Brian Zhengyu Li

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Education

Georgia Institute of Technology 2023–*current*

PhD in Computer Science

University of Waterloo 2022–2023

Master of Mathematics in Computational Mathematics

- Cumulative GPA: 3.80 / 4.00

University of Toronto 2018–2022

Bachelor of Science (with High Distinction) in Mathematics

- Annual GPA: 3.68/4.00
- Cumulative GPA: 3.52 / 4.00

Honors & Awards

Resource Allocation Competitions ($18,841): Digital Research Alliance 2023

Ontario Graduate Fellowship: University of Waterloo 2022-2023

Dean's List Scholar: University of Toronto 2021-2022

Department Honour Roll: University of Toronto 2021-2022

Best VR/AR Application: HackWestern Hackathon 2020

Best Machine Learning Application Award: Hack the Six Hackathon 2019

Third Place: Scotiabank & University of Toronto Big Data & A.I. Competition 2019

Entrance Scholarship: University of Toronto 2018

Employment & Research

Data Science and Advanced Analytics Intern: TD Insurance *May – September* 2022

- Collaborated with data scientists to develop a predictive model for call center efficiency using supervised machine learning algorithms, and applied principal component analysis on a large customer interaction data set.
- Implemented reliability enhancements to the data pipeline, including fixes to the data transformation process, which eliminated recurrent errors in downstream data analysis and enabled effective data-driven decision-making.
- Presented analysis on customer satisfaction data to the executive team, leading to the implementation of initiatives that streamline the customer service process. Resulted in a 60% increase in customer satisfaction, as measured by follow-up surveys.

Research Assistant: University of Toronto *May* 2021–*August* 2021

Supervisors: Jane Howe and Bin Shi - Department of Material Science and Engineering

- Collaborated with PhD candidate Bin Shi on "Identification and Auto-count of Microplastic sunder Scanning Electron Microscope" using convolutional neural networks.

- Researched on optimizing the UNet Image Segmentation algorithm to adjust to the noisiness of SEM images to produce better result for boundary detection.
- Proposed, presented, and implemented improved UNet architecture for microplastic detection.

Machine Learning Research, Intern: AIH Technology *January* 2021–*May* 2021

- Worked on facial recognition and image processing (Frequency Based Replay Attack Detection) research, aiming to prevent the usage of digital videos to pass facial detection.
- Collected image and video data for model training, developed OpenCV algorithm to process the video using Multi-task Cascaded Convolutional Networks (MTCNN).
- Implemented Scale-invariant feature transform (SIFT) feature extractor and Bag of Visual Words on image and spectrum map for classification to compare traditional algorithm with ours.

Undergraduate Researcher: Random Walks on Groups *Summer* 2020

Supervisor: Parker Glynn-Adey

- Conducted research on random permutations, boolean function's fourier transform, de Bruijn sequence, as well as their applicability in mathematical magic tricks.
- Wrote mathematical blog post weekly to document research progress, which can be found on my personal website / blog.
- Extracted research result to publication in Math Horizons by American Mathematics Association, presented research in multiple seminars and conferences.

Research Assistant: University of Toronto *July – August* 2020

Department of Material Science and Engineering

- Obtained a strong knowledge of technical fundamentals by renovating the department website and providing engaging virtual experience to incoming students.
- Effectively designed and organized creative videos and animations featuring professors and students to better showcase the strength of the department.

Web Developer, Data Security Manager: University of Toronto *May – August* 2019

In Situ and Correlative Microscopy Research Group

- Enhanced research image data security by leading data cloning and synchronization in the department, while building the website "insitumicroscopy.ca", designed components using Adobe Illustrator.
- Synchronized data between multiple microscopes to help researchers share data in a secured and reliable environment under the supervision of professor Jane Howe.

Publications

Publications

1. Shi, B. et al. (2022). Automatic quantification and classification of microplastics in scanning electron micrographs via deep learning. *Science of The Total Environment* 825, p. 153903.
2. Glynn-Adey, P. and Z. Li (2021). In Tetracycles: a SET Deck Magic Trick. *Math Horizons* 28.4, pp. 16–18.
3. Li, Z., C. Bright, and V. Ganesh (Submitted to IJCAI). A SAT Solver + Computer Algebra Attack on the Minimum Kochen–Specker Problem.

Posters

1. Li, Z. (2020a). A Magic Trick Using the SET Deck and De Bruijn Sequence.

Talks

Conference & Seminar Presentations

1. A SAT Solver + Computer Algebra Attack on the Minimum Kochen–Specker Problem (2023). *Southeastern International Conference on Combinatorics, Graph Theory & Computing*.
2. A SAT +CAS Attack on the Minimum Kochen-Specker Problem (2022). *University of Toronto Scarborough Undergraduate Seminar*.
3. An SC-Square Approach to the Minimum Kochen–Specker Problem (2022). *Satisfiability Checking and Symbolic Computation - Federated Logic Conference 2022*.
4. Combinatorial Magic with the SET Deck (2022). *Mathematics of Various Entertaining Subjects - National Museum of Mathematics*.
5. A Combinatorial Magic Trick Using the SET Deck (2021). *MAA MathFest*.
6. A Magic Trick Using the SET Deck (2021). *Talk Math with Your Friend*. URL: https://404briannotfound.tech/views/MAT388/2020/TMWYF.html.
7. Building a Knotty Dictionary using Number Theory (2021). *Discrete and Combinatorial Mathematics Reading Group*. URL: https://www.youtube.com/watch?v=6tDizDe_cCo&t.
8. Cops and Robbers with Many Variants (2021). *University of Toronto Scarborough Undergraduate Seminar*. URL: https://www.youtube.com/watch?v=ha-Q1lUsUpY.
9. A Magic Trick Using the SET Deck (2020). *Canadian Undergraduate Mathematics Conference*. URL: https://404briannotfound.tech/views/MAT388/2020/CUMCvideo.html.

