

# ALUN CENNYTH STOKES

McMaster University, Hamilton, ON

stokeal@mcmaster.ca

+1 (647)-287-2418

## RESEARCH INTERESTS

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My interests lie in **mathematics and computing**, particularly **number theory** and **symbolic algebra**. Very recent interests include homotopy continuation and symbolic regression. Generally, I study **dessins d'enfants** and my work is often predicated on the computation of **Belyi maps** from permutation representations and passports. I often write software for **high-performance, parallel, and distributed computing** and have reasonably extensive experience with a broad range of **modern machine learning** techniques.

## EDUCATION

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**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 cGPA)

Supervisor: *Dr Cameron Franc*

*The Search for Self-Contained Numbers*

## PUBLICATIONS

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- [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] <sup>†</sup> **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] <sup>†</sup> \* **Stokes, A.** The search for self-contained numbers: k-special 3-smooth representations and the Collatz conjecture. **MacSphere**, 2021, [Online]. Available at: [The search for self-contained numbers](#).

*Entries marked with <sup>†</sup> have **not** been peer-reviewed.*

*Entries marked with \* are theses.*

## FUNDING, GRANTS, AND AWARDS

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**Ontario Graduate Scholarship**

*\$ 15,000*

May 2022 - April 2023

**Competitive**

**NSERC USRA**

*\$ 8,120*

May 2021 - August 2021

**Competitive**

**Oriel College (Oxford University) General Funding**

*£10,000*

<sup>†</sup> *Declined*

**Non-competitive**

**Dean's Honour List**

*Awarded all 4 years of undergraduate degree*

September 2017 - April 2021

**Non-competitive**

<b>Global Undergraduate Awards</b> <i>1<sup>st</sup> place for computer science in North America</i>	September 2020 <b>Competitive</b>
<b>McMaster Stewart Award</b> <i>\$ 3,750</i>	May 2020 <b>Competitive</b>
<b>CANDEV Data Challenge</b> <i>1<sup>st</sup> place (out of ~350 participants in small teams)</i>	January 2020 <b>Competitive</b>
<b>STEM Fellowship Big Data Competition</b> <i>\$ 3,000</i>	July 2019 <b>Competitive</b>
<b>McMaster President's Award</b> <i>\$ 2,500</i>	September 2017 <b>Non-competitive</b>

<sup>†</sup> indicates an award was declined due to not attending the funding institution.

## TEACHING ASSISTANTSHIPS

<b>McMaster University</b> <i>Graduate Topics in Risk Management</i> <i>Introductory Number Theory</i>	January 2022 - April 2022 MFM 763 MATH 3H03
<b>McMaster University</b> <i>Numerical Linear Algebra</i> <i>Linear Algebra I</i>	September 2021 - December 2021 MATH 3NA3 MATH 1B03
<b>McMaster University</b> <i>Introduction to Discrete Mathematics</i>	January 2021 - April 2021 CS 1DM3

## RESEARCH EXPERIENCE

<b>Research Assistant</b> <i>McMaster University</i>	May 2021 - August 2021 <i>Dr Cameron Franc</i>
Investigated machine learning strategies to discriminate non-congruence finite-index subgroups of the modular group and compute Belyi maps corresponding to dessins d'enfants.	
<b>Data Scientist</b> <i>Statistics Canada</i>	June 2020 - August 2020 <i>Consumer Prices Division (Serge Goussev)</i>
Developed NLP methods for hierarchical data structure mapping to aid in calculating the consumer price index.	
<b>Research Assistant</b> <i>McMaster University</i>	May 2020 - July 2020 <i>Dr George Dragomir, Dr Andy Nicas</i>
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.	
<b>Research Assistant</b> <i>McMaster University</i>	May 2019 - May 2020 <i>Dr Ned Nedialkov</i>
Developed convolutional neural networks to segment photoacoustic breast images for a group from Western University developing a hand-held <i>in-situ</i> scanner.	

## INVITED 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.

**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.

**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.

**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.

**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.

**TECHNICAL SKILLS****Languages<sup>†</sup>**

Python, **Julia**, Java, MATLAB, C/C++, CUDA, JavaScript, SQL, PHP, Mathematica

**Major Libraries<sup>†</sup>**

**SageMath**, Pytorch, HomotopyContinuation.jl, Macaulay2

**Software & Tools**

L<sup>A</sup>T<sub>E</sub>X, Git, MySQL

**Operating Systems<sup>†</sup>**

**GNU/Linux** (Ubuntu, primarily), MacOS, Windows

<sup>†</sup>Listed in order of proficiency

**Bolding** indicates preferentiality

**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.

**REFERENCES**

**Are available upon request**, preferably made to [stokea1@mcmaster.ca](mailto:stokea1@mcmaster.ca).