Thuy-Duong Vuong

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Research Interests

Approximate Sampling and Counting
Markov chain analysis
Geometry of Polynomials and Algorithmic Applications
Combinatorial Optimization

Education

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

2019–Present **PhD Candidate**, *Stanford University*, Stanford, CA, *4.0/4.0*.

Publications

Conference & Journal

[1] 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 (to appear).

[2] 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.

[3] 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.

[4] 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.

[5] 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.

[6] 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.

[7] 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.

[8] 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 2024 (to appear)*, abs/2307.10466, 2024.

[9] 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.

[10] Vishesh Jain, Huy Tuan Pham, and Thuy-Duong Vuong. Spectral independence, coupling, and the spectral gap of the glauber dynamics. *Information Processing Letters*, 177:106268, 2022.

[11] 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.

[12] 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.

[13] 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.

[14] 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.

[15] 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.

[16] 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.

[17] 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.

[18] 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

[19] Sepideh Mahabadi and Thuy-Duong Vuong. Composable coresets for constrained determinant maximization and beyond, 2022.

[20] Moses Charikar, Paul Liu, Tianyu Liu, and Thuy-Duong Vuong. On the complexity of sampling redistricting plans, 2022.

[21] Frederic Koehler and Thuy-Duong Vuong. Sampling multimodal distributions with the vanilla score: Benefits of data-based initialization, 2023.

[22] 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.

[23] 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").

[24] 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

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

Reviewer for SODA 2021-23, STOC 2021-22, FOCS 2022-23, TALG, SICOMP

Miscellaneous Teaching & Work

2019–Present **Stanford University**, *Stanford, CA*.
Graduate Student Researcher
Teaching Assistant for Counting and Sampling

Jun-Aug 2022 **Microsoft Research**, *Redmond, WA*.
Research Intern

Jun-Aug 2020 **VISA Research**, *Palo Alto, CA*.
Research Intern

Aug 2019 **Projects in Mathematics & Applications**, *Ho Chi Minh City*, Vietnam.
Teaching & Mentoring Highschool Students in Machine Learning

2015–2019 **Massachusetts Institute of Technology**, *Cambridge, MA*.
Undergraduate Researcher at CSAIL. Supervisor: Vinod Vaikuntanathan
Undergraduate Researcher (SuperUROP program). Supervisor: Virginia V. Williams
Undergraduate Researcher in Brain & Cognitive Sciences
Undergraduate Researcher in Department of Economics

Jan - Feb 2018 **Tech Square Trading**, *Boston, MA*.
Quantitative Research Intern

May - Aug 2017 **Applied Predictive Technologies**, *Ballston, VA*.
Software Engineer Intern

Jun-Aug 2016 **REU in Algebraics Combinatorics**, *Minneapolis, MN*.
Undergraduate Researcher. Supervisor: Gregg Musiker

Honors & Awards

2021 **Microsoft Research PhD Fellowship**.

2019 **Anna Pogosyants 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

IMO 2014 **Silver Medal**.