Luis M. B. Varona

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Education

- **Mount Allison University** — Sackville, NB
  Bachelor of Arts with First Class Honours — *2022 – 2027*
  - Triple Major: Mathematics (Hons.), Political Science, and Computer Science & Economics
  - Double Minor: Canadian Public Policy and International Politics
  - Thesis: Computational Methods for Modelling Continuous-Time Quantum Walks (May 2026)

Research Interests

Combinatorial graph algorithms, graph structure of neural networks, and/or computational social science on graphs. Recent summer research centred around investigating recurrent neural networks subject to graph-theoretic constraints, and my thesis applied optimization algorithms to probe spectral properties of graphs. Previous summers of research similarly encompassed both spectral and algorithmic graph theory.

Publications

Peer-Reviewed Journal Articles

1. L. M. B. Varona. MatrixBandwidth.jl: Fast algorithms for matrix bandwidth minimization and recognition. *Journal of Open Source Software*, 2025. doi:10.21105/joss.09136

Unpublished Papers

3. L. M. B. Varona. *A polynomial-time algorithm for recognizing high-bandwidth graphs*. E-print: arXiv:2602.01755 [cs.DS], 2026. Under review at *Discrete Applied Mathematics*.

2. F. A. Steinke and L. M. B. Varona. *Efficient spectral bounds on the chromatic number of Hamming, Johnson, and Kneser graph powers*. E-print: arXiv:2601.01962 [math.CO], 2026. Under review at the *Rose-Hulman Undergraduate Mathematics Journal*.

1. N. Johnston, S. Plosker, C. Torrance, and L. M. B. Varona. *Generalizing the Cauchy–Schwarz inequality: Hadamard powers and tensor products*. E-print: arXiv:2507.10327 [math.FA], 2025. Under review at *Linear and Multilinear Algebra*.

Drafts in Preparation

4. C. Brett and L. M. B. Varona. *The effects of changes in effective prices of services on municipal tax rates: evidence from New Brunswick* (working title).

3. W. A. Hunt and L. M. B. Varona. *Foundational models of sociopolitical change lag behind the ongoing reality of an algorithmic revolution* (working title).

2. L. M. B. Varona. *Formal language learning in bandwidth-constrained recurrent neural networks* (working title).

1. N. Johnston, S. Plosker, and L. M. B. Varona. *Laplacian integral and* $\{-1, 0, 1\}$*-diagonalizable graphs* (working title).

Presentations

- **Spectral Heuristics for k-Incoherent Decompositions**
  Atlantic Undergraduate Physics and Astronomy Conference 2026 (UPEI) *March 2026*
- **Advancements in Graph Bandwidth Reduction**
  Science Atlantic MSCS Conference 2025 (Cape Breton University) *October 2025*
- **S-Bandwidth as an Indicator of PST on Quantum Networks**
  Atlantic Undergraduate Physics and Astronomy Conference 2025 (MUN) *February 2025*
- **Computing the S-Bandwidth of a Quantum Network**
  Science Atlantic MSCS Conference 2024 (Acadia University) *October 2024*

Research Experience

- **Student Researcher** Mount Allison University
  Computer Science *May 2026 – Aug. 2026*
  - Investigated the training dynamics of bandwidth-constrained RNNs using Python/PyTorch
    - Ran formal language classification and modelling experiments using DFA-sampled strings
    - Tracked and analyzed eigenvalue geometry to explain observed differences in trainability
    - Wrote custom CUDA kernels and CPU routines in C for inference time benchmarking
  - **Advised by:** Dr. Nathaniel Johnston, MtA Department of Mathematics & Computer Science

- **Student Researcher** Mount Allison University
  Political Science *Apr. 2026 – Aug. 2026*
  - Investigated gaps in political philosophy frameworks given modern technological developments
  - **Advised by:** Dr. Wayne A. Hunt, MtA Department of Politics & International Relations

- **Research Assistant** Mount Allison University
  Economics *Sep. 2025 – Dec. 2025*
  - Modelled the effects of exogenous expenditure on short-term municipal tax rates using Python
  - **Worked for:** Dr. Craig Brett, MtA Department of Economics

- **Student Researcher** Government of New Brunswick
  Public Policy *May 2025 – Aug. 2025*
  - Studied limitations of accessibility policy/legislation in the New Brunswick education system
  - **Worked for:** Accessibility Office, NB Department of Post-Secondary, Training and Labour

- **Research Assistant** Mount Allison University
  Mathematics *Apr. 2024 – Aug. 2024; May 2025 – Aug. 2025*
  - Explored tightened Cauchy–Schwarz-type bounds and generalized to matrices/multiple vectors
  - Ran computational surveys of Laplacian integral and $\{-1, 0, 1\}$-diagonalizable graphs in Julia
  - Implemented various algorithms in MATLAB to assist with quantum information research

– **Worked for:** Dr. Nathaniel Johnston, MtA Department of Mathematics & Computer Science

Teaching Experience

- **Calculus II (MATH 1121)** — Mount Allison University
  Teaching Assistant — *Winter 2026*
  – Co-led weekly labs with 30+ students, fielding questions and marking half of the assignments
- **Math Help Centre** — Mount Allison University
  Teaching Assistant — *Winter 2025, Winter 2026*
  – Supervised semiweekly sessions with students from 6+ different first- and second-year courses
- **Linear Algebra (MATH 2221)** — Mount Allison University
  Marker — *Winter 2025*
  – Marked 30+ student assignments per week
- **Applied Calculus (MATH 1151)** — Mount Allison University
  Teaching Assistant — *Fall 2024*
  – Co-led weekly labs with 30+ students, fielding questions and marking half of the assignments

Awards, Grants, and Honours

Independent Student Research Grant ($9,000) — Mount Allison University 2026
3rd Place Team Award — Atlantic Canada Programming Competition 2025
2nd Place Undergraduate Research Award for Computer Science — Science Atlantic 2025
President's Scholarship — Mount Allison University 2022

Other Academic and Professional Activities

- Creator and maintainer of MatrixBandwidth.jl, a peer-reviewed Julia package offering fast algorithms for matrix bandwidth minimization and recognition.
  June 2025 – present
- Contributor to the On-Line Encyclopedia of Integer Sequences.
  April 2025 – present
- Core member of the Mount Allison Competitive Programming Team.
  November 2024 – present
- Contributed to the following open-source software packages:
  – QETLAB, a MATLAB package for exploring quantum entanglement.
  – Spectre, an SDR-agnostic Python program for recording radio signals and spectrograms.
  – scikit-learn, a machine learning library for Python.
  – Polars, a high-performance DataFrame library for Python and Rust
  – The Julia standard library (in particular, LinearAlgebra.jl).