

Personal Data

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Summary

Ph.D. in Mathematics with experience in Reinforcement Learning (RL) for Automated Theorem Proving (ATP), high-performance computational mathematics, and the innovation of new algorithms (CPU/GPU). Expertise in complex algebraic/analytic Number Theory and probabilistic methods, providing a research-level domain for AI applications. Proven track record includes developing novel, data-efficient RL pipelines for formal proof verification (inspired by Metamath), pioneering HPC algorithms using CUDA (achieving $1000\times$ speedup), and three publications in high-ranking number theory journals.

Skills and Abilities

Programming Languages: Python, C, C++, CUDA, MetaMath

HPC & Performance Tools: NVIDIA Nsight Tools, GDB, Valgrind

Numerical & Symbolic Libraries: GMP (GNU Multiple Precision), FLINT, PARI/GP, SageMath

Developer Tools: Git, Linux, VS Code, Jira

DL Platform/RL Paradigm: PyTorch, TensorFlow, Keras, Scikit-learn, Policy Optimization, Multi-turn Reasoning

Languages: English (Expert), Korean (Native), French (Beginner)

Education

Ph.D. Mathematics & Statistics, Concordia University, Canada	Sept. 2014 - May 2019
Supervisors: Prof. Hershy Kisilevsky, Prof. Chantal David	
M.Sc. Mathematics & Statistics, Concordia University, Canada	Jan. 2010 - May 2012
Supervisor: Prof. Hershy Kisilevsky	
B.A. Mathematics & Statistics, Concordia University, Canada	Sept. 2004 - May 2009
With Great Distinction (CGPA: 4.16/4.3)	
Honours Project Supervisor: Prof. Hershy Kisilevsky	
Graduate Diploma in Computer Science, Concordia University, Canada	Sept. 2002 - May 2004

Research and Other Professional Experiences

Independent Mathematics Researcher, CICMA, Montréal, Québec, Canada Jun. 2020 - Present

1) RL & GNN-Driven Formal Proof Generation (Inspired by MetaMath) - In Progress:

- Conducting research and development on an innovative more mathematician-friendly formal proof verifier interface, designed to provide two layers of theorems and proofs (human-readable and machine-verifiable).
- Applying state-of-the-art Deep Learning and Reinforcement Learning (RL) algorithms - leveraging sequential decision-making policy optimization to generate rigorously correct proofs for machine-readable theorems. Crucially, the system is engineered to minimize the reliance on massive labeled training data, focusing on building data-efficient RL policies that address the data scarcity challenge in formal mathematics.
- Embedding the binary data for theorems and proofs using Graph (Tree) Neural Network over local fields.

2) Algorithmic Innovation and High-Performance Computational Number Theory:

- Engineered a high-performance C++/CUDA backend to accelerate the calculation of elliptic L -values, generating a massive, high-precision dataset and achieving a $> 1000\times$ performance increase compared to conventional CPU implementations.
 - Developed sophisticated Python code within the SageMath environment to perform statistical analysis and validate number-theoretic conjectures using the GPU-generated data.
 - Integrated low-level C++ libraries such as GMP and FLINT to handle arbitrary-precision arithmetic within the high-performance kernel.
 - Conducted extensive performance analysis and optimization on the C++/CUDA engine using NVIDIA Nsight Tools for profiling and GDB/Valgrind for debugging, ensuring numerical accuracy and code robustness.
 - Demonstrated research impact by authoring two publications in high-ranking journals and by releasing the full dataset to the public via a dedicated web portal, fostering continued research within the number theory community.
(<https://github.com/jbnam/twists/>).

3) Number-Theoretic Analysis of Bias in Sums of Two Squares in Arithmetic Progressions

- Analyzed a statistical bias (a "Chebyshev-type bias") in the distribution of integers representable as a sum of two squares within arithmetic progressions and published the results in Experimental Mathematics.
 - Developed computational scripts in Python - SageMath, Pari/GP, and Mathematica to model the observed phenomenon, calculating singular series with Euler products to explain the distribution patterns.

4) Machine Learning Predictive Model (Titanic Kaggle Competition)

- Developed a prediction model in Python, leveraging NumPy, Pandas, Scikit-learn, and XGBoost for data manipulation and feature engineering.
 - Achieved a top 5% ranking by implementing and tuning an XGBoost model, demonstrating strong practical ML skills.

5) Dataset Contributor and reviewer for Mathematics - Humanity's Last Exam (HLE)

- Created and reviewed a dataset in mathematics for the HLE paper: One of the more challenging benchmarks of human knowledge including mathematics (<https://agi.safe.ai/>).

AI Trainer for mathematics, Scale AI, San Francisco, California, U.S. March 2024 - Present

- Authored complex mathematical training data to refine LLMs, ensuring high factuality and relevance in technical responses.

