# ALUN C. STOKES

Hamilton, Ontario

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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

McMaster University

Supervisor: Dr Cameron Franc

Bachelor of Integrated Science (Mathematics & Statistics)

September 2017 - June 2021

Honours: summa cum laude (10.8/12 GPA)

Supervisor: Dr Cameron Franc The Search for Self-Contained Numbers

Turner Fenton Secondary School

International Baccalaureate Program

September 2013 - June 2017 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

# <sup>†</sup>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 Introductory Number Theory MFM 763 MATH 3H03

McMaster University

September 2021 - December 2021

Numerical Linear Algebra

McMaster University

MATH 3NA3 MATH 1B03

 $Linear\ Algebra\ I$ 

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 squarepiece 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<sup>†</sup> Python, Julia, Java, MATLAB, C/C++, CUDA, JavaScript,

SQL, PHP, Mathematica

Major Libraries SageMath, Pytorch, HomotopyContinuation.jl

Software & Tools LATEX, Git, MySQL

Operating Systems<sup>†</sup> GNU/Linux (Ubuntu, primarily), MacOS, Windows

## GRANTS AND AWARDS

Ontario Gradua	to Scholarship
Omario Gradua	te 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<sup>st</sup> 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

<sup>&</sup>lt;sup>†</sup>Listed in order of proficiency