Lucas MacQuarrie

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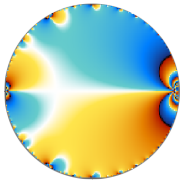
Course list and references available upon request



Education

M.Sc Applied Mathematics - Korea Advanced Institute of Science and Technology(KAIST)	Feb. 2024 - Feb. 2026
B.Sc Applied Mathematics - University of Western Ontario(UWO)	Sept. 2021 - April 2023
B.Sc Mathematics - University of Prince Edward Island(UPEI), transferred to UWO in 2021	Sept. 2018 - April 2021
Colonel Gray High School, Prince Edward Island	Sept. 2015 - May 2018

Awards and Scholarships

2024	KAIST Scholarship
2023	NSERC Undergraduate Student Research Award
2020	Academic Excellence Award, University of Prince Edward Island
2019	NSERC Undergraduate Student Research Award
2019	TD Bank SMCS Scholarship, University of Prince Edward Island
2019	Academic Excellence Award, University of Prince Edward Island
2018-2019	UPEI Dean's Honours List
2018	John H. Bell County Scholarship, University of Prince Edward Island
2018	Hart-Gorrill Entrance Award, University of Prince Edward Island

Research Experience

July 9, 2024 - Feb. 2026

Graduate Student, KAIST, Supervisor : Prof. CheolWoo Park

- Currently a master's student under Prof. Cheolwoo Park. I started working on statistical methods for microbiome data but have since moved to modelling the opioid epidemic in America.
- My first project was to improve a novel method of dimension reduction for microbiome data by incorporating phylogenetic data. I became familiar with kernel methods and the nuances of compositional data analysis. I preprocessed microbiome count data and trained my models using python.
- To better match my career goals, I switched my project to differential equation modelling. I looked to see if symbolic regression can be used with Kolmogorov Arnold Networks to improve system identification when using universal differential equations. Here I used the SciML environment and Lux neural network package in Julia to simulate systems of ODEs and train my model.
- My search for an application lead to a collaboration Professor Chris Delcher who studies drug policy for the opioid epidemic. We are currently working together to calibrate and validate a compartmental model to the epidemic in Kentucky. Our goal is to create a dashboard that policy makers can use to explore a model using system dynamics.
- Reviewed a paper.

Julia | Python | Git | LaTeX

Feb. 22, 2024 - July 9, 2024

Research Intern (While a Graduate Student at KAIST), Institute of Basic Science, PI : Prof. Jae Kyoung Kim

- Reformulated and analyzed a known model with Dr. Eui Min Jeong in both the deterministic and stochastic setting using a mix of analytical techniques and simulations in python and julia. I implemented the Gillespie algorithm to determine that noise was having a considerable affect on the production of mRNA in DNA replication for which the corresponding differential equation model could not account for.
- Compiled my work and code on the project into a document for incoming interns.
- Reviewed a paper with Prof. Jae Kyoung Kim and Dr. Eui Min Jeong.

Python | Julia | LaTeX

May 1, 2023 - Aug. 18, 2023

Research Assistant (NSERC USRA) | Simple Conditions for Recurrence in Systems of Differential Equations, Western University, Prof. Pei Yu

- Extended previously hypothesized conditions for the existence of recurrence in systems of ODEs to fit more models exhibiting recurrence
- Created a google colab page to quickly introduce and simulate the ODE models I was studying. I wrote the code in python to integrate the models and present solutions in an informative and aesthetically pleasing manner.
- Used the matlab package MatCont to analyze various ODE models in order to find models which exhibit the recurrence phenomenon but do not follow the previously hypothesised conditions
- Wrote my results into a draft of a paper which we are looking to get published.

Python | LaTeX

May 4, 2020 - Aug. 21, 2020

Research Assistant | Asymptotic Iteration Method(AIM) for the Hahn Operator, UPEI, Dr. Nasser Saad and Dr. Shafiqul Islam

- Extending the AIM method for solving second order linear homogeneous ODEs to **Hahn operator equations**
- Presented results at the **Canadian Undergraduate Mathematics Conference**
- Use of various mathematical languages and packages for symbolic computations
- Published **Lucas MacQuarrie**, Nasser Saad, Shafiqul Islam. *Asymptotic Iteration Method for the Hahn difference equations*. Advances in Difference Equations, 2021.
- Weekly meetings to present and discuss work

Mathematica | Maple | Matlab | Python | LaTeX

May 5, 2019 - August 23, 2019

Research Assistant(NSERC USRA) | Mathematical Oncology, UPEI, Dr. Nasser Saad and Dr. Shafiqul Islam

