VU-ANH LE

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Personal Website • **ORCID** • **LinkedIn**

RESEARCH INTERESTS & SKILLS

Research Interests: Computational Learning Theory, Geometric Methods, Numerical Methods
Programming Languages and Software: Python, C++, Java, MATLAB, Haskell, Lisp, Coq, Isabelle, Lean, Git

EDUCATION

Beloit College — Beloit, Wisconsin
Bachelor of Science, Mathematics — *Aug 2021 - May 2025*
Relevant Coursework: Mathematical Statistics, Differential Equations, Complex Analysis, Topology, Algorithm Design and Analysis, Data Mining

ARTICLES AND PREPRINTS

1. Le, Vu Anh and Dik, Mehmet, "Topology-Preserving Scaling in Data Augmentation," in *arXiv, Nov 2024*
2. Le, Vu Anh and Dik, Mehmet, "The Stability of Persistence Diagrams Under Non-Uniform Scaling," in *arXiv, Nov 2024*
3. Le, Vu Anh, and Dik, Mehmet, "How Analysis Can Teach Us the Optimal Way to Design Neural Operators," in *Proceedings of International Mathematical Sciences, Nov 2024* (Accepted for publication, the full paper version is available on *arXiv*)
4. Le, Vu Anh, and Dik, Mehmet, "A Mathematical Analysis of Neural Operator Behaviors," in *arXiv, Oct 2024*. (Accepted as a chapter to the book issue *Advances in Quantum Calculus and Functional Analysis*, CRC Press, Taylor & Francis Group)
5. Le, Vu Anh, Wainwright, Haruko, Gonzalez-Raymat, Hansell, and Eddy-Dilek, Caroll, "Machine Learning Algorithms to Assess Site Closure Time Frames for Soil and Groundwater Contamination," in *arXiv, Nov 2024*
6. Vu, Thi Phuong Thao, and **Le, Vu Anh**, "Computational Modelling of Climate Change Impacts on Flood Inflows Using Remote Sensing and SAWT," in *EarthArXiv, Oct 2024*
7. Vu, Thi Phuong Thao, Dang, Truong Giang, and **Le, Vu Anh**, "Reliability Assessment of Land Subsidence Monitoring Results Using PSI Technique in Ho Chi Minh City, Vietnam," in *International Journal of Environmental Studies, March 2024*
8. Le, Quoc Hung, Vu, Thi Tuyet, Vuong, Trong Kha, and **Le, Vu Anh**, "Applying Technical Regulations of IPCC for Landcover Data used to Estimate Carbon Emission in Vietnam," in *Journal of Science on Natural Resources and Environment, March 2020*

RESEARCH EXPERIENCE

Google Research — Remote
Student Researcher, B.S. — *Aug 2024 - Present*

- **Research Advisors: Jake Garrison (Google Research)** and **Prof. Mehmet Dik (Beloit College)**.
- Developed a mathematical framework to analyze the behaviors of neural operators, focusing on these aspects:
  - **Stability:** Established bounds for neural operators using **Lipschitz continuity conditions**.
  - **Convergence:** Proved exponential convergence via the **Banach Fixed Point Theorem**.
  - **Clustering Behavior:** Analyzed long-term solution dynamics through **gradient flow interpretation**.
  - **Universality:** Extended the **Universal Approximation Theorem** and **Stone-Weierstrass Theorem** to demonstrate the approximation capabilities of neural operators.
- Provided **theoretical guarantees** on **stability, exponential convergence, and generalization**. Detailed results published in the following papers **1** and **2**.
- Applied the proposed framework in designing a case study model for solving complex partial differential equations. Compared with the state-of-the-art works e.g. DeepONet, it requires **15% fewer epochs**.

Massachusetts Institute of Technology Cambridge, Massachusetts
Intern, MIT Summer Research Program - General *June 2024 - Aug 2024*

- **Research Advisor: Prof. Haruko Murakami Wainwright.**
- Integrated two machine learning models, namely **Random Forest and Bidirectional LSTM,** into the Python-based computational chemistry library PyLEnM to monitor the behavior of toxic analytes.
- Achieved **97.7% accuracy** in predicting the time taken for analyte concentration to drop to safety levels. Outperformed baseline models e.g. linear regression and univariate LSTMs with accuracies between 70–85%.

Vietnam's Ministry of Natural Resources and Environment Hanoi, Vietnam
Research Assistant and Compliance Reporter, Remote Sensing Department *April 2020 - Present*

- **Research Advisor: Dr. Le Quoc Hung.**
- Adopted SAR data and developed standardized software tools integrating computational models for monitoring human-induced land deformation. This year's project achieved a **1-millimeter resolution** in generated maps.

University of Tokyo Kashiwa, Chiba, Japan
Summer Intern, Graduate School of Frontier Sciences *April 2022 - Aug 2022*

- **Research Advisor: Prof. Frith Martin.**
- Developed a sorting algorithm using **dynamic programming and hidden Markov models (HMMs)** to identify regions responsible for targeted disease mechanisms.

SELECTED AWARDS AND HONORS

Presidential Scholarship, Beloit College, Awards 48,000 USD annually *Aug 2021 - May 2025*
Board of Trustees Grant, Beloit College, Awards 10,000 USD annually *Aug 2021 - May 2025*
Dean's list, Beloit College *Every semester*
MIT Summer Research Program, Massachusetts Institute of Technology, Fully funded *June 2024*
Weissberg Human Rights Grant, Weissberg Foundation, Awards 1,000 USD *March 2024*
Semifinalist, InSPiR2eS Global Pitching Research Competition 2023 (IGPRC 2023) *Jan 2024*
Station1 Frontiers Fellowship, Massachusetts Institute of Technology, Awards 13,500 USD *June 2023*
National Research Grant, Vietnam's Ministry of Finance, Awards 10,000 USD *Jan 2023*
Friends of UTokyo Scholarship, University of Tokyo, Awards 4,000 USD *April 2022*

SELECTED PRESENTATIONS

1. "Mathematical Foundations of Neural Operators."

- Infinite Possibilities Conference, *Institute for Mathematical and Statistical Innovation (University of Chicago)*, April 2025
- National Conference on Undergraduate Research 2025, *Pittsburgh*, April 2025
- 38th Annual Pi Mu Epsilon Undergraduate Regional Conference, *St. Norbert College*, Nov 2024

2. "Machine Learning Algorithms to Assess the Site Closure Time Frame for Toxic Analytes."

- AGU Annual Meeting 2024 at Washington D.C., *American Geophysical Union*, Dec 2024
- Midstates Physical Sciences, Mathematics and Computer Science Undergraduate Research Symposium, *Washington University in St. Louis*, Nov 2024
- MIT Summer Research Program Conference, *Massachusetts Institute of Technology*, Aug 2024

ADDITIONAL EXPERIENCE

Legal Initiatives for Vietnam Remote
Paralegal Assistant *Dec 2023 - Present*

- Conducted legal research on the current political strategies and policies implemented by Vietnamese authorities.
- Published opinions on critical political issues via the affiliated newspaper "Luat Khoa Tap Chi."

Beloit Math and Computer Science Club Beloit, Wisconsin
Co-founder and President *Aug 2021 - May 2023*

- Updated students on field-related opportunities such as research projects, internships, and employment.
- Set preparatory sessions for academic competitions like the Mathematical Contest in Modeling and Putnam.