

Mattie Ji

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Education

Brown University

Sc.B. Mathematics and Computer Science with Honors, Sc.B. Applied Mathematics with Honors

Providence, RI

September 2020 - May 2024

Byron Nelson High School

Class of 2020 Valedictorian

Trophy Club, TX

September 2016 - May 2020

Coursework

Relevant Coursework:

- **Graduate Level:** Modern Algebra (Groups, Modules, Infinite Galois Theory), Commutative Algebra, Complex Function Theory, Algebraic Topology, Combinatorial Theory (graphs, matroids, chip-firing), Numerical Solutions to PDEs (finite difference methods), Theoretical PDEs, Algebraic and Analytic Number Theory, Algebraic Geometry.
- **Undergraduate Level:**
 - Real Analysis (Measure Theory, Lebesgue Integrals), Calculus on Manifolds, Number Theory, Topology, Abstract Algebra, Wavelets and Applications, Honors Linear Algebra, Honors Multivariable Calculus, Statistical Inference I, Applied ODEs and PDEs.
 - Computer Systems, Logic For Systems (Formal Methods), Software Engineering, Accelerated Introduction to Functional Programming.
- **Independent Study:**
 - **Vector Bundles, K-Theory, and Characteristics Classes**, with Professor Thomas Goodwillie (Fall 2023).
 - **Morse Theory**, with Professor Thomas Goodwillie (Spring 2023).
 - **Tame Topology and O-minimal Structures**, with Professor Kun Meng (Spring 2023).
 - **Local Rational Formula in Computational Topology**, with Professor John Hughes (Fall 2022).

Papers

1. *Rationality of Real Conic Bundles with Quartic Discriminant Curve*, with Lena Ji (no relation). **International Mathematics Research Notices**; rnad003. Preprint at [arXiv:2208.08916](https://arxiv.org/abs/2208.08916) (2022).
2. *On the Geometry of a Fake Projective Plane with 21 Automorphisms*, with L. Borisov, Y. Li, and S. Mondal. Preprint at [arXiv:2308.10429](https://arxiv.org/abs/2308.10429). Submitted (2023).
3. *Explicit Equations of the Fake Projective Plane ($a = 7, p = 2, \emptyset, D_3 X_7$)*, with L. Borisov, and Y. Li. Preprint at [arXiv:2308.14237](https://arxiv.org/abs/2308.14237). Submitted (2023).
4. *Statistical Inference of Grayscale Images via the Euler-Radon Transform*, with K. Meng, J. Wang, K. Ding, H. Kirveslahti, A. Eloyan, and L. Crawford. Preprint at [arXiv:2308.14249](https://arxiv.org/abs/2308.14249). Submitted (2023).
5. *Euler Characteristics and Homotopy Types of Definable Sublevel Sets, with Applications to Topological Data Analysis*, with K. Meng and K. Ding. Preprint at [arXiv:2309.03142](https://arxiv.org/abs/2309.03142), Submitted (2023).
6. *On the Invertibility of Euler Integral Transforms with Hyperplanes and Quadric Hypersurfaces*. [Preprint](#) (2023).

Research Experience

Topological Data Analysis Research Assistant

Providence, Rhode Island

Brown University, Department of Applied Mathematics

January 2023 - PRESENT

- Working with **Professor Kun Meng** in the applications of tame topology, o-minimal structures, and Euler calculus in topological data analysis.
- Developed the frameworks of the **Euler-Radon transform** that generalizes the Euler characteristics transform to definable real-valued functions (e.g. grayscale images).
- Produced non-trivial results in the Euler characteristic and homotopy type of definable sublevel sets.

DIMACS REU Program

Providence, Rhode Island

Rutgers University, Department of Mathematics, [Website](#)

June 2023 - August 2023

- Worked with **Professor Lev Borisov** to study the geometry of fake projective planes.
- Improved, in dimensions, an embedding of the fake projective plane ($a = 7, p = 2, \emptyset, D_3 2_7$) into $\mathbb{C}P^5$ and studied properties of certain linear systems on it, leading to an explicit construction of the fake projective plane ($a = 7, p = 2, \emptyset, D_3 X_7$) in $\mathbb{C}P^9$.

Computational Topology Research Assistant

Providence, Rhode Island

Brown University, Department of Computer Science, [Code Repository](#)

September 2022 - March 2023

- Worked with **Professor John Hughes** to study locally rational invariants of combinatorial manifolds and compute pontryagin numbers of 4-manifolds.
- Designed and implemented algorithms in **Python** and **Sage** to compute local rational formulae for Euler characteristics and turning numbers. Constructed a rudimentary framework for the know-nothing method.

University of Michigan, Mathematics REU Program

Ann Arbor, Michigan

University of Michigan, Department of Mathematics

June 2022 - Aug 2022

- Worked with **Professor Lena Ji** (no relation) to study the rationality of real conic bundles over \mathbb{P}^2 with quartic discriminant curves.
- Designed and implemented algorithms in **computational algebraic geometry** for searching examples of rational and irrational conic bundles satisfying certain constraints, checking whether the Intermediate Jacobian torsor obstructions to rationality vanishes, and computing singular fibers for families of conic bundles.
- Using the topology