Education

University of Toronto   **September 2024 - December 2025 (Expected)**
MSc in Applied Computing (MScAC), Applied Mathematics stream.
2024 Vector Scholar in Artificial Intelligence ($17,500)
Coursework: Generative NN, Nonlinear Numerical Analysis, Physics-Based Animation, Physics-Informed Neural Representations for Visual Computing, Communication for Computer Scientists, Technical Entrepreneurship.

University of Toronto   **September 2020 - June 2024**
HBSc Mathematics and Physics Specialist. High distinction.
Coursework: Machine learning, Deep learning, numerical analysis, optimization, real analysis, complex analysis, PDEs, linear algebra, Fourier analysis, probability, topology, differential geometry, nonlinear physics, quantum information theory.

Experience

1. **Deep Learning Researcher** · **Vector Institute**   **November 2023 - Present**
   - Conduct extensive empirical experimentation and theoretical exploration on the transformer architecture.
   - Discovered novel phenomenon coined Transformer Block Coupling, displayed positive correlation with generalization.
   - Performed extensive experimentation on hundreds of open source transformer-based models.
   - Submitted work to ICML, NeurIPS and ICLR. See a preprint here.

2. **Algorithms Researcher** · **University of Toronto, Department of Mathematics**   **April 2023 - Present**
   - Developing algorithms for solving scalar differential equations and for numerical integration.
   - Our methods dominate over alternative methods in the high-frequency regime.
   - Independently decreased time complexity by a factor of n by exploiting an over-determined system.
   - Proved algorithm correctness by establishing theoretical bounds on computation error.
   - Establish theoretical framework, implement, test and iteratively optimize, publish results in academic journals.

3. **Teaching Assistant** · **University of Toronto**   **September 2023 - Present**
   - Run tutorials, host office hours, mark and invigilating exams.
   - Winter 2025: APM348, Mathematical Modeling.
   - Fall 2024: MAT292, ODEs for second-year engineering students.
   - Winter 2024: MAT187, Calculus 2 for first-year engineering students.
   - Fall 2023: MAT244, ODEs for second-year math major students.

4. **Machine Learning Researcher** · **DUNE × University of Toronto**   **September 2023 - April 2024**
   - Trained a graph neural network to detect tau neutrinos and their decay products.
   - Combatted an imbalanced dataset by implementing a modified, weighted loss function.
   - Improved classification performance on underrepresented training samples by over 20%.

5. **Tutor** · **Forest Hill Tutoring**   **April 2023 - August 2024**
   - High school math and physics tutoring, largely focused on helping grade 11 and 12 IB students.
   - Principal instructor for Ontario credited courses such as MDM4U, MHF4U and MCV4U.

6. **Structural Engineering Assistant** · **Safeline Construction Group**   **April 2022 - October 2022**
   - Worked on a 57 storey building in downtown Toronto assisting the senior and assistant supervisors.
   - Independently managed interior renovation of a small townhouse in downtown Toronto.
   - Worked alongside mechanical, civil, and electrical engineers throughout entire construction process.

Awards, Publications & Talks

- **Vector Scholarship in Artificial Intelligence**.   **2024**
  Awarded by the Vector Institute. Masters entrance scholarship valued at **$17,500**.

- **Transformer Block Coupling and its Correlation with Generalization in LLMs.** *Preprint.*   **2024**
  Murdock Aubry, Hoaming Meng, Anton Sugolov, Vardan Papyan. Work affiliated with experience (1). PDF.

- **A Solver for Linear Scalar ODEs Whose Running Time is Bounded Independent of Frequency**. *Preprint.*
  Murdock Aubry, James Bremer. Work affiliated with experience (2). PDF.   **2023**

- **On the Two Dimensional Levin Method.** *Preprint.*   **2024**
  Murdock Aubry, Kirill Serkh, James Bremer. Work affiliated with experience (2). PDF.

- **The Emergence of Clusters in Self-attention Dynamics.** *Talk.*   **2023**
  UofT Graduate Applied² Math Seminar. Work affiliated with experience (1). Slides.

- **Development of Graph Neural Networks for Tau (τ) Neutrino Detection.** *Talk.*   **2023**
  CERN and Deep Underground Neutrino Experiment (DUNE). Work affiliated with experience (4). Slides.

- **On the Adaptive Levin Method.** *Talk.*   **2023**
  Canadian Undergraduate Mathematics Conference. Work affiliated with experience (2). Slides.

Technical Skills

- **Languages.** Python, MATLAB, Fortran, HTML, CSS, SQL, Bootstrap, Bash, Mathematica, LaTeX, Markdown.
- **Packages.** PyTorch, Transformers, TensorFlow, Numpy, Scipy, CUDA, Pandas, Matplotlib, Seaborn, JSON, OS, Selenium, BeautifulSoup, ezdxf, dxfgrabber.
- **Software.** Git, SSH, SLURM, Tensorboard, AutoCAD, Unix.