- Supported the initiative of forming a mathematical oncology research group at UPEI.
- Conducted a literature review and taught myself common methodologies that were being used in mathematical oncology
- Analyzed various mathematical models of cancer growth and treatment to gain an understanding of a mathematicians role in cancer research.
- Worked with Python to simulate **differential equation models** in oncology and competing populations.
- Attended AARMS summer school at UPEI with courses *q-series in Analysis and Combinatorics by* **Dr. Mourad Ismail**, *The Mathematics and Science of Chaos by* **Dr. James Yorke** and *Iterated Fractal Systems by* **Dr. Franklin Mendiliv.**
- Attended **Society of Mathematical Biology** conference 2019 in Montreal
- Attended **Fields Institute's Summer Course on Nonlinear Dynamics in Life Sciences** in Toronto
- Presented at **Science Atlantic** at Dalhousie University in Halifax

Maple | Python | Mathematica

Presentations and Publications

July 2025 | Society for Mathematical Biology Annual Meeting - 2025, University of Alberta,
Poster : *Kolmogorov Arnold Networks and Symbolic Regression can Recover Dynamics from Time Series Data*
This was a poster presentation showing that Kolmogorov Arnold Networks can replace traditional neural networks in universal differential equations to identify unknown dynamics. Universal differential equations can be combined with symbolic regression to perform system identification but symbolic regression can fail if the hidden dynamics are quite complicated. The architecture of Kolmogorov Arnold Networks can break these complicated hidden dynamics into an easier-to-analyze composition of univariate functions, but a naive implementation of this idea is not enough for consistent results.

June 2025 | Korean Statistical Society Annual Conference, Korean Statistical Society,
Poster : *Kolmogorov-Arnold Networks for System Identification*
I tailored the poster *Kolmogorov Arnold Networks and Symbolic Regression can Recover Dynamics from Time Series Data* for an audience of statisticians who were unfamiliar with system dynamics and differential equation modelling. This involved a high level explanation of the type of data that ODE models need to train and the type of data they can produce. I also focused on introducing Kolmogorov Arnold Networks and Symbolic Regression, which often was of more interest to my audience.

May 2024 | IBS Journal Club, Institute for Basic Science,
Presentation : *Data driven governing equations approximation using deep neural networks*
This was a PowerPoint presentation discussing some recent work by Professor Dongbin Xiu's group at Ohio State University in the area of flow map learning. It is a common problem to want to predict the states of some system in the future given only past data points. If the dynamics to not depend on time, this problem is equivalent to finding the flow map of the system. Flow map learning proposes using real world data to train a neural network to approximate the flow map. The algorithms and results were presented to the Biomedical Mathematics Group with a focus on applications to my colleagues research.

April 2024 | KAIST Math Graduate student Seminar, KAIST,
Presentation : *The Asymptotic Iteration Method and Hanh Difference Equations*
This was a 40-minute chalk-talk on the Asymptotic Iteration Method (AIM). AIM is a method for solving second order linear homogeneous differential equations. The method was presented with examples and applications to eigenvalue problems in physics, as well as generalization to difference equations, q-difference, and Hanh operator equations. Open problems for the eigenvalue algorithm, extension to systems of differential equations, and other operators were discussed.

November 2022 | Applied Dynamical Systems Seminars, Western University,
Presentation : *The Asymptotic Iteration Method : A Method to Solve Certain 2nd Order Linear Homogeneous ODEs with Functional Coefficients and Related Topics*
This was a 45-minute talk on the Asymptotic Iteration Method. The original theory was presented with examples, alongside various generalizations to other operators such as the q-Derivative, forward difference, Hanh difference, and beta derivative operators. Generalization to n'th-order systems and it's limitations were also discussed, introducing recent work on the problem.

July 2022 | Canadian Undergraduate Mathematics Conference, Université Laval,
Poster and Presentation : *qwAim : The Asymptotic Iteration Method(AIM) Generalized*
This was a talk and poster presentation on the paper that I published with Dr. Nasser Saad and Dr. Shafiqul Islam. I introduced the AIM and showed how it can be extended to the case of Hanh operators, as well as some of the calculus of Hanh operators. This included some exposition on q-series and the q-calculus.

March 2022 | Undergraduate Math Talks, Western University,
Presentation : *A Soft Introduction to q-Series*
This was a short undergraduate talk organized by the Math Club at Western (MaCAW). I showed where q-Series appear in number theory, combinatorics, physics, and special functions. I introduced some q-analogues to fundamental mathematical objects, solved a basic set of q-difference equations, and proved the q-binomial theorem.

August 2020 | Advances in Difference Equations, Springer,
Paper : *Asymptotic Iteration Method for the Hahn difference equations*
Abstract : The Hahn difference operator $D_{q;w}f(x) = \frac{f(qx+w)-f(x)}{(q-1)x+w}, q, w > 0$, is used to unify the recently founded the difference and q-Asymptotic Iteration Methods (DAIM, qAIM). The technique is applied to solve the second-order linear homogeneous Hahn-difference equations. The necessary and sufficient conditions for polynomial solutions are introduced and examined for the $(q; w)$-hypergeometric equation.

