ALUN CENNYTH STOKES

McMaster University, Hamilton, ON
stokea1@mcmaster.ca | alunsto99@gmail.com
+1 (647)-287-2418

EDUCATION

Master of Science (McMaster University) September 2021 - April 2023
Dessins d'Enfants: On Computations and Analysis (Working) Dr Cameron Franc

Bachelor of Integrated Science (McMaster University) September 2017 - April 2021
The Search for Self-Contained Numbers Dr Cameron Franc
Graduated *summa cum laude* (10.8/12 cGPA)

RESEARCH INTERESTS AND CURRENT WORK

I currently study **number theory** at McMaster University, with the two main areas of investigation (amongst two distinct groups) concerning (1) the 4-category equivalence of which most people know the **dessin d'enfant** and what we may say about particular infinite families of such dessins under the action by the absolute Galois group of $\mathbb{Q}$, and (2) the expressibility of the double parameterisation of discrete metric spaces by their **additive** Gromov hyperbolicity and the recently introduced **multiplicative hyperbolicity**. In particular, how these parameters allow for the refinement of error bounds on combinatorial graph problems with asymptotics known only in terms of the additive constant.

FUNDING, GRANTS, AND AWARDS

M. Novotony Fellowship (McMaster University) Sept 2022 - April 2023
$ 2,500 **Competitive**
For a graduate student with demonstrated excellence in analysis.

Ontario Graduate Scholarship May 2022 - April 2023
$ 15,000 **Competitive**
A very limited scholarship for highly meritorious GPA over previous 6 trimesters.

McMaster Master's Student Funding September 2021 - August 2022
$ 16,000 **Non-competitive**
Funding provided (in addition to TA income) to undertake studies over this period.

USRA (NSERC) May 2021 - August 2021
$ 8,120 **Competitive**
Undergraduate research award to be taken up at their host institution.

Oriel College (Oxford University) †*Declined*
£10,000 **Non-competitive**
Entrance scholarship for meritorious academic performance prior to acceptance.

Dean's Honour List September 2017 - April 2021
Awarded all 4 years of undergraduate degree **Non-competitive**
Awarded each year if a first-class GPA is maintained for every trimester of the year.

Global Undergraduate Awards September 2020
1^{st} *place for computer science in North America (Jigsaw Paper)* **Competitive**

McMaster Stewart Award May 2020
$ 3,750 **Competitive**
Grant for undergraduate research at McMaster.

STEM Fellowship Big Data Competition July 2019
$ 3,000 **Competitive**
Won all three prizes awarded at the conference and gave a talk on our methods.

McMaster President's Award September 2017
$ 2,500 **Non-competitive**
Entrance scholarship for an entrance GPA of at least 95%.

† indicates an award was declined due to not attending the funding institution.

TEACHING ASSISTANTSHIPS

McMaster University September 2022 - December 2022
Combinatorics MATH 3U03
Math Help Centre

McMaster University January 2022 - April 2022
Graduate Topics in Risk Management (Financial Mathematics) MFM 763
Introductory Number Theory MATH 3H03

McMaster University September 2021 - December 2021
Numerical Linear Algebra MATH 3NA3
Linear Algebra I MATH 1B03

McMaster University January 2021 - April 2021
Introduction to Discrete Mathematics *CS 1DM3*

EMPLOYMENT

Graduate Research and Teaching Assistant (Dessins d'Enfants) September 2021 - April 2023
McMaster University *Dr Cameron Franc*

- Continuing my theoretical work on dessins d'enfants, both in terms homotopy continuation schemes and theoretical analysis of certain infinite families of dessins induced by group actions

Research Assistant (Number Theory and Symbolic ML) May 2021 - August 2021
McMaster University *Dr Cameron Franc*

- Designed a symbolic evolutionary learning framework to allow the machine learning of discrete number theoretic and algebraic problems from statistical and probabilistic data —to the end of identifying congruential subgroup membership.

Data Scientist (NLP and the CPI) June 2020 - August 2020
Statistics Canada *Consumer Prices Division (Serge Goussev)*

- Employed numerous NLP methods (including novel strategies) for hierarchical data structure mapping between non-isomorphic trees (representing store inventories) to more quickly calculate the consumer price index.
- Learned to quickly write meaningful literature reviews on then current state-of-the-art methods, and then about the new state-of-the-art I achieved as I wrote technical reports on my work.

