ALUN C. STOKES

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RESEARCH INTERESTS

My interests lie at the intersection of computing and mathematics, particularly in number theory. I am currently interested in the theory of dessins d'enfants and the computation of their Belyi maps. In general, I write software for high-performance and distributed computing and have substantial experience in several areas of machine learning.

EDUCATION

Master of Science (Pure Mathematics) September 2021 - April 2023
McMaster University
Supervisor: *Dr Cameron Franc*

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

Turner Fenton Secondary School September 2013 - June 2017
International Baccalaureate Program *97% Cumulative Average*

PUBLICATIONS

[1] **Stokes, A.** Hum, W., Zaslavsky, J. A Minimal-Input Multilayer Perceptron for Predicting Drug-Drug Interactions Without Knowledge of Drug Structure. **STEM Fellowship Journal. 6**(1): 1-5.

[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: https://gua.soutron.net/Portal/Default/en-GB/RecordView/Index/61.

[3] †**Stokes, A.** The search for self-contained numbers: k-special 3-smooth representations and the Collatz conjecture, 2021, [Online]. Available: https://macsphere.mcmaster.ca/handle/11375/27543

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

RESEARCH EXPERIENCE

Research Assistant May 2021 - August 2021
McMaster University *Dr Cameron Franc*

Investigated machine learning strategies to discriminate non-congruence finite-index subgroups of the modular group and strategies to compute Belyi maps corresponding to passports of dessins d'enfants.

Data Scientist June 2020 - August 2020
Statistics Canada *Consumer Prices Division*

Developed NLP methods for hierarchical data structure mapping to aid in calculating the consumer price index.

Research Assistant May 2020 - July 2020
McMaster University *Dr George Dragomir, Dr Andy Nicas*

Building on work by Dragomir and Nicas, we investigated how quasi-hyperbolicity could be exploited to reduce roughness and distortion in quasi-isometric graph embeddings.

Research Assistant May 2019 - May 2020
McMaster University *Dr Ned Nedialkov*

Developed convolutional neural networks to segment photoacoustic breast images for a group from Western University developing a hand-held *in-situ* scanner.

Math & Computer Science Tutor December 2013 - Present
Private

Worked one-on-one with each of two students to develop skills in math and computer programming.

TALKS AND SEMINARS

†**Algebra and Algebraic Geometry Seminar** November 2021
McMaster University *An Introduction to Belyi Maps*

Gave a 30-minute presentation on dessins d'enfants, their relevance, and pertinent computational techniques used in my research open to McMaster's math faculty and graduate students.

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.

CANDEV January 2020
Government of Canada *Using Transformer-based Embeddings to Identify Course Redundancies*

Gave a short talk on our use of transfer-learning with a transformer model to cluster courses offered by the Canadian School of Public Service and identify redundancies in course offerings.

Undergraduate Big Data Competition July 2019
STEM Fellowship *Predicting Drug-Drug Interactions Without Knowledge of Drug Structure*

This was a talk given with coauthors on our method of using machine learning to predict *in-vivo* drug-drug interactions using only analytical chemical properties. This was held at York University.

Synopsis 2019 April 2019
McMaster University *Prime Distribution by Linear Flow on the Torus*

A 15 minute expository talk on the primary findings of a 4-month project investigating prime distributions over non-intersecting curves on closed surfaces.

Entries marked with † are invited talks.

TEACHING ASSISTANTSHIPS

McMaster University January 2022 - April 2022
Graduate Topics in Risk Management *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*

OTHER PROJECTS

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

Won first place in North America for a paper on hybrid machine learning techniques to solve square-piece jigsaws; state-of-the-art matching accuracy was reported.

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

Devised a matrix factorization-based recommender system to predict effective drugs for treating several mental illnesses, given a patient's history with other drugs.

TECHNICAL SKILLS

Languages†	Python, Julia, Java, MATLAB, C/C++, CUDA, JavaScript, SQL, PHP, Mathematica
Major Libraries	SageMath, Pytorch, HomotopyContinuation.jl
Software & Tools	LaTeX, Git, MySQL
Operating Systems†	GNU/Linux (Ubuntu, primarily), MacOS, Windows

†Listed in order of proficiency

GRANTS AND AWARDS

Ontario Graduate Scholarship May 2022 - April 2023
$15000

NSERC USRA May 2021 - August 2021
$8120

Dean's Honour List September 2017 - April 2021
Awarded all 4 years of undergraduate dregree

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

McMaster Stewart Award May 2020
$3750

CANDEV Data Challenge January 2020
1^{st} *place*

STEM Fellowship Big Data Competition July 2019
$3000

McMaster President's Award September 2017
$2500