

Zachary Gerald Sarver

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Auburn Online

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Education

PhD, Auburn University

2016

Dissertation: *Extension of Monotonicity Results to Semisimple Lie Groups*

Bachelor of Science in Mathematics and Computer Science, Jacksonville State University

2009

Distinguished Graduate in Mathematics

Special Honors in Computer Science

Magna Cum Laude

Research Interests

- Lie Theory
- Matrix Theory
- Category Theory
- Linear and Multilinear Algebra
- Computability
- Functional Reactive Programming

Publications

- *An Extension of Wang-Gong Monotonicity Result to Semisimple Lie Groups*. Accepted for publication in *Special Matrices*
- Currently untitled paper on Lie groups. Writing

Talks and Presentations

The Action of $\mathfrak{sl}_2(\mathbb{C})$ and Independent Sets

April 05, 2014

This talk was given at the 2014 Graduate Student Combinatorics Conference. It detailed a particular action of the Lie algebra $\mathfrak{sl}_2(\mathbb{C})$ on graphs and contained results related to this action.

The Very Basics of Multilinear Algebra

October 08, 2014

This talk was on definitions and basic theorems in multilinear maps between complex vector spaces, tensor spaces, matrix representation of tensors and tensor representation of matrices, and tensor products of R -modules. It was aimed at first year graduate students as an introduction to the topic of multilinear algebra.

The Category **Hask**

November 11, 2014

This talk described the category **IdealHask** whose objects are Haskell types without bottom values and morphisms are Haskell functions. It described some category theoretic constructions in **IdealHask** as well as endofunctors and natural transformations between endofunctors. It remarked on the differences between **IdealHask** and **Hask**, the latter's types containing bottom values.

On Kostant's Preorder

April 13, 2015

This talk detailed the background material needed to understand the definition of Kostant's preorder on semisimple Lie groups: the Cartan decomposition, the Iwasawa decomposition, the complete multiplicative Jordan decomposition, and the Weyl group.

Lie Groups and Why You Might Care About Them

September 8, 2015

This talk was given in the Auburn COSAM Interdisciplinary Colloquium. It was a short talk on the basic definitions of Lie theory given to a general audience of graduate students and undergraduate students in the

College of Science and Mathematics (COSAM.) This colloquium is intended to foster interested in cross-discipline collaboration of graduate students.

Tensor Products of Graphs: A Categorical Perspective

December 15th, 2015

This talk was given at the 2nd annual Southern Combinatorics, Graph Theory, and Game Theory Mini-Conference held at Lamar University in Beaumont, TX. The aim was to motivate the study of the tensor products of graphs from an algebraic and category-theoretic perspective. This talk introduced the concept of a category, the category of undirected graphs, the binary categorical product, and the tensor product of graphs. It was shown that the binary categorical product in the category of undirected graphs is the tensor product of graphs.

Extension of Wang-Gong monotonicity results in semisimple Lie groups

December 19th, 2015

This talk was given at the 5th International Conference on Matrix Analysis and Applications held at Nova Southeastern University in Ft. Lauderdale, FL. It gave extensions of both eigenvalue and singular value type inequalities to semisimple Lie groups with Kostant's preorder.

Everything is a Turing Machine

December 27th, 2016

This was an invited talk given at the 2016 Kyoto Math Camp in Kyoto, Japan. It was kept to a high school level and focused on the invention of the Turing machine by Alan Turing himself, the existence of uncomputable numbers, Markov algorithms, and the fact that every theory of computing and computing device is equivalent to a Turing machine.

Teaching Experience, Auburn University

Instructor of Mathematics

Fall 2016 – Present

- Math 1120 Pre-Calculus Algebra
- Math 1130 Pre-Calculus Trigonometry
- Math 1150 Pre-Calculus Algebra and Trigonometry

Graduate Teaching Assistant of Mathematics

Spring 2010 – Spring 2016

- Oversaw computer-based pre-calculus classes.
- Aided with lecturing and grading in a sophomore linear algebra class.
- Worked as a tutor for Pre-Calculus, Calculus I, Calculus II, and Calculus III.
- Served as the instructor of record for six courses:

Math 1130	Pre-Calculus	Summer 2013
Math 1680	Calculus with Business Applications I	Spring 2012
Math 1610	Calculus I	Fall 2011, Fall 2012, Spring 2015
Math 1620	Calculus II	Spring 2013, Fall 2013, Fall 2015
Math 2630	Calculus III	Spring 2014, Summer 2014
Math 2660	Linear Algebra	Summer 2015

Table 1: Courses Taught at Auburn University

- Wrote tests, assignments, and finals for almost every course taught.
- Excellent student evaluations. Detailed records available upon request.

Calculus Tutor

Fall 2010

Staffed weekly university “Help Room” where students could go for help in their undergraduate Calculus courses.

Pre-Calculus Labs

Spring 2010

Oversaw two sections of the computer based Pre-Calculus classes at Auburn University, holding weekly help

sessions as well as additional review sessions for the midterm and final. Answered questions and taught class as the students completed the assignments on the computer.

Pre-Calculus Algebra*Summer 2013 and Fall 2016*

Covered polynomials and factoring, rational functions, conic sections, and complex numbers.

