

Thuy-Duong Vuong

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Research Interests

Approximate Sampling and Counting, Markov chain analysis, Diffusion models, Geometry of Polynomials and Algorithmic Applications

Education

2015–2019 **Bachelors of Science in Mathematics & in Computer Science**, *Massachusetts Institute of Technology*, Cambridge, MA, GPA: 4.9/5.0.

2019–2024 **PhD in Computer Science**, *Stanford University*, Stanford, CA.
Advisors: Nima Anari, Moses Charikar

2024–Present **Postdoctoral Fellow**, *Miller Institute, UC Berkeley*, Berkeley, CA.
Host: Alistair Sinclair

Publications

Conference & Journal

- [1] Frederic Koehler, Holden Lee, and Thuy-Duong Vuong. Efficiently learning and sampling multimodal distributions with data-based initialization. *The 38th Annual Conference on Learning Theory (COLT)*, 2025 (to appear).
- [2] Nima Anari, Sinho Chewi, and Thuy-Duong Vuong. Fast parallel sampling under isoperimetry. In Shipra Agrawal and Aaron Roth, editors, *Proceedings of Thirty Seventh Conference on Learning Theory*, volume 247 of *Proceedings of Machine Learning Research*, pages 161–185. PMLR, 30 Jun–03 Jul 2024.
- [3] Frederic Koehler and Thuy-Duong Vuong. Sampling multimodal distributions with the vanilla score: Benefits of data-based initialization. *The 12th International Conference on Learning Representations (ICLR)*, 2024.
- [4] Nima Anari, Frederic Koehler, and Thuy-Duong Vuong. Trickle-down in localization schemes and applications. In *Proceedings of the 56th Annual ACM Symposium on Theory of Computing*, STOC 2024, page 1094–1105, New York, NY, USA, 2024. Association for Computing Machinery.
- [5] Marwa El Halabi, Jakub Tarnawski, Ashkan Norouzi-Fard, and Thuy-Duong Vuong. Fairness in submodular maximization over a matroid constraint. In Sanjoy Dasgupta, Stephan Mandt, and Yingzhen Li, editors, *Proceedings of The 27th International Conference on Artificial Intelligence and Statistics*, volume 238 of *Proceedings of Machine Learning Research*, pages 1027–1035. PMLR, 02–04 May 2024.

- [6] Vishesh Jain, Marcus Michelen, Huy Tuan Pham, and Thuy-Duong Vuong. Optimal mixing of the down-up walk on independent sets of a given size. *IEEE 64rd Annual Symposium on Foundations of Computer Science (FOCS)*, 2023.
- [7] Nima Anari, Callum Burgess, Kevin Tian, and Thuy-Duong Vuong. Quadratic speedups in parallel sampling from determinantal distributions. *The 35th ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)*, pages 367–377, 06 2023.
- [8] Nima Anari, Yizhi Huang, Tianyu Liu, Thuy-Duong Vuong, Brian Xu, and Katherine Yu. Parallel discrete sampling via continuous walks. In *Proceedings of the 55th Annual ACM Symposium on Theory of Computing*, STOC 2023, page 103–116, New York, NY, USA, 2023. Association for Computing Machinery.
- [9] Nima Anari, Yang P. Liu, and Thuy-Duong Vuong. Optimal sublinear sampling of spanning trees and determinantal point processes via average-case entropic independence. In *2022 IEEE 63rd Annual Symposium on Foundations of Computer Science (FOCS)*, pages 123–134, 2022.
- [10] Vishesh Jain, Huy Tuan Pham, and Thuy Duong Vuong. Dimension reduction for maximum matchings and the fastest mixing markov chain. *Comptes Rendus. Mathématique*, 361:869–876, 2023.
- [11] Nima Anari and Thuy-Duong Vuong. From sampling to optimization on discrete domains with applications to determinant maximization. *The 35th Annual Conference on Learning Theory (COLT)*, 178:5596–5618, 2022.
- [12] Nima Anari, Vishesh Jain, Frederic Koehler, Huy Tuan Pham, and Thuy-Duong Vuong. Entropic independence: Optimal mixing of down-up random walks. In *Proceedings of the 54th Annual ACM SIGACT Symposium on Theory of Computing*, STOC 2022, page 1418–1430, New York, NY, USA, 2022. Association for Computing Machinery.
- [13] Nima Anari, Vishesh Jain, Frederic Koehler, Huy-Tuan Pham, and Thuy Duong Vuong. Universality of spectral independence with applications to fast mixing in spin glasses. *ACM-SIAM Symposium on Discrete Algorithm (SODA) 2024*, abs/2307.10466, 2024.
- [14] Nima Anari, Michał Dereziński, Thuy-Duong Vuong, and Elizabeth Yang. Domain sparsification of discrete distributions using entropic independence. *The 13th Innovations in Theoretical Computer Science (ITCS)*, pages 5:1–5:23, 2022.
- [15] Vishesh Jain, Huy Tuan Pham, and Thuy-Duong Vuong. Spectral independence, coupling, and the spectral gap of the glauher dynamics. *Information Processing Letters*, 177:106268, 2022.
- [16] Vishesh Jain, Huy Tuan Pham, and Thuy Duong Vuong. Towards the sampling lovász local lemma. In *2021 IEEE 62nd Annual Symposium on Foundations of Computer Science (FOCS)*, pages 173–183, 2022.

