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 *GPA: 10.8 (/12)*
Supervisor: *Dr Cameron Franc* *The Search for Self-Contained Numbers*

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

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.

Entries marked with † have not been peer reviewed.

RESEARCH EXPERIENCE

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

Investigated the use of machine learning strategies in discriminating 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 natural 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, 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 the topic of dessins d'enfants, their relevance, and pertitnent computational techniques used in my research to the math faculty and graduate students at McMaster.

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*
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 Math *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 treatment of several mental illnesses, given a patient's history with other drugs.

Coursework April 2017
Agent-Based Modelling to Simulate Tumour Growth and Progression

Simulated canine transmissible venereal tumours and the effects of the immunohistological environment of the tumour, with specific respect to MHC expression Ig concentration.

TECHNICAL SKILLS

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

†Listed in order of proficiency

GRANTS AND AWARDS

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
Entrance scholarship of $2500