

# Duc Toan Nguyen

 [ductoanng.github.io](https://ductoanng.github.io) |  [duc.toan.nguyen@rice.edu](mailto:duc.toan.nguyen@rice.edu) |  Houston, TX

## EDUCATION

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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

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**Rice University, Dept. of Electrical and Computer Engineering**

Aug 2025 - Present

- **Role:** Graduate Researcher (Network Regression with Bures-Wasserstein Metric)
- **Advisor:** Dr. Cesar 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 autonomous **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 (Network Architecture)
- **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

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- **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

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- 2024 **Top 300** (of 3,988 students) – 85th William Lowell Putnam Mathematical Competition  
2024 **Honors College Heritage Scholarship** – TCU  
*(Most prestigious annual scholarship; awarded to 1 student out of >1000 honors students)*  
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 **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

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- **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.

## POSTERS & PRESENTATIONS

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- **Nguyen, D. T.** & Chi, E. C. “Towards Tuning-Free Minimum-Volume Nonnegative Matrix Factorization.” *AMS Contributed Papers Session, Numerical Analysis I*, JMM, Jan 2025. (Accepted).
- **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

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**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