Duc Toan Nguyen

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EDUCATION

Aug 2025 - Present	**Ph.D. in Electrical and Computer Engineering (ECE)** *Rice University*, Houston, TX George R. Brown School of Engineering and Computing
May 2025	**Bachelor of Science in Mathematics** **Bachelor of Science in Computer Science** *Texas Christian University (TCU)*, Fort Worth, TX College of Science and Engineering, John V. Roach Honors College

RESEARCH EXPERIENCE

Rice University, Dept. of Electrical and Computer Engineering   Aug 2025 - Present
- **Role:** Graduate Researcher (Network Regression with Bures-Wasserstein Metric)
- **Advisor:** Dr. César A. Uribe
- Leveraging the intrinsic Riemannian geometry of the **Bures-Wasserstein metric** to design efficient optimization algorithms for **network regression** on graph Laplacians.
- Deriving rigorous **bottleneck conditions** characterizing stationary points of the **Fréchet mean** optimization problem with Wasserstein metric.
- Applying network regression methods on real-world datasets, specifically modeling **aging brain networks** using **fMRI data** to advance computational methods in **Neuroscience**.

Independent Research (Collaboration with IBM/Lehigh)   Apr 2024 - May 2025
- **Role:** Researcher (Variance-Reduced Shuffling Stochastic Optimization)
- **Advisors:** Dr. Lam M. Nguyen (IBM Research), Dr. Trang H. Tran (Lehigh University)
- Proposing a novel variance-reduced optimization method by applying shuffling paradigms to SARAH, creating a protocol that is practically efficient for **large-scale machine learning** workloads.
- Proving a **faster convergence rate** for the proposed method compared to existing state-of-the-art algorithms, directly addressing **AI computational efficiency**.
- Developing an inexact version for Expectation Maximization (EM) problems with rigorous proofs of complexity comparable to leading stochastic methods.

Texas Christian University, Dept. of Computer Science   Jan 2023 - May 2025
- **Role:** Research Assistant (GO2AI Project)
- **Advisors:** Dr. Liran Ma, Dr. Ze-li Dou
- Implementing Monte Carlo Tree Search (MCTS) and Convolutional Neural Networks (CNNs) into the policy architecture of distributed **AI agents** (Go).
- Optimizing **reinforcement learning** algorithms by enhancing the training pipeline through distributed learning techniques.
- Implementing **Grad-CAM (Explainable AI/XAI)** to visualize and interpret black-box learning processes, evolving the transparency of AI decision-making.

Texas Christian University, Dept. of Mathematics   Sep 2022 - May 2025
– **Role:** Honors Research Scholar (Geodesic Nets - Construction and Existence)
– **Advisor:** Dr. Ken Richardson
– Developing a first-of-its-kind heuristic algorithm to construct approximate Steiner Trees for arbitrary point sets, reducing total network length by 2% compared to Minimum Spanning Trees.
– Applying the algorithm to optimize network architecture designs, with direct implications for efficient **communication infrastructures** and **genetic network analysis**.
– Proving theoretical conditions for the existence of Fermat points in triangles on general 2-D surfaces.

Rice University, Dept. of Statistics (REU)   May 2023 - July 2023
– **Role:** Undergraduate Researcher (STAT-DATASCI REU 2023)
– **Advisor:** Dr. Eric C. Chi
– Investigating the sensitivity of optimal tuning parameters to noise levels in Nonnegative Matrix Factorization (NMF), a critical technique for **dimensional reduction**.
– Spearheading the development of a novel algorithm, "Square-Root Min-Vol NMF," and establishing its rigorous convergence guarantees.
– Validating the algorithm on large-scale datasets of **hyperspectral images**, demonstrating superior error reduction compared to recent methods, with applications in **biomedical imaging**.

Academic Publications

- **Nguyen, D. T.**, Tran, T. H., & Nguyen, L. M. "Adjusted Shuffling SARAH: Advancing complexity analysis via dynamic gradient weighting." *(In Revision for Journal of Optimization Theory and Applications - JOTA)*.

- **Nguyen, D. T.**, & Chi, E. C. "Towards tuning-free minimum-volume nonnegative matrix factorization." *Proceedings of the 2024 SIAM International Conference on Data Mining (SDM24)*.

- **Nguyen, D. T.** "On the existence of a balanced vertex in geodesic nets with three boundary vertices." *Journal of Geometry*, 116.3 (2025): 36.

- **Nguyen, D. T.** "Geodesic Nets - Construction and Existence." *(Outstanding Honors Thesis)*.

