# Bangzheng (Benjamin) Li

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## Introduction

I am a senior at MIT majoring in mathematics. My current interests are in algebra and number theory.

## Education

- **Massachusetts Institute of Technology** *2022 - Present*
  *Undergraduate* Cambridge, MA
  ◦ GPA: 5.0/5.0.

- **Christian Heritage School** *2018 - 2022*
  *High School* Trumbull, CT

## Awards

- **Hartley Rogers Jr. Prize** *August 2024*
  *MIT* [link]
  ◦ Awarded for the best paper in the Summer Program in Undergraduate Research (SPUR).

## Activities

- **Undergraduate Research Opportunities Program Plus (UROP+)** *June 2025 - August 2025*
  *MIT* [link]
  ◦ It was conjectured that a binary sequence satisfying certain conditions is the X-ray of a permutation matrix. My mentor Yannick Yao (PHD student) and I proved a weaker statement: under the same constraint, the sequence is the X-ray of a doubly stochastic matrix.

- **Undergraduate Research Opportunities Program (UROP)** *2025*
  *MIT* [link]
  ◦ In his paper, Professor Victor Kac showed that the quiver problem is in NP. In this UROP, Professor Victor Kac and I proved that the quiver problem is NP-complete.

- **PRIMES-USA (mentor)** *2024*
  *MIT* [link]
  ◦ Working with Doctor Felix Gotti, we mentored three students and produced a paper titled *On finitary power monoids of linearly orderable monoids*.

- **Summer Program in Undergraduate Research (SPUR)** *June 2024 - August 2024*
  *MIT* [link]
  ◦ Working with Luis Modes, we generalized a result from $K = \mathbb{Q}$ to any number field with class number 1.

- **Directed Reading Program (DRP)** *January 2024*
  *MIT* [link]
  ◦ Read the book *Primes of the Form $x^2 + ny^2$* by David Cox and gave a presentation at the end of DRP.

- **Joint Mathematics Meetings** *January 2024*
  *San Francisco* [link]
  ◦ Gave a presentation titled *Hereditarily Atomicity, Underatomicity, and ACCP*.

- **Conference on Rings and Factorizations** *July 2023*
  *University of Graz* [link]
  ◦ Gave a presentation titled *Divisibility and a weak ascending chain condition on principal ideals*.

- **CrowdMath** *2022*
  *Art of Problem Solving* [link]
  ◦ Worked on additive structure of $\mathbb{N}_0[\alpha]$ and produced a paper titled *Factorization in additive monoids of evaluation polynomial semirings*.

- **PRIMES-USA (mentee)** *2021*
  *MIT* [link]
  ◦ Mentored by Doctor Felix Gotti, we produced several papers, including *Divisibility and a weak ascending chain condition on principal ideals*, *On the primality and elasticity of algebraic valuations of cyclic free semirings*, *Atomic semigroup rings and the ascending chain condition on principal ideals*, and *Divisibility in rings of integer-valued polynomials*.

## Publications

**[5]** Gotti, F., Li, B. (2025). *Arithmetic properties encoded in undermonoids*. Semigr. Forum. doi.org/10.1007/s00233-025-10578-3

**[4]** Ajran, K., Bringas, J., Li, B., Singer, E., Tirador, M. (2023). *Factorization in additive monoids of evaluation polynomial semirings*. Commun. Algebra, 51(10), 4347–4362. doi.org/10.1080/00927872.2023.2208672

**[3]** Gotti, F., Li, B. (2023). *Atomic semigroup rings and the ascending chain condition on principal ideals*. Proc. Amer. Math. Soc., 151, 2291-2302. doi.org/10.1090/proc/16295

**[2]** Jiang, N., Li, B., Zhu, S. (2023). *On the primality and elasticity of algebraic valuations of cyclic free semirings*. Int. J. Algebra Comput., 33:02, 197-210. doi.org/10.1142/S021819672350011X