Teaching

Teaching Assistant: University of Waterloo *September 2022–Current*

- MATH115 - Linear Algebra for Engineering
- MATH135 - Algebra for Honours Mathematics

Teaching Assistant: University of Toronto Mississauga *September 2020–May 2022*

- MAT344 - Introduction to Combinatorics (2021 fall)
- MAT223 - Linear Algebra I (2020 summer)
- MAT202 - Discrete Mathematics (2020 fall & winter)

Conferences & Schools Attended

Federated Logic Conference 2022: 2022

Fields Academy Graduate Courses at the Fields Institute: 2021

- Markov Chains and Random Walks - University of Ottawa
- Mining Complex Networks - Ryerson University

School on Experimental Quantum Information Processing: 2021

- *Organized by Institute for Quantum Computing, University of Waterloo*

Canadian Discrete and Algorithmic Mathematics Conference: 2021

Extremal and Probabilistic Combinatorics Webinar: 2021

Mini-workshop on Graph Container Methods: 2021

Canadian Undergraduate Mathematics Conference: 2020

Activities & Leadership

Organizer: Talking Math With Your Friends Colloquium 2021–*current*

- Talk Math With Your Friends (TMWYF) is a weekly virtual mathematics colloquium created to provide a replacement of sorts for mathematics departments' weekly colloquia during the COVID-19 shutdown of colleges and universities. I joined the organizing team to focus on attracting undergraduate speaker and audience in mathematics.

President: Mathematical and Computational Sciences Society *September* 2020–*current*

- Led the largest academic societies in the Mathematical Computational Sciences Department.
- Led the team in hosting various types of events, putting students first and serving them with our best effort. Some highlights include hackathon, info session, professor masterchef contest, game night, and coding competitions.

Founder and President: Society for Algorithmic Modelling (UTMSAM) 2019–2021

- Founded UTMSAM to motivate the application of mathematics and statistics through various initiatives and collaborations.
- Attracted over 1000 student members in a year by actively introducing new learning opportunities and interesting technology topics to students.
- Led a team of 10 executives to organize workshops, seminars, conferences on topics such as data science, machine learning, and applied mathematics.

Organizer: Discrete and Combinatorial Mathematics Reading Group *Summer* 2021

- Met with group of 20 students and Professor weekly to discuss current research topics and papers in discrete mathematics and optimization.

Judge: MAA Undergraduate Student Paper Sessions at MathFest *Summer* 2021

Judge: Microsoft Discover AI Challenge *Summer* 2021

Webmaster: Microscopical Society of Canada 2019–*current*

- Improved organizations of members' data using Adeo database integration system, updated information regarding events, bulletins, and job postings.

Technical Projects

PhysicsCheck: 2022

An Automated Reasoning Pipeline for Quantum Foundations

- Designed a robust pipeline in Python and Bash that incorporates satisfiability (SAT) solver, computer algebra system (CAS), and satisfiability modulo theories (SMT) solver to solve open problems in quantum foundations with orders-of-megnitude speedup

VIAplanner: 2020

A tool designed to provide university students with better course selection experience

- The webapp is built with Vue and JavaScript, while the documentation website is made using VuePress and backend is powered by GraphQL.
- My contribution is the algorithm that helps students generate the optimal timetable and enable customization, as well as the documentation website.
- Currently receiving over 5000 views per month by students at the University of Toronto Mississauga.

Othello Game: 2019

An Othello game built in Java with JavaFx pacakage

- Built Othello game application using multiple design patterns, such as MVC, Factory, Observer/Observable, Singleton.
- Practice scrum methodology and efficiently collaborate with teammates.

GUI Paint Program: 2019

In-course Assignment for CSC207: Software Design

- Designed a Java GUI application which allows users to paint on a layered pixel canvas with various shapes and texts, putting multiple common design patterns into practice, such as Model View Controller, visitor, Command, Strategy and Factory.

Resonance Investment: 2019

Matches individual investors with financial advisors based on investing behaviours

- Contributed to a machine learning oriented project that analyzed personal and investment traits to make the best matches between an individual and an advisor.
- Built with Python using several libraries (NumPy, Panda, scikit-learn) for gathering financial data from Quandl, processing and building scalable models using Amazon Web Service. Learnt a whole new machine learning framework using SageMaker.

Summary of Skills

- **Programming Languages:** Python, C, Java, JavaScript, MATLAB, R
- **Data Analysis:** NumPy, Panda, Quandl, Tidyverse
- **Machine Learning:** Scikit-Learn, SageMaker, TensorFlow
- **Languages:** Fluent in English and Mandarin
- **Framework, Software and Others:** Vue, Photoshop, AutoCAD, CSS, HTML, Linux, Git, Tableau, GraphQL, OpenCV, SAT Solvers, SageMath, Z3