Kareem Jaber

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EDUCATION

Princeton University   Princeton, NJ

A.B. in Mathematics, GPA 3.976   Aug. 2022 – Present

Expected minor in Computer Science

Relevant coursework:

- **Analysis**: Complex Analysis, Measure and Probability Theory, Functional Analysis, Harmonic Analysis (independent work), Geometric Measure Theory
- **Algebra**: Linear Algebra, Abstract Algebra, Representation Theory
- **Number Theory**: Quadratic Forms, Algebraic Number Theory, Analytic Number Theory
- **Topology and Geometry**: Point set Topology, Algebraic Topology, Differential Geometry (independent work), Riemann Surfaces, Algebraic Geometry (independent work)
- **Combinatorics and Probability**: The Probabilistic Method, Algebraic Combinatorics (independent work)
- **Computer Science**: Systems programming (in C), Functional programming (in OCaml), Economics and Computing, Computational Geometry

PUBLICATIONS, PREPRINTS, AND INDEPENDENT WORK

Expository Papers

- On Dimension-Free L^p bounds for Maximal Functions: My junior independent work at Princeton, advised by Assaf Naor. I wrote an exposition of work of Stein, Bourgain, Carbery, and Muller on dimension independent estimates for the Hardy-Littlewood maximal functions of families of convex bodies.
- A Proof of the Gauss-Bonnet Theorem: My final paper for a Junior Seminar on Geometric Analysis, advised by Ravi Shankar.

Research Papers

- Congruence Classes of Simplex Structures in Finite Field Vector Spaces: at SMALL REU 2024, with Tim Cheek, Joe Cooper, Pico Gilman, Vismay Sharan, Jenna Shuffelton, and Marie-Hélène Tomé, advised by Eyvindur Palsson and Alex Iosevich. Published in the *Bulletin of the Hellenic Mathematical Society*, Volume 69.
- Numerical Investigation of Lower Order Biases in Moment Expansions of One Parameter Families of Elliptic Curves: at SMALL REU 2024, with Tim Cheek, Pico Gilman, Marie-Hélène Tomé, and Vismay Sharan, advised by Steven J. Miller. Accepted in the *Journal of Number Theory*, Volume 279.
- On the Density of Low Lying Zeros of a Large Family of Automorphic L-functions: at SMALL REU 2024, with Tim Cheek, Pico Gilman, and Marie-Hélène Tomé, advised by Steven J. Miller.
- Colorings of Symmetric Unions and Partial Knots: At the Polymath Junior REU 2022 (virtual). With Ben Clingenpeel, Zongzheng Dai, Gabriel Diraviam, Krishnendu Kar, Ziyun Liu, Teo Miklethun, Haritha Nagampoozhy, Michael Perry, Moses Samuelson-Lynn, Eli Seamans, Ana Wright, Nicole Xie, and Ruiqi Zou, advised by Alexander Zupan. Accepted in the *Journal of Knot Theory and its Ramifications*.

Recreational Mathematics Papers

- Variants of Conway Checkers and k-nacci Jumping: At SMALL REU 2024, with Glenn Baruda, Joe Cooper, and Raul Marquez, advised by Steven J. Miller. Accepted in *The Fibonacci Quarterly*.
- The Unsolvable Configuration of the 15 Puzzle and an Interesting Approach to Abstract Algebra: An expository paper I wrote right before entering university, which won runner-up for the Steven H. Strogatz Prize for Math Communication 2022.

RELEVANT EXPERIENCE

Senior Thesis | Princeton, NJ   Fall 2025 - Present
- Currently working under Prof. János Kollár on complex birational geometry, the Enriques-Kodaira classification of surfaces, and applications to the geography problem for complex surfaces

Geometric Measure Theory Research | Princeton, NJ   Summer 2025
- Worked under Professors Camillo De Lellis and Federico Glaudo on improving best known results on the Besicovitch 1/2 conjecture, building upon their recent work using a min-max algorithm and linear programming
- Provided approaches to optimize the discretized linear program in their paper, and related heuristics on the efficacy of the min-max algorithm to the packing dimension of sets in the minimization domain

Algebraic Geometry Independent Work | Princeton, NJ   Summer 2025
- Worked under Prof. Jakub Witaszek on scheme theory, quasicoherent sheaves, vector bundles, derived functors, and cohomology through Vakil's *The Rising Sea*

SMALL Williams REU | Willamstown, MA   Summer 2024
- Researched point configurations over finite fields with Professors Eyvindur Palsson and Alex Iosevich, and low-lying zeros of L-functions and moments of families of elliptic curves with Steven J. Miller. These experiences led to several paper and talks at the 2024 Young Mathematicians Conference as well as the 2025 Joint Mathematics Meetings.

Undergraduate Course Assistant | Princeton University   Sept. 2023 - Present
- Work as a course assistant for Princeton's advanced introductory analysis sequence (MAT216/218) and introductory algebra course (MAT345)

Engineering Teacher | Kuching, Malaysia; International Internship Program   Summer 2023
- Worked at Chumbaka, an engineering education company in Malaysia; co-taught their coding and electronics curriculum in after-school programs; trained teachers in using material in their classrooms; contributed to company-wide curriculum development and R&D meetings
- Mentored a group of secondary students designing a device to track hemorrhagic shock treatment information in a hospital environment; students won first place in regional competition and are now working closely with Sarawak emergency room doctors

Polymath Jr REU | Virtual   Summer 2022
- Collaborated virtually for 8 weeks under the guidance of Prof. Alexander Zupan, University of Nebraska-Lincoln, focusing on n-colorings of symmetric union presentations, resulting in a publication in the *Journal of Knot Theory and It's Ramifications*

Mathematics and Education Outreach   Summer 2020 - present
- Established my own math circle after-school program, the Princeton Community Math Circle, at two local elementary schools in the Princeton area
- Attended the Math Circle Institute 2025 at Notre Dame to share my outreach experiences and learn from professional groups involved with mathematics outreach globally
- Organize and administer Princeton Splash, an annual education outreach event for high school students, and represented Princeton at SplashCon 2024, a conference at MIT
- Write expository mathematics papers on problem solving for high schoolers

Selected Awards and Honors

Princeton University Andrew H. Brown Prize 2025, awarded to four outstanding juniors in mathematics

HackPrinceton 2025 Education Category Winner for a 4D VR graphing calculator

William Lowell Putnam Mathematical Competition 2023, Top 500 nationally

Princeton University Shapiro Prize For Academic Excellence 2023 (awarded to top 3% of students in class)

Princeton International Internship Program 2023, Best Reflection

Runner up in Steven H. Strogatz Prize for Math Communication 2022