**[1]** Gotti, F., Li, B. (2021). *Divisibility in rings of integer-valued polynomials*. New York J. Math. 28, 117-139.

## Preprints

**[6]** Kac, V., Li, B. (2025). *The Quiver Problem is NP Complete*. arXiv:2508.02975

**[5]** Li, B., Xiao, Y. (2025). *Commutative Quantale and Localization*. arXiv:2508.02991

**[4]** Dani, J., Gotti, F., Hong, L., Li, B., Schlessinger, S. (2025). *On finitary power monoids of linearly orderable monoids*. arXiv:2501.03407

**[3]** Li, B., Modes, L. (2024). *The spherical Hall algebra of* $\overline{\mathrm{Spec}(\mathcal{O}_K)}$. arXiv:2411.17055

**[2]** Bu, A., Gotti, F., Li, B., Zhao, A. (2024). *One-dimensional monoid algebras and ascending chains of principal ideals*. arXiv:2409.00580

**[1]** Gotti, F., Li, B. (2022). *Divisibility and a weak ascending chain condition on principal ideals*. arXiv:2212.06213

## Math Courses Taken

F=Fall Term, S=Spring Term

All courses taken after 2022 Fall (inclusive) are at MIT.

- **2025 F:** 18.155 Differential Analysis I
- **2025 F:** 18.965 Geometry of Manifolds I
- **2025 S:** 18.102 Intro to Functional Analysis
- **2025 S:** 18.737 Algebraic Groups
- **2025 S:** 18.821 Project Lab in Mathematics
- **2024 F:** 18.745 Lie Groups and Lie Algebras I
- **2024 F:** 18.785 Number Theory I
- **2024 S:** 18.786 Number Theory II
- **2024 S:** 18.906 Algebraic Topology II
- **2023 F:** 18.101 Analysis and Manifold
- **2023 F:** 18.783 Elliptic Curves
- **2023 F:** 18.905 Algebraic Topology I
- **2023 S:** 18.152 Intro: Partial Differential Equations
- **2023 S:** 18.726 Algebraic Geometry II
- **2023 S:** 18.901 Introduction to Topology
- **2022 F:** 18.112 Functions of Complex Variable
- **2022 F:** 18.725 Algebraic Geometry I
- **2022 S:** MATH603 Introductory Topics in Representation Theory, Professor Ivan Loseu, at Yale
- **2021 F:** Reading Group, *Commutative Algebra with a View Toward Algebraic Geometry* by David Eisenbud, at Yale
- **2021 S:** MATH353 Introduction to Representation Theory, Professor Congling Qiu, at Yale
- **2020 F:** MATH380 Modern Algebra I, Professor Ivan Loseu, at Yale

## Books Read (Fully or Partially)

- *Basic Topology*, M.A. Armstrong
- *Algebra*, Michael Artin
- *Linear Algebra Done Right*, Sheldon Axler
- *The Calculus Lifesaver*, Adrian Banner
- *Primes of the Form* $x^2 + ny^2$, David A. Cox
- *Commutative Algebra with a View Toward Algebraic Geometry*, David Eisenbud
- *Algebraic Curves*, William Fulton
- *Surreal Numbers*, Donald Knuth
- *Thirty-three Miniatures: Mathematical and Algorithmic Applications of Linear Algebra*, Jiri Matousek

- (Note) *Algebraic Geometry*, J.S. Milne
- (Note) *Algebraic Number Theory*, J.S. Milne
- (Note) *Field and Galois Theory*, J.S. Milne
- (Note) *Group Theory*, J.S. Milne
- *Algebraic Curves and Riemann Surfaces*, Rick Miranda
- *Visual Complex Analysis*, Tristan Needham
- *Lie Groups and Algebraic Groups*, A.L. Onishchik and E.B. Vinberg
- *A Course in Arithmetic*, J-P. Serre
- *A Friendly Introduction to Number Theory*, Joseph H. Silverman
- *Complex Analysis*, E. Stein
- *Fourier Analysis*, E. Stein
- *Real Analysis*, E. Stein
- *A Course in Algebra*, E.B. Vinberg