

Sai Sivakumar

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University of Florida

Goals

Pursuing a B.Sc. in Mathematics, minors in Computer Science and Physics. Intending to complete a Ph.D. in Mathematics.

Education

- 2020– **B.Sc. in Mathematics**, *University of Florida*, 3.98 GPA
- 2020– **Minor in Computer Science**, *University of Florida*, 4.0 GPA
- 2020– **Minor in Physics**, *University of Florida*, 4.0 GPA
- 2016–2020 **IB Diploma**, *Stanton College Preparatory High School*, 4.0 GPA

Research

Summer 2023 **REU at the University of Minnesota, Twin Cities**, Two projects:

- 1) Worked with Dr. Christine Berkesch and four undergraduates on a project in algebraic geometry and homological algebra. We extended results in [previous work](#) by Harada et al. to provide two methods for finding [virtual resolutions](#) (Berkesch et al.) for ideals of sets of points in $\mathbb{P}^n \times \mathbb{P}^m$, and created [this report](#) (preprint in progress).
- 2) Worked with Dr. Michael Perlman and four undergraduates on a project in commutative algebra, homological algebra, and representation theory. We studied $GL_n(k)$ -stable ideals of polynomial rings in positive characteristics and their free resolutions. We provide a method for finding minimal free resolutions for a wide class of $GL_2(k)$ -stable ideals generated in a single degree in any positive characteristic. We created [this report](#) (preprint in progress).

Summer 2022 **REU at the Georgia Institute of Technology**

Worked with Dr. Ashley Wheeler and two other undergraduates on a project in algebraic geometry. We studied the toric varieties given by the vanishing of principal 2-minor ideals in affine and projective space. We proved a number of properties about these varieties, and created [this poster](#).

Talks and Presentations

- Oct. 2023 Virtual resolutions of points in $\mathbb{P}^n \times \mathbb{P}^m$
To the UF Algebra seminar; outlining the first project I worked on at the UMN Twin Cities mathematics REU.
- Sep. 2023 Stable ideals and their syzygies
Talk for undergraduates about the second project I worked on at the UMN Twin Cities mathematics REU.
- Apr., Jul. 2023 Fourier analysis on LCA groups and Pontryagin duality
For Dr. Sin's MAS7397 Introduction to representation theory class and for the Student Summer Representation Theory Seminar at the University of Minnesota, Twin Cities ([abstract and recording](#)).
- Oct. 2022 What is representation theory?
Intro to the topic for undergraduates, applications in Fourier analysis.

- May 2022 The Smith normal form
For a summer course in topological data analysis; discussed the Smith normal form for Euclidean domains and PIDs and applications in computing simplicial homology.
- Feb.–Mar. 2022 Fourier analysis on finite Abelian groups
Five lectures briefly outlining the theory and applications as they appear in Stein and Shakarchi I.
- Feb. 2022 Combinatorial proof of existence of Sylow subgroups
To the UF Algebra seminar; proof due to Wielandt in 1959.
- Oct. 2021 The Hamilton quaternions
With classmate; discussed history, properties, functions of quaternionic variables, applications.
- Falls 2021 Annual \LaTeX seminar
- 2021–2023 Joint with the UF Graduate Mathematics Association (GMA) and the UF Association for Women in Mathematics (AWM) chapter.
- Jun. 2021 The inverse Laplace transform
Integral definition of the inverse Laplace transform, computations using the integral using the residue theorem. ([YouTube](#); gave an abridged version of this talk Jan. 2023.)
- Mar. 2021 The fundamental theorem of calculus
Proved the theorem at a high school/pre-real analysis level.

Skills

- \LaTeX 4+ years
- Macaulay2 used in both REUs I attended
- Java, C++ with understanding of data structures and algorithms

Outreach and Service

- Aug. 2023– President of the University Math Society at UF. I manage the club (delegating responsibilities, reserving venues, responding to queries, etc.), ensure all events run smoothly, form collaborations with the AWM chapter and the GMA, and encourage a friendly, inclusive environment for all members.
- Aug. 2021– Teaching assistant and grader for *MAP2302* Elementary Differential Equations.
- Mar. 2021– Moderator for a large online community exceeding 160,000 members globally, which seeks to stimulate mathematical discussion and interest, as well as to provide assistance with math.
- Aug. 2021– Academic Director of the University Math Society at UF. I scheduled talks from professors, gave talks myself, and encouraged undergraduate students to give talks.
- 2021–May 2023
- Aug.–Dec. 2020 Contributed around 47 pages to the solution manual for *Concepts in Calculus III* by Miklos Bona and Sergei Shabanov, working with two other students to form 141 pages of solutions which are posted on the course page.

