Marcus Lai

CONTACT INFORMATION

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EDUCATION

University of British Columbia, Vancouver, BC
BSc in *Honours Computer Science* Sept 2021 - May 2026

- **GPA**: 3.88/4, **CGPA**: 89.4%
- **Science Scholar (Year Average $\geq$ 90):** 2024
- **Dean's List (Year Average $\geq$ 80):** 2021, 2022, 2023
- **Thesis**: Approximation Algorithms in Multicommodity Network Flow with prof. Bruce Shepherd (*ongoing*)

RESEARCH EXPERIENCE

Error Detection in the Linux Kernel with eBPF
prof. Thomas Pasquier @ UBC Systopia Lab May-Sept 2025

- Enchanced detection coverage of kernel errors in the Linux Kernel with eBPF, and improved existing detection templates in **C**.
- Designed and implemented automation steps in the pipeline from Syzkaller, a linux kernel fuzzer, to detector eBPF programs.

Optimal Cost-sensitive Decision Trees
prof. Margo Seltzer @ UBC Systopia Lab Sept 2024-May 2025

- Recent advancements in computation enables finding optimal decision trees (NP-hard) under constraints. However, interpretability is often not considered during decision tree training. This is crucial in medical and social settings where features are not equally important or costly.
- Extended the UBC Systopia GOSDT framework, a branch and bound optimal decision tree algorithm, with a novel objective function which incorporates feature weights.
- Proved theoretical optimality guarantees on the new weighted objective and implemented the algorithm on top of GOSDT in **C++**.

Bi-level Decision Tree Heuristic (in submission)
phD student Chenxuanyin Zou @ Cao Research Group March 2025
Neurips 2025 *#13797*

- Implemented acceleration to the CART algorithm in **Julia** by linear and binary threshold pruning, achieving 10% training-speedup across 64 datasets (used to approximate accuracy of complete trees below depth-3 in the novel decision tree heuristic).

Cache Sidechannel Attacks on Serverless Applications
prof. Aastha Mehta @ UBC Systopia Lab May-Sept 2024

- Designed and ran cache latency and multicore synchronization experiments to reverse-engineer undocumented behaviors in Intel's Icelake architecture.
- Implemented flushed+reload, prime+probe cache attacks on non-inclusive cache architecture to extract RSA secrets.

Modelling Chirality in 4-cell stage of C. Elegans (in submission)
prof. Eric Cybrynbaum @ Cytryn Lab May-Sept 2023
Developmental Cell *EMID#713d1c5a8836c1ed*

- Developed a physics-based ODE model simulating embryonic development of *C. elegans* at the 4-cell stage to test hypotheses related to biological chirality.

- Implemented a **Python** simulation suite, with SciPy for parameter fitting and Matplotlib animations for visualization of model-dynamics.

Generalizations of Artin's Constant (PIMS VXML)
prof. Greg Martin — Sept - Dec 2022

- The Goldmakher-Martin conjecture captures the density of certain desired primes with an infinite product. This conjecture generalizes Artin's constant as the base case evaluates exactly to Artin's formula.
- Analytically derived the density of primes from professor's Martin conjecture. Calculated the density constants to high precision and designed techniques to approximate the error on truncated sums and products.
- Compared empircal data against analytical results to reinforce the conjecture.
- My observations of a recursive derivates pattern led to a closed-form formula to calculate the conjecture constants, which is incorporated into future works.

Additional Experience

Undergraduate Teaching Assistance (UTA)
Math 100 (Calculus I), 101 (Calculus II), 110 (Calculus I) — Sept 2022-May 2025

- Delivered supplementary lecture content in tutorials to reinforce student understanding of core calculus concepts
- Led group discussions and guided problem-solving sessions to promote active learning and peer collaboration
- Assisted with assignment grading by providing constructive, detailed feedback

Awards

Undergraduate Student Research Award (NSERC USRA)
Summer research award valued at 10,000. — Summer 2023, 2024 2025

Programming Languages

Proficient: Python, C++, C, Julia, JavaScript / Typescript, HTML, CSS
Familiar: Java, MATLAB