- [17] Yeganeh Alimohammadi, Nima Anari, Kirankumar Shiragur, and Thuy-Duong Vuong. Fractionally log-concave and sector-stable polynomials: Counting planar matchings and more. In *Proceedings of the 53rd Annual ACM SIGACT Symposium on Theory of Computing*, STOC 2021, page 433–446, New York, NY, USA, 2021. Association for Computing Machinery.
- [18] Nima Anari, Kuikui Liu, Shayan Oveis Gharan, Cynthia Vinzant, and Thuy-Duong Vuong. Log-concave polynomials iv: Approximate exchange, tight mixing times, and near-optimal sampling of forests. In *Proceedings of the 53rd Annual ACM SIGACT Symposium on Theory of Computing*, STOC 2021, page 408–420, New York, NY, USA, 2021. Association for Computing Machinery.
- [19] Nima Anari and Thuy-Duong Vuong. An extension of plücker relations with applications to subdeterminant maximization. In Jaroslaw Byrka and Raghu Meka, editors, *Approximation, Randomization, and Combinatorial Optimization. Algorithms and Techniques, APPROX/RANDOM 2020, August 17-19, 2020, Virtual Conference*, volume 176 of *LIPIcs*, pages 56:1–56:16. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, 2020.
- [20] Mina Dalirrooyfard, Thuy Duong Vuong, and Virginia Vassilevska Williams. Graph pattern detection: Hardness for all induced patterns and faster non-induced cycles. In *Proceedings of the 51st Annual ACM SIGACT Symposium on Theory of Computing*, STOC 2019, page 1167–1178, New York, NY, USA, 2019. Association for Computing Machinery.
- [21] Mina Dalirrooyfard, Thuy Duong Vuong, and Virginia Vassilevska Williams. Graph pattern detection: Hardness for all induced patterns and faster noninduced cycles. *SIAM Journal on Computing*, 50(5):1627–1662, 2021.
- [22] Alex Lombardi, Vinod Vaikuntanathan, and Thuy-Duong Vuong. Lattice trapdoors and ibe from middle-product lwe. In Dennis Hofheinz and Alon Rosen, editors, *Theory of Cryptography*, pages 24–54, Cham, 2019. Springer International Publishing.
- [23] Yibo Gao, Zhaoqi Li, Thuy-Duong Vuong, and Lisa Yang. Toric mutations in the dp_2 quiver and subgraphs of the dp_2 brane tiling. *Electron. J. Comb.*, 26(2):P2.19, 2019.

Manuscripts

- [24] Sepideh Mahabadi and Thuy-Duong Vuong. Composable coresets for constrained determinant maximization and beyond, 2022.
- [25] Moses Charikar, Paul Liu, Tianyu Liu, and Thuy-Duong Vuong. On the complexity of sampling redistricting plans, 2022.
- [26] Vishesh Jain, Huy Tuan Pham, and Thuy-Duong Vuong. On the sampling lovász local lemma for atomic constraint satisfaction problems. *CoRR*, abs/2102.08342, 2021.
- [27] Nima Anari, Vishesh Jain, Frederic Koehler, Huy Tuan Pham, and Thuy-Duong Vuong. Entropic independence I: modified log-sobolev inequalities for fractionally

log-concave polynomials and high-temperature ising models, 2021 (appear in STOC 2022 as "Entropic independence: Optimal mixing of down-up random walks").

- [28] Nima Anari, Vishesh Jain, Frederic Koehler, Huy Tuan Pham, and Thuy-Duong Vuong. Entropic independence II: optimal sampling and concentration via restricted modified log-sobolev inequalities, 2021 (merged with Entropic independence I and appear in STOC 2022 as "Entropic independence: Optimal mixing of down-up random walks").

Service

Serving as PC Member of STOC 25, RANDOM 25, and SODA 25 Conferences

Reviewer for COLT25, STOC 2021-24, SODA 2021-24, FOCS 2022-24

Journal reviewer for SICOMP, TALG, Annal of Probability

Mentor in Stanford's CS Mentoring Program 2020-2021, CURIS Summer 2021-2023, LINXS 2023

Honors & Awards

2021 **Microsoft Research PhD Fellowship.**

2019 **Anna Pogonyants UROP Award**, *Massachusetts Institute of Technology.*

Awarded to undergraduates for outstanding research project.

Nominated by V.V. Williams and V. Vaikuntanathan.

2017 **Outstanding Poster at the Joint Mathematics Meetings (JMM).**

Awarded to top 15% posters in each topic at the JMM's MAA Student Poster Session

2014 **Silver Medal at International Mathematical Olympiad (IMO).**

Invited talks

May 2025 CANADAM Invited Minisymposium on Log-concave polynomials, Ottawa

March 2025 Yale Statistics & Data Science Seminar

March 2025 Harvard Probabilitas Seminar

Feb. 2025 Spectral Theory Seminar, Berkeley

January 2025 Connections Workshop: Probability and Statistics of Discrete Structures, Simon Laufer Mathematical Institute

July 2024 SIAM Minisymposium on "Mathematical and Computational Redistricting: Algorithms and Analysis", Spokane

January 2024 AMS Special Session on Thresholds in Random Structures, San Francisco

January 2024 AMS Special Session on Recent Progress in Inference and Sampling (Associated with AMS Invited Address by Ankur Moitra), San Francisco

Dec. 2023 Junior Theorists Workshop 2023 at Northwestern

October 2023 Algorithmic & Randomness Center (ARC) Colloquium, Georgia Tech

Nov. 2022 Toyota Technological Institute at Chicago (TTIC) Young Researcher Seminar Series

April 2022 University of Chicago Combinatorics Seminar

Dec. 2021 ETH Zurich Algorithm & Complexity Seminar

June 2021 Google Research Mountain View (Virtual)

■ Teaching experience

Teaching assistant: Design and Analysis of Algorithms (CS 161)–Winter 2022,
Counting and Sampling (CS 263)–Fall 2020