Honors and Awards

- 2023 The Kermit Sigmon Scholarship.
\$200, awarded every spring to promising undergraduate mathematics majors ([info](#)).

2020–2023 Dean's list.
Fall 2020, Spring 2021, Summer 2021, Fall 2021, Spring 2022, Fall 2022, Spring 2023.

Graduate Mathematics Coursework

Course codes in the 4000s indicate mixed undergraduate-graduate courses.

- No code Modular Forms, *Fall 2023*, (reading course)
With Dr. Jeremy Booher, reading from Ch. 7 of *A Course In Arithmetic* by Serre and from *A First Course in Modular Forms* by Diamond and Shurman. In preparation for senior thesis.
- MAT6932 Analytic Number Theory, *Fall 2023*, (audited)
Topics in analytic number theory including proving the prime number theorem, sieve methods, probabilistic number theory. Professor's notes.
- MTG6256 Differential Geometry 1, *Fall 2023*, (audited)
Basic concepts of differential and Riemannian geometry. Using do Carmo.
- MAP6505 Mathematical Methods for Physics and Engineering I, *Fall 2023*
Topics in real analysis, complex analysis, geometry which are used in physics and engineering. Theory of distributions, distributional solutions to linear differential equations, and Green's functions. Professor's notes.
- MAS7397 Introduction to Representation Theory, *Spring 2023*
Module-theoretic representation and character theory of finite groups and of finite-dimensional semisimple complex Lie algebras, theorems of Burnside and Frobenius. Professor's lectures following content from Fulton-Harris.
- MTG6347 Topology II, *Spring 2023*
Singular, axiomatic, and cellular homology/cohomology, and their algebraic structure and dualities. Professor's notes and chapters 10-12, parts of chapters 16-18 in tom Dieck.
- MAA6407 Complex Analysis II, *Spring 2023*
Weierstrass factorization, analytic continuation and Riemann zeta function, harmonic functions, Picard theorems, and other topics. Professor's notes and chapters 7, 9, 10, parts of 12 in Conway.
- MAA6617 Analysis II, *Spring 2023*
Introductory functional analysis. Theory of Banach and Hilbert spaces, linear operators, L^p spaces and their duality, L^1 and L^2 Fourier transform, theory of distributions. Touched on Banach algebras. Professor's notes.
- MAS6332 Algebra II, *Spring 2023*
Projective, injective, and flat modules. Introduction to homological algebra, group cohomology, category theory, commutative algebra, and algebraic geometry. Chapters 15-17 in Dummit and Foote and professor's notes.
- MAT6932 Calculus of Variations and Optimal Control, *Fall 2022*
Covered basic theory of calculus of variations and optimal control following several examples. Professor's lectures.
- MTG6346 Topology I, *Fall 2022*
Topology I – Covered the fundamental group, covering spaces, intro homotopy theory, cofibrations and fibrations, homotopy groups, CW complexes, singular homology. Chapters 1-6, 8, 9 of tom Dieck.
- MAA6406 Complex Analysis I, *Fall 2022*
Analytic functions, integral formulas, zeroes and singularities of functions, Morera's and Goursat's theorems, Cauchy's theorem and integral formula, Laurent series, spaces of holomorphic functions. Professor's notes and chapters 1-7 in Conway.

- MAA6616 Analysis I, *Fall 2022*
Sigma-algebras, measures, the Lebesgue measure, signed measures, integration of measurable functions, modes of convergence, and differentiation theorems. Professor's notes.
- MAS6331 Algebra I, *Fall 2022*
Field and Galois theory, as well as tensor products and some coverage of projective modules. Chapters 10.4, 10.5, 13, 14 of Dummit and Foote.
- MTG4303 Introductory Topology II, *Spring 2022*
Basic algebraic topology and topics from point-set topology. Chapters 5-6, 9-12 from Munkres.
- MAP4341 Introduction to Partial Differential Equations, *Spring 2022*
Elementary theory of solving partial differential equations. Professor's notes and lectures.
- MAS5312 Introduction to Algebra II, *Spring 2022*
Rings, fields, modules. Chapters 7-13 of Dummit and Foote.
- MAA5228 Modern Analysis I, *Fall 2021*, (audited)
Metric spaces and topology, convergence of sequences and series, continuity, differentiation. Chapters 1-5 of Rudin PMA.
- MAS5311 Introduction to Algebra I, *Fall 2021*
Group theory. Chapters 1-6 from Dummit and Foote.