Pre-Calculus Trigonometry*Fall 2016*

Covered circles and periodic functions, right triangle trigonometry, laws of sines and cosines, and trigonometric identities.

Calculus with Business Applications I*Spring 2012*

Covered limits, derivatives of algebraic, exponential, and logarithmic functions, anti-derivatives, the definite integral, multivariate functions, partial derivatives, the method of Lagrange multipliers, and applications of the preceding to business and economics.

Calculus I*Fall 2011, Fall 2012, Spring 2015*

Covered limits; the derivatives of algebraic, trigonometric, exponential, and logarithmic functions; applications of the derivative; anti-derivatives; the definite integral and its applications to area problems; and the Fundamental Theorem of Calculus.

For Fall 2012 I taught the class in an active learning style. The philosophy of active learning is that students should learn by doing. I prepared worksheets for teaching the entire course via guiding questions and the Socratic method.

Calculus II*Spring 2013, Fall 2013, and Fall 2015*

Covered techniques of integration, applications of the integral, vectors, lines and planes in space, and infinite sequences and series.

Calculus III*Spring 2014 and Summer 2014*

Covered multivariable calculus, including vector-valued functions, partial derivatives, multiple integration, and vector calculus.

Linear Algebra*Fall 2010 and Summer 2015*

Taught the majority of lectures for one section of a sophomore linear algebra class as well as graded for said class.

Served as the instructor of record in 2015, during which I covered systems of linear equations, matrix algebra, vector spaces, basis and dimension, change of basis, and eigenvalues.

Math Summer Bridge Program*Summer 2012*

The COSAM Summer Bridge Program was an intensive four-week residential program for talented and highly motivated minority students (with respect to the sciences) who wanted to get a head start in their college career.

Work and Research at Jacksonville State University

Tutor at ACE Tutoring Center*Fall 2006 – Fall 2008*

The Academic Center for Excellence is a Jacksonville State University program for providing free tutoring to JSU undergraduates. Tutored undergraduate mathematics and computer science students primarily, as well as the occasional English Composition student.

Undergraduate Research Assistant*Fall 2007 – Fall 2008*

Aided Dr. Monica Trifas and Dr. Ming Yang in their research in multi-reference frame video encoding. Reviewed code and implemented functions in C.

Service and Extracurriculars

AMP'd Challenge*Fall 2015*

Helped to design puzzles, worked with students during the event, and played a character during the event. AMP'd Challenge is an outreach program for middle school students, giving them mathematical challenges in the guise of puzzles.

Web Developer at Mathematical Puzzle Programs*Fall 2015 – Spring 2016*

Maintaining and updating the official MaPP website at <http://mappmath.org>. Mathematical Puzzle Programs is an extension of AMP'd Challenge to bring mathematical challenges, cleverly disguised as puzzles, to high- and middle-school students nationwide.

Lead Game Designer at Mathematical Puzzle Programs*Summer 2016 – Present*

Design and editing of puzzles for the Mathematical Puzzle Programs High School Challenge 2017. Additionally editing the rules and over all game design of the same.

Puzzle Designer at Kyoto Math Camp*December 2016*

Design and editing of puzzles for talented Japanese middle and high school students drawn from schools in the Kansai region. The math camp is held in Kyoto, Japan and associated with Otomae High School in Osaka, Japan.

Auburn Puzzle Parties

Auburn has a thriving puzzle and puzzlehunt community of people who like to design and solve puzzles. In addition to participating in a number of puzzle events, I have also designed puzzles, organized events, playtested puzzles, and played villainous characters.

- **Auburn Puzzle Party 4: Puzzle Patrol** Playtester and organizational assistant. *Fall 2010*
- **Auburn Puzzle Party 5: Puzzle Patrol II** Puzzle designer, playtester, villain, and organizational assistant. *Fall 2012*
- **Puzzle Potluck 4** Organizer, puzzle designer, and participant. *Summer 2013*

Additional Skills and Work Experience**Computer Languages and C Libraries**

Proficient in Haskell, C, C++, and Python. Some experience with Java, Objective-C, Go, Ruby, GAP, Zilog Z80 Assembly, and MOS 6502 Assembly. Familiar with the SDL multimedia library, the LAPACK numerical linear algebra library, and various POSIX libraries including pthreads.

Programmer at Envizions*2008-2009*

Worked on a custom user interface and associated daemons and helper programs in C, C++, and Ruby. Envizions was a startup based in Anniston, AL that produced Linux-based set-top boxes for enjoying games and media on your TV.

Software Developer at Auburn Online*Summer 2016 – Present*

Auburn Online is a division of Auburn University striving to bring education into the modern era with the power of the internet. I am involved with designing and building interactive apps for online course materials and design and programming of a plugin for the Canvas LMS.

Awards, Honors, and Special Programs**Winner of the City of Auburn Municipal Hackathon***Fall 2014*

For “[Is Toomer's Corner Being Rolled?](#)”, a webapp that uses image recognition techniques on still images periodically captured from a municipal webcam to determine if Toomer's Corner is being rolled, an Auburn football victory tradition.