title: *Maximum entropy distributions on the Grassmannian*
- MPI Leipzig** **Leipzig, Germany**  
*(Polytop)ics: Recent advances on polytopes* April 2021  
 Title: *Flow polytope volume bounds via polynomial capacity*
- Institut Mittag-Leffler** **Stockholm, Sweden**  
*Unimodality, Log-concavity, and Beyond* March 2020  
 Title: *Approximate Counting via Polynomial Capacity*
- Simons Institute, UC Berkeley** **Berkeley, CA, USA**  
*Deterministic Counting, Probability, and Zeros of Partition Functions* March 2019  
 Title: *Counting Matchings via the Capacity Method*
- Simons Institute, UC Berkeley** **Berkeley, CA, USA**  
*Beyond Randomized Rounding and the Probabilistic Method* February 2019  
 Title: *On the Further Structure of Finite Free Convolutions*
- Institut Mittag-Leffler** **Stockholm, Sweden**  
*Hausdorff Geometry of Polynomials and Polynomial Sequences* May 2018  
 Title: *Capacity Preserving Operators*
- IPAM, UCLA** **Los Angeles, CA, USA**  
*Expected Characteristic Polynomial Techniques and Applications* April 2018  
 Title: *Extending the Borcea-Brändén Characterization*

## Grants, Fellowships, and Awards

---

- NSERC Discovery Grant (with Early Career Researcher Supplement)** **Faculty**  
*Project: Entropy Optimization and Lorentzian Polynomials* 2023–2028
- Startup grant** **Faculty**  
*University of Waterloo* 2022–2027
- BMS Dirichlet Postdoctoral Fellowship** **Postdoc**  
*Berlin Mathematical School* 2020–2022
- James H. Simons Fellowship** **Graduate**  
*Simons Institute* Spring 2019
- Various academic scholarships** **Undergraduate**  
*Texas A&M University* 2006–2010

## Teaching and Mentorship

---

- Research Advisor** **University of Waterloo**  
*Maryam Mohammadi Yekta (M.Math) and Thomas Lee (M.Math)* 2023–2025
- Faculty Lecturer** **University of Waterloo**  
*MATH 239, CO 250, CO 739: Lorentzian Polynomials* 2022–now

- **Lecturer** **TU Berlin**  
*Polynomial Capacity: Theory, Applications, Generalizations* *Winter 2020–2021*
- **Graduate Student Instructor** **UC Berkeley**  
*Calculus and Discrete Mathematics* *2014–2017*
- **Teaching Assistant** **Texas A&M University**  
*Calculus* *2010–2012*

## Service

---

- **Program Committee Member** **Seattle, WA, USA**  
*FPSAC 2026* *July 2026*
- **Minisymposium Organizer** **Ottawa, ON, Canada**  
*CanaDAM 2025* *May 2025*
- **Committee Member** **Waterloo, ON, Canada**  
*Grad Committee, University of Waterloo* *Fall 2024–now*
- **Journal and Conference Referee** **Various venues**  
*30+ articles in Adv. Math., FOCS, Proc. AMS, IMRN, JMAA, SIAGA, JCTB, etc.* *2019–now*