ALUN CENNYTH STOKES

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RESEARCH INTERESTS AND PROFILE

I currently study **number theory** at McMaster University. My research primarily concerns two topics: the 4-category equivalence of which most people know the **dessin d'enfant**, and the expressibility of the double parameterisation of discrete metric spaces by their **additive** and (this is the novel bit) **multiplicative hyperbolicity**.

The first topic, supposing it has an answer to the question of the action of the absolute Galois group, would change the landscape of arithmetic as we understand it, full stop. My work is both **computational and theoretical in this domain**. The second, as present, is just kind of interesting. However, how we tell whether we can or have found the ideal embedding of a metric space so as to analytically say anything meaningful is a problem that then becomes **very interesting**, especially in the context of our parameterisation. Recently, I've devised significant, yet minimal node features for **graph neural networks** to predict generally intractable **routing approximation problems** by means of this hyperbolicity concept.

My specialty is in addressing these **traditionally analytic, combinatorial, and algebraic problems** not only as they come, but by **using methods in numerical mathematics** to solve otherwise intractable problems, and then **regenerating exact solutions from approximations**. I also do a shocking amount of **data analytics and machine learning** given my formal study, and all my research positions have ended up involving ML significantly.

EDUCATION

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

Bachelor of Integrated Science (Mathematics & Statistics) September 2017 - June 2021
McMaster University Honours: *summa cum laude* (10.8/12 cGPA)
Supervisor: Dr Cameron Franc *The Search for Self-Contained Numbers*

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.*

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*

EMPLOYMENT

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

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

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

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

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

FUNDING, GRANTS, AND AWARDS

M. Novotony Fellowship Sept 2022 - April 2023
$ 2,500 **Competitive**

Ontario Graduate Scholarship May 2022 - April 2023
$ 15,000 **Competitive**

NSERC USRA May 2021 - August 2021
$ 8,120 **Competitive**

Oriel College (Oxford University) General Funding †*Declined*
£10,000 **Non-competitive**

Dean's Honour List September 2017 - April 2021
Awarded all 4 years of undergraduate degree **Non-competitive**

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

McMaster Stewart Award May 2020
$ 3,750 **Competitive**

STEM Fellowship Big Data Competition July 2019
$ 3,000 **Competitive**

McMaster President's Award September 2017
$ 2,500 **Non-competitive**

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

TEACHING ASSISTANTSHIPS

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*

TECHNICAL SKILLS

Languages†	**Python, Julia**, Java, SQL, C/C++, CUDA, MATLAB.
Major Libraries†	SageMath, **Pytorch**, HomotopyContinuation.jl, 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 ORGANIZATIONS

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

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