Contractor, The Government of Canada, Ottawa, Ontario, Canada May 2022 - Jun. 2022

- Non-Disclosure Agreement

Research Assistant Professor, Concordia University Sept. 2019 - May 2020

1) The moments of central elliptic L -values for cubic twists

- Led a computational research project implementing com

- Conjecture the moments of the central elliptic L -values twisted by cubic Dirichlet characters and supported the conjectures with numerical data obtained.

2) Mentoring on software development best practices

- Mentored junior researchers on software development best practices for computational mathematics projects about elliptic curves and modular forms in Python - SageMath and Pari/GP.

Ph.D. Research Assistant, Mathematics & Statistics, Concordia University Sept. 2014 - May 2019

1) Critical L -values of primitive modular forms of even weight for twists

- Computed the critical L -values of primitive modular forms of even weight twisted by odd prime characters and proved nonvanishing theorems for them using the random matrix theory and analytic/algebraic techniques.
- Conjecture the moments of the central elliptic L -values twisted by cubic Dirichlet characters and supported the conjectures with numerical data obtained.

Localization Quality Assurance Tester, Babel Media, Montréal, Québec Mar. 2012 - June 2014

1) Localization Quality Assurance Test

- Conducted linguistic testing and reviewed translation qualities.
- Provided accurate solutions with considering the required compliance, culturalization, internationalization, etc. in computer games and software under intensive time pressure using some databases such as TTP, JIRA and SpiraTest for the issue reports and their regressions.

Master Research Assistant, Mathematics & Statistics, Concordia University Jan. 2010 - May 2012

1) The ratio conjecture for the ratios of central L -values of a family of twists of elliptic curves

- Derived the ratio conjecture for the ratios of central elliptic L -values for a family of twists.
- Supported the conjecture with numerical data using Python - SageMath and Pari/GP.

Publications

Long Phan, Alice Gatti et al.	Apr. 2025
<i>Humanity's Last Exam</i> , (Link).	
H. Kisilevsky, J. Nam	Jan. 2025
<i>Non-Zero Central Values of Dirichlet Twists of Elliptic L-Functions</i> , <i>Journal of Number Theory</i> , 266:166-194, 2025, (Link).	
C. David, L. Devin, J. Nam, J. schlitt	Nov. 2021
<i>Lemke Oliver and Soundararajan bias for consecutive sums of two squares</i> , <i>Math. Ann.</i> , Nov. 2021, (Link).	
C. David, M. Lalín, J. Nam	Jul. 2021
<i>Conjecture for Moments Associated with Cubic Twists of Elliptic Curves</i> , <i>Experimental Mathematics</i> , pages 1-28, 07 2021, (Link).	
Ph.D. Thesis Mathematics & Statistics, Concordia University	May 2019
<i>Critical L-values of Primitive Forms Twisted by Dirichlet Characters</i> , (Link).	
M.Sc. Thesis Mathematics & Statistics, Concordia University	May 2012
<i>Heuristic Results for Ratio Conjectures of $L_E(1, \chi)$</i> , (Link).	

Teaching Experiences

Assistant in a Senior/Master Project, Mathematics & Statistics, Concordia University	2019
Assisted their project for elliptic curves and modular forms using SageMath and Pari/GP.	
Course Instructor, Mathematics & Statistics, Concordia University	2014 - May 2020
Courses: Algebra & Functions: College Algebra; Differential & Integral Calculus	
Teaching Assistant, Mathematics & Statistics, Concordia University	2010 - 2012, 2014 - 2018
Courses: Linear Algebra, Differential Equations, Operation Research, Real Analysis, etc.	
Tutor in Math Help Centre Mathematics & Statistics, Concordia University	2010 - 2019

Honors and Awards

Research Assistantship CICMA, Concordia University (CAD 5,000/year)	2010 - 2012, 2014 - 2018
Teaching Assistantship Concordia University (CAD 10,000/year)	2010 - 2012, 2014 - 2018
ISM Graduate Scholarships Institut des Sciences Mathématiques (CAD 1,000)	2010
Dean's List Concordia University	2005 - 2007
New Millennium Scholarship Concordia University (CAD 1,000)	2005

Seminars-Conferences

Analytic Number Theory and Arithmetic Statistics	Aug. 2024
Moments of L -functions Workshop, Pacific Institute for the Mathematical Sciences	July 2022
Séminaire Québec-Vermont Number Theory	2012 - Present
Montréal Inter-University Seminar on Analytic Number Theory (MOBIUS ANT)	2012 - Present
Number Theory Web Seminar (ntwebseminar.org)	2020 - Present
Maine-Québec Number Theory Conference	2012 - 2021
The Canadian Number Theory Association meeting (CNTA XV)	Jul. 2018
Workshop at Harvard: "Distribution of Modular Symbols and L -values"	May 2017
Workshop at Fields Institute: "Serre's Uniform Boundedness Conjecture"	Apr. 2016

References Upon Request