

# jacobdenson

Mathematics Student

## Research Interests

Harmonic Analysis,  
Geometric Measure  
Theory, Additive  
Combinatorics.

## Contact Information

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Info Redacted For  
Web Version  
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## Websites

Github Profile: jdjake  
  
Stack Overflow Profile:  
jacob-denson  
  
<https://jdjake.github.io/>

## Languages

English, Elementary  
German, Very Rusty  
Elementary Chinese  
Python, Perl, C++, C,  
C#, Matlab, HTML,  
Javascript, Latex (This  
resume is proof!)

## Summary

I am a masters student at the University of British Columbia, applying my strong and diverse foundation in mathematical knowledge to do research in the harmonic analysis research group, studying continuous variants of discrete configuration avoidance problems emerging from additive combinatorics. My previous work in theoretical computing science has given me a strong knowledge of the algorithmic viewpoint of problems, which gives me a fresh perspective on classical ideas in the field. I am currently working on the problem of finding high dimensional subsets of intervals avoiding solutions to polynomial equations.

## Talks<sup>1</sup>

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|------|--|--|
| 2017 | Graduate Seminar<br>Proofs in Three Bits or Less<br>An hour talk introducing nonspecialists to the theory of probabilistically checkable proofs, and PCP theory. By changing the language by which we discuss the theory from accessing random bits from a string, to 'playing a game of 20 questions', I introduced a novel way to discuss the theory which avoids the technicalities of the field, making the talk accessible to students without any background in theoretical computing science. | University of British Columbia           |
| 2016 | Noncommutative Harmonic Analysis Class<br>Why Physicists Care About The Fourier-Stieltjes Transform<br>A 20 minute talk emphasizing the naturality of the generalization of the Fourier transform to the Fourier-Stieltjes transform by proving the weak * density of $L^1(G)$ in $M(G)$ , and discussing why this matters.  | University of Alberta, Canada            |
| 2016 | Noncommutative Harmonic Analysis Class<br>A Brief Respite In Abelian Analysis<br>A 20 minute talk introducing the abstract Fourier transform on abelian locally compact groups, and discussing the generalization of the Poincare summation formula to this domain, which hints at the depth of Pontryagin duality.  | University of Alberta, Canada            |
| 2016 | CUMC Conference<br>On Molecular Gases and the Natural Numbers<br>A talk introducing Ergodic theory to undergraduate students, and emphasizing its relation to a variety of problems in mathematics, especially number theory.  | University of Victoria, Vancouver Island |
| 2016 | Algebraic Topology Graduate Class<br>Vector Fields, Hex, and Jordan Curves<br>A 20 minute talk on the Brouwer fixed-point theorem, emphasizing the intuitive vector field interpretation of the theorem, and discussing how the fixed-point theorem relates to the combinatorial game of hex, reflecting the nice interweaving of discrete and point-set methods in algebraic topology.  | University of Alberta, Canada            |

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<sup>1</sup>Notes for my talks can be found on my website: <https://jdjake.github.io/>

2015	Microsoft Intern Talks Category Theory for Computer Programmers My original talk on category theory, shortened to a 20 minutes talk, and edited to reduce mathematical prerequisites and to emphasize the practical uses for the average programmer, as a talk in the weekly talk seminar for interns I ran about various interesting topics in computing science.	Microsoft Campus, Redmond
2015	Honours Computing Science Seminar Category Theory and its relation to Computing Science an hour-long talk introducing the subject to Honours computing scientists and emphasizing its relation to the Curry Howard isomorphism.	University of Alberta
2014	NLP Research Group Cognates for Reconstruction of Native American Language groups a 20 minute talk emphasizing my work over the summer and explaining the organization method and SVM classification method for identifying cognates.	University of Alberta
2013	RLAI Tea Time Talks Room Abstraction in Sokoban a 15 minute talk introducing the game of Sokoban, its combinatorial issues, and room abstraction as an aid to attacking the game.	University of Alberta

## Experience

### Selected Mathematics Courses (3.96 Math GPA, 3.8 General GPA)<sup>2</sup>

#### FUNCTIONAL ANALYSIS

- Banach Spaces (A)
- Operator Algebras (A+)
- Euclidean Harmonic Analysis\*
- Abstract Harmonic Analysis (A+)
- Partial Differential Equations

#### COMPLEX ANALYSIS

- Complex Variables (A-)
- Modular Forms (A)

#### ALGEBRA

- Galois Theory (A)
- Representation Theory of Lie Algebras (B+)

#### TOPOLOGY

- Topology (A+)
- Algebraic Topology (A+)