August 2020 | Canadian Undergraduate Mathematics Conference, Western University, Online
Poster : *q,w-AIM for the Second Order Linear Difference Equation*
A poster presentation for the results of my supervisors and I's results for the extension of the Asymptotic Iteration Method to the Hahn differential operator. Conditions for solutions and examples are given to a general audience.

February 2020 | UPEI Undergraduate Journal Club, UPEI, Charlottetown, PE
Presentation : *Sudden Cardiac Death, a Problem in Topology*
A presentation of the paper of the same name by Arthur T. Winfree published in Scientific American. Presented to an audience of biology students to share the connection between Mathematics and Biology beyond typical statistical models.

October 2019 | Science Atlantic 2019, Dalhousie University, Halifax, NS
Presentation : *An Introduction to Mathematical Biology and Modelling of Tumour Growth*
A contributed talk presenting simulations and methodologies of cancer modelling. I also presented recent research in radiotherapy sequencing by JCL Alfonso et al. (2019)

August 2019 | Summer Program for Academic Research(SPUR), UPEI, Charlottetown, PE
Poster : *Understanding Cancer using Mathematical Modeling*
A poster presentation on common methodologies and current research in mathematical modelling of biological systems with a focus on oncology. Included results from "*Immunologic Consequences of Sequencing Cancer Radiotherapy and Surgery*" JCL Alfonso et al. 2019

Community Involvement

President of Math Club At Western (MaCAW) 2022-2023

MaCAW

MaCAW is the Mathematics Club at Western. Due to the club dissolving in the previous year, me and a friend rebuilt the club and were the heads for 2022-2023. We hosted social events and organized student talks to foster community. We co organized with the science student counsel at western a cross-campus bar night with a local club and collaborated with the biology society to host nature walks and garbage clean ups. .

Association for Women in Mathematics 2021-2023

AWM Homepage

I was one of the founding members in the Association for Women in Mathematics (AWM). I was the secretary for AWM where I kept track of meetings, planned events, and ran events. One of our events was a generative art tutorial where participants learned how to use the Processing programming language to draw strange attractors. The blog post created by me and my friends is available *here*. We also organize outreach programs to local highschools and hosted a headshot event to provide free professional photos to students. Our biggest event was a poster competition where highschool students were advised by undergraduate students on an undergraduate level math topic of their choosing.

English Language Centre at UPEI Sept 19, 2020-May 02, 2021

English Language Centre

Working with the English Language Centre (ELC) at UPEI involves organizing activities and helping international students get involved at UPEI and help in the English Academic Preparation program(EAP). The EAP is a mandatory program for international students to evaluate and improve their English level to academic standards. I prepare and run weekly social and academic events, plan and host exchange group activities. I have also conducted surveys on the efficiency of online learning for UPEI students as well as a Professional Communications Course for mature students. I prepared reports of the results and info graphics both independently and with a partner.

Buddy Program and Language Exchange Program 2019-2021

UPEI Buddy Program

I've participated in buddy programs and language exchange programs where students from PEI are paired with international students to help them become accustomed to PEI and meet new friends. The language exchange is similar in that new students are paired together to help them learn English or another target language. In Fall 2020, I was given the privilege of organizing the Language Exchange Program alongside my coworker.

Translating Software Documentation into French 2016 - 2017

Gnuastro

Gnuastro is an official GNU software package used by astronomers. I helped translate the documentation and the website for Gnuastro into French. I collaborated with programmers and translators from different parts of the world to make sure documents were formatted and translated correctly. Git was used to submit and record translations.

Git HTML

Teaching Experience

Sept. 2024-Dec. 2025 — Teaching Assistant for Differential Calculus , KAIST,
I taught differential calculus to first year students at KAIST. **I proctored quizzes, marked exams, ran claim sessions and Every second week I would prepare a 45 minute lecture relating their current class topic to exciting areas of math they might not have experienced otherwise.** I am most proud of turning the class's interest in prime counting functions and their section on convergence of infinite series into a lecture introducing the Riemann hypothesis. **I had multiple students join my lectures who were not part of my class due to my reputation amongst the students.**

2018-2024 — Private Tutor, Self Employed,
Since highschool I have tutored highschool and university students in math, statistics, computer science, chemistry, and writing. I have been a part of multiple tutoring groups including the help center at UPEI's Math and Computer Science department, tutoring for residence buildings at UPEI, and a writing center for IB students in high school. I also do private tutoring both online and in person.

Feb. 6, 2023-April 30, 2023 — Teaching Assistant for Differential Calculus, University of Western Ontario,
I was a teaching assistant for Westerns calculus course on Differential Calculus (CALC 1000B). This involved marking exams, assignments, and proctoring.

Jan., 2020-
April, 2020

Teaching Assistant for Differential Calculus, UPEI,
In my third year I was a teaching assistant for calculus I at UPEI. This consisted of running tutorials alongside the professor and answering questions that students had about the course material. As part of this experience **I proctored tests and gave short lectures** on the whiteboard for students.