- **Nguyen, D. T.** "Anti-Steiner Point Revisited." *Mathematical Reflections*. Vol. 2020 and 2021, 30 Sep. 2022, pp. 568–608. (*Book Chapter*).

Honors & Awards

2024	**Top 300** (of 3,988 students) – 85th William Lowell Putnam Mathematical Competition
2026	**Pi Mu Epsilon Outstanding Speaker Award** – Joint Mathematics Meetings (JMM)
2025	**Senior Scholar** – Department of Mathematics, TCU
2025	**Best Undergraduate Poster** – TCU Student Research Symposium
2025	**Finalist**, Best Honors Thesis Presentation (Boller Competition) – TCU
2025	**Student Travel Funding** – Pi Mu Epsilon (PME) for JMM 2025
2024	**Honors College Heritage Scholarship** – TCU
	(Most prestigious annual scholarship; awarded to 1 student out of >1000 honors students)
2024	**SIAM Student Travel Award** – SIAM Int. Conference on Data Mining (SDM24)
2023	**Outstanding Session Presentation** – Comp. Math & Operations Research, GCURS
2023	**Finalist**, Best Undergraduate Poster Presentation – TCU Student Research Symposium
2022	**Top 500** (of 3,415 students) – 83rd William Lowell Putnam Mathematical Competition
2025	Member, **Pi Mu Epsilon** (TCU Texas Alpha chapter)
2025	Member, **Upsilon Pi Epsilon** (TCU chapter)

Professional Activities

- **Reviewer**, *Journal of Machine Learning Research (JMLR)* - Top-tier journal in Machine Learning.
- **Reviewer**, *International Conference on Learning Representations (ICLR) 2025* - Top-tier conference in Machine Learning.
- **Reviewer**, *Journal of Optimization Theory and Applications (JOTA)* - Top-tier journal in Mathematical Optimization.

Posters & Presentations

- **Nguyen, D. T.** "Geodesic Nets - Construction and Existence." *PME Contributed Session on Research by Undergraduates*, JMM, Jan 2026.
- **Nguyen, D. T.** & Chi, E. C. "Towards Tuning-Free Minimum-Volume Nonnegative Matrix Factorization." *AMS Contributed Papers Session, Numerical Analysis I*, JMM, Jan 2025.
- **Nguyen, D. T.** "On the existence of a balanced vertex in geodesic nets with three boundary vertices." *AMS - PME Undergraduate Student Poster Session*, JMM, Jan 2025.
- **Nguyen, D. T.** & Chi, E. C. "Towards Tuning-Free Minimum-Volume Nonnegative Matrix Factorization." *SIAM Conference on Mathematics of Data Science (MDS24)*, Oct 2024. (Poster).
- **Nguyen, D. T.** "Towards Tuning-Free Minimum-Volume Nonnegative Matrix Factorization." *Summer school on Bayesian learning and network analysis*, VIASM, Hanoi, July 2024. (Poster).
- **Nguyen, D. T.** & Chi, E. C. "Towards Tuning-Free Minimum-Volume Nonnegative Matrix Factorization." *SIAM International Conference on Data Mining (SDM24)*, Apr 2024. (Slides/Poster).
- **Nguyen, D. T.** "A Majorization-Minimization Variant For Minimum-Volume Nonnegative Matrix Factorization." *National Collegiate Research Conference (NCRC)*, Harvard University, Jan 2024.
- **Nguyen, D. T.** "Towards Tuning-Free Minimum-Volume Nonnegative Matrix Factorization." *Gulf Coast Undergraduate Research Symposium (GCURS)*, Rice University, Oct 2023.
- **Nguyen, D. T.** "Searching for networks of minimum length." *Research and Creative Activities Week*, TCU, Sep 2023. (Poster).
- Leath, H., Good, B., Fahimi, S., **Nguyen, D. T.**, Ma, L., & Dou, Z. "The Sybil in AI: The Many Personalities of a Go Playing Model." *Research and Creative Activities Week*, TCU, Sep 2023. (Poster).
- **Nguyen, D. T.** "Geodesic Nets construction using Genetic Algorithm." *Student Research Symposium (SRS)*, TCU, April 2023. (Poster).

Technical Skills

Languages	Python, Java, MATLAB, R, MySQL, C, C++, HTML, JS, PHP
AI/ML	PyTorch, Scikit-learn, NetworkX, NumPy, Pandas, Captum, TensorFlow
Systems	Linux, MacOS, Windows, Distributed Computing