#### DISCRETE MATHEMATICS

- Combinatorial Optimization (A)
- Fourier Analysis of Boolean Functions (A+)
- Analytic Number Theory\*

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<sup>2</sup>An asterix indicates a course I plan to take in the winter semester

## PROBABILITY THEORY

- Stochastic Processes (A+)
- Multi Armed Bandits (A+)
- Brownian Motion and Stochastic Integration

## GEOMETRY

- Riemannian Geometry\*

## LOGIC AND THEORETICAL COMPUTING SCIENCE

- Mathematical Logic (B+)
- Nonstandard Logical Systems (A)
- Formal Language Theory (A)

## Relevant Work & Experience

2017	UNIVERSITY OF ALBERTA Undergraduate Research Assistant Worked with combinatorial optimization researcher Zachary Friggstadt to come up with novel techniques for approximation algorithms to variants of the capacitated vehicle routing problem. We used Lagrangian preserving approximations for linear programming relaxations of the problem to obtain solutions to vehicle routing problems with cardinality requirements.	Edmonton, Alberta
2015	UNIVERSITY OF ALBERTA 'Tangible Introduction To Computing Science' Teaching Assistant Advised students in the honours stream of Computing Science who were taking CMPUT 275, a class which introduced students to basic algorithmics, such as asymptotic analysis, divide and conquer, dynamic programming, and such. Led office hours weekly and marked assignments.	Edmonton, Alberta
2013-Now	Competitive Programming club Competitor Strong Competitor in Competitive Programming, which presses competitors to find fast solutions to combinatorial problems. Won the Microsoft 2014 Coding for Cash competition, placed 4th in the Alberta Collegiate programming contest in 2014 and 2015. Coached by Zachary Friggstadt (zacharyf@ualberta.ca), ACM world finalist.	

## Summer Internships

2016	Microsoft Universal Store Mobile Device Forensics Developed algorithms for the mobile section of the Microsoft fraud detection team, which uses machine learning techniques on large data sets to predetermine fraud and protect the accounts of Microsoft store customers. The software I designed is set to be implemented on the two most popular Microsoft phone applications.	Redmond, Washington
2015	Microsoft Universal Store Spell Correction Developed algorithms for data linkage. Utilizing various data-cleansing methods together with the Azure and Bing data-analysis packages, cleansed Microsoft's business partner database, removing redundant info, reducing database entries by 20%. My manager for this project was Aman Kansal (Kansal@microsoft.com). I also worked off-hours with a group of interns to send robot adventurers around the world ( <a href="http://www.projectatlas.ms/">http://www.projectatlas.ms/</a> ), and organized weekly talk sessions!	Redmond, Washington
2014	University of Alberta Natural Language Processing and Cognate Identification Worked with the NLP group at the University of Alberta to develop cognate recognition algorithms. Successfully pushed to create a centralized database for storing cognate information, simplifying the learning process. This program was successfully used by linguists at the University of Alberta to understand the Totonac language group. Garrett Nicolai supervised the project (Nicolai@ualberta.ca).	Edmonton, Alberta
2013	University of Alberta Reinforcement Learning GAMES group Implemented efficient abstraction algorithms to create a Sokoban solver for the RLAI group at the University of Alberta, under mentor Harm Van Seijen (Harm.Van.Seijen@gmail.com).	Edmonton, Alberta

## Awards

2017	Faculty of Science Graduate Award	Graduate Support Initiative
2017	NSERC Undergraduate Student Research Award To Nurture the interest and fully develop potential for a research career in the natural sciences and engineering. Recieved twice, both in the spring and summer, but only accepted in the summer.	Alberta Scholarships
2014-2016	Jason Lang Scholarship (3 Time Award Winner) Awarded to students Alberta post-secondary students continuing full-time in undergraduate programs with outstanding academic achievements.	Alberta Scholarships
2014	NSERC Undergraduate Student Research Award To Nurture the interest and fully develop potential for a research career in the natural sciences and engineering.	Alberta Scholarships
2013	Academic Excellence Scholarship Awarded to students with superior academic achievement entering the first year of an undergraduate degree program at the University of Alberta.	University of Alberta
2013	Faculty of Science Academic Excellence Scholarship Awarded annually on the basis of superior academic achievement to students entering the first year of an undergraduate degree program in the Faculty of Science at the University of Alberta.	University of Alberta
2013	Alexander Rutherford Achievement Scholarship To recognize and reward academic achievement at the senior high school level and to encourage students to pursue post-secondary studies.	Alberta Scholarships

## Education

2017-Present	Masters in Mathematics	The University of British Columbia
2013-2017	Bachelors in Computing Science	The University of Alberta
2011-2013	International Baccalaureate High School Diploma	Harry Ainlay High School