Catherine Fontaine

e-mail: catherine.fontaine2@mail.mcgill.ca
website: https://catherinefontaine.github.io/en/

EDUCATION

McGill University 09/2025 – 01/2027
Master of Science (M.Sc.) in Mathematics and Statistics (Thesis)

McGill University 09/2021 – 04/2025
B.Sc. Joint Honours Mathematics and Computer Science
Earned a First Class Honours Degree with Distinction GPA : 3.91

- Courses : Advanced Probability Theory I, Mathematics for Machine Learning, Honours Analysis III, Honours Algebra IV, Honours Algorithm Design

COMPLEMENTARY TRAINING

CRM-PIMS Summer School in Probability University of British Columbia, 06/2025

- Attended conferences on percolation, heat kernel estimates and other topics in stochastic processes.

Directed Reading Program McGill Universtiy, Supervisor : Tasmin Chu, 01/2025-06/2025

- A mentorship initiative pairing graduate and undergraduate students to collaborate on a supervised reading project.
- Studied Markov chains, random walks on graphs, and electrical network analogies (Levin & Peres, Lyons & Peres)
- Analyzed percolation and some branching processes

CRM-PIMS Summer School in Probability Université de Montréal, 07/2024

- Attended conferences on random matrices, random walks and other topics in stochastic processes.

CRM-ISM Probability Seminar McGill University, 09/2024-12/2024

Accelerated Introduction to ML McGill Artificial Intelligence Society, 01/2023-04/2023

- One of twenty students selected to participate in a ten-week intensive course on machine learning.
- Implemented various machine learning algorithms including KNN, linear regression, naive Bayes, SVM and random forest.

SKILLS

Languages : French (native), English (fluent)

Programming Languages : Java, Python, C, Bash, MIPS

Libraries and Tools : Scikit-Learn, NumPy, SageMath, Pandas

RESEARCH PROJECTS

McGill University Department of Mathematics and Statistics 06/2025 – 08/2025
Summer Undergraduate Researcher
Project : Root-finding algorithms in trees generated by superlinear preferential attachment
Supervisor : Prof. Louigi Addario-Berry

- Conducted a literature review on the superlinear preferential attachment model
- Analyzed and synthesized existing results to identify open research directions

McGill University School of Computer Science 2024/09 – 2024/12
Research Project Course
Project : Clique Dimension in the Contradiction Graph of a Concept Class.
Supervisor : Prof. Hamed Hatami

- Investigate the clique dimension of contradiction graphs for various concept classes.
- Improve the known upper bound as a function of the Littlestone dimension.
- Tackle a problem introduced in "A Unified Characterization of Private Learnability via Graph Theory" by Alon, Moran, Schefler, and Yehudayoff.

McGill University Department of Mathematics and Statistics 2024/05 – 2024/11
Summer Undergraduate Researcher
Project : Optimal root recovery for uniform attachment trees and d-regular growing trees.
Supervisor : Prof. Louigi Addario-Berry

- Conduct research on root-finding algorithms in random growing trees generated using the uniform attachment model.
- Improve bounds from "Finding Adam in Random Growing Trees" by Bubeck, Devroye and Lugosi.
- Co-author a paper that outlines these findings, available on arXiv.

McGill University Department of Computer Science 2024/02 – 2024/04
Graduate course project on Mathematics for Artificial Intelligence
Project : Differential Privacy in the Non-Interactive Setting
Professor : Prof. Prakash Panangaden

- Conducted a critical analysis of the paper "A Learning Theory Approach to Non-Interactive Database Privacy" by Blum et al., which presented a direct method for protecting sensitive data.

McGill University Department of Mathematics and Statistics 2023/05 – 2023/08
Summer Undergraduate Researcher
Project : Computing Counterexamples to Serre's Modularity Conjecture
Supervisor : Prof. Patrick Allen

- Designed and implemented a Python algorithm using SageMath to compute counterexamples to a part of Serre's Modularity Conjecture in the fields of modular forms and Galois representations.

PUBLICATION

L. Addario-Berry, C. Fontaine, R. Khanfir, L.-R.. Langevin, S. Têtu, (2024) *Optimal root recovery for uniform attachment trees and d-regular growing trees,* https://arxiv.org/abs/2411.18614,

SCIENTIFIC TALKS

C. Fontaine (2025), *Arbres aléatoires,* **Collège André-Grasset.**

C. Fontaine, and S. Têtu (2025), *Identification de la racine d'un arbre aléatoire généré par attachement uniforme,* **Les séminaires universitaires en mathématiques à Montréal (SUMM).**

C. Fontaine, (2024), *Where does a random tree begins ?* **McGill University.**

C. Fontaine, R. Aron and Z. Horton, (2023), *Computing Counterexamples to Serre's Modularity Conjecture*, **McGill University**

ACADEMIC AWARDS AND RESEARCH FUNDING

Lorne Trottier Science Accelerator Fellowships — McGill	5,000 CAD, 2025
Canada Graduate Scholarships — Master's program — NSERC	27,000 CAD, 2025
Faculty of Science registration bonus — McGill	5,000 CAD, 2025
Grad Excellence Awards — McGill	2,870 CAD, 2025
Undergraduate Student Research Award — NSERC	8,950 CAD, 2025
Supplement to the Undergraduate Student Research Award — FRQ	1,500 CAD, 2025
Undergraduate Student Research Award — NSERC	8,700 CAD, 2024
Supplement to the Undergraduate Student Research Award — FRQ	1,500 CAD, 2024
Science Undergraduate Research Awards — McGill	8,350 CAD, 2023

SERVICE

First-Year Student Representative 07/2025 – 04/2026
Graduate Student Association for Mathematics and Statistics, McGill

Coordinator McGill Directed Reading Program in Mathematics 07/2025 – 04/2026

- Organized a mentorship program pairing undergraduate and graduate students to collaborate on a supervised reading project.
- Coordinated communication and collaboration between participating undergraduate and graduate students.

VP Events — McGill Artificial Intelligence Society 11/2024 – 04/2025

- Organized MAIS Hacks, a 100-participant AI/ML hackathon featuring industry partnerships and technical workshops.

Podcast Producer — McGill Artificial Intelligence Society 04/2024 – 11/2024

- Planned podcasts featuring AI experts from academia and industry, exploring emerging trends and challenges in AI.

VP Event — McGill Artificial Intelligence Society 04/2023 – 04/2024

- Organized MAIS Hacks, a 150-participant AI/ML hackathon featuring industry partnerships and technical workshops.
- Organized MAIS Learnathon, a conference series with 80 participants, showcasing AI/ML experts.

CODING PROJECTS

Building Neural Networks for Image Classification McGill University, 03/2025-04/2025

- Implemented a multilayer perceptron (MLP) from scratch to classify Kuzushiji-MNIST image data, exploring the impact of network depth, activation functions, and regularization on model performance. Also experimented with convolutional neural networks (CNNs) to compare results.

File System in C McGill University, 10/2023

- Designed a file system in C for low-level memory management, allowing users to create, delete, read and write files.

WORK EXPERIENCE

Assistant Manager — Hogg Hardware Jun. 2020 – Jan. 2024

- Worked part-time at a hardware store during school semesters, assisting with stock management.