Research Assistant (Quasi-Hyperbolicity and GNNs) May 2020 - July 2020
McMaster University *Drs George Dragomir and Andy Nicas*

- Finite metric spaces (here, graphs) are generically not precisely any of the usual topological shapes we study – and so we study how much they deviate from exactness.
- Doing so combinatorially, a graph on < 5000 vertices would naively take longer to compute than the sun will exist – with even 'fast' methods having $\mathcal{O}(n^4)$ time-complexity.
- Using particularly designed GCN-based models, I achieved unprecedented (and previously unseen) accuracy at predicting this hyperbolicity in constant time — with the most fascinating contribution being my novel node features generation that appears to allow encoded global structure at the level of node-groups.

Research Assistant (CNNs for Biomedical Applications) May 2019 - May 2020
McMaster University *Dr Ned Nedialkov*

- Developed novel convolutional neural networks to segment photoacoustic cancerous breast tissue images.
- Used sophisticated techniques (eg, autoencoder-preprocessing over the Fourier-domain) to mitigate the unique style of photoacoustic noise rarely seen in other medical imaging.
- Developed data pipelines and infrastructure with an automated experiment tracking, ranking, monitoring, and batching software to train 1000s of models simultaneously for aggressive (given my access to at maximum 4000 GPUs simultaneously) hyperparameter optimisation.
- Networks used for intrasurgical device to assess tumour boundary *during* operations without a radiologist, to reduce reoccurrence rate.

PUBLICATIONS

[1] **Stokes, A.** Hum, W., Zaslavsky, J. **STEM Fellowship Journal.** **6**(1): 1-5. Available at A Minimal-Input Multilayer Perceptron for Predicting Drug-Drug Interactions.

[2] † **Stokes, A.** Automatically Solving Square-Piece Jigsaw Puzzles using Convolutional Neural Networks with Gradient Boosted Decision Trees. **The Undergraduate Journal.** (12th edition). Accessible at: Automatically Solving Square-Piece Jigsaw Puzzles.

[3] † * **Stokes, A.** The search for self-contained numbers: k-special 3-smooth integer representations and the Collatz conjecture. **MacSphere**, 2021, [Online]. Available at: The search for self-contained numbers.

*Entries marked with † have **not** been peer-reviewed.* *Entries marked with * are theses.*

OTHER SIGNIFICANT WRITINGS

[1] Stokes, A. **May 2022.** Course Notes on O-minimality and the Pila-Wilkie Theorem.

Available upon request, if no link is given.

INVITED TALKS AND SEMINARS

Algebra and Algebraic Geometry Seminar November 2021
McMaster University *An Introduction to Belyi Maps: Computations in Genus 0*

CANDEV January 2020
Government of Canada *Transformer embeddings + t-SNE for course redundancy identification*

Undergraduate Big Data Competition July 2019
STEM Fellowship *Predicting in-vivo Drug Interactions Without Drug Structure*

OTHER PRESENTATIONS

Synopsis 2021 April 2021
McMaster University *k-special 3-smooth Representations and the Collatz Conjecture*

- A 15-minute expository talk on a formulation of the Collatz conjecture by a family of Diophantine equations and a conjecturally sparse set of numbers that are 'almost' solutions.
- See OEIS A005184 for computational contributions made via highly-distributed computation

LaTeX Workshops for Integrated Sciences Students 2019 - 2021
McMaster University *Introductory LaTeX workshops for mathematical document preparation*

TECHNICAL SKILLS

Languages†	**Python, Julia**, Java, SQL, C/C++, CUDA, MATLAB.
Major Libraries†	**SageMath**, **Pytorch**, Tensorflow.
Software & Tools	LaTeX, Git, Zotero, Macuaulay2.
Operating Systems†	**GNU/Linux** (Debian-based, primarily), MacOS, Windows
Misc.	Cloud-based computing (AWS, GCP, Compute Canada)

† *indicates order of proficiency* ***Bolding*** *indicates preferentiality*

OTHER PROJECTS

Global Undergraduate Awards September 2021
Dr Ned Nedialkov *Fully Automated Jigsaw Puzzle Solving by Hybrid ML*

National Big Data Competition June 2020
Dr Yasaman Amannejad *Medication Recommendation by Matrix Factorisation*

PROFESSIONAL ORGANISATIONS

American Mathematical Society (AMS) *September 2021 - Present*

Society for Industrial and Applied Mathematics (SIAM) *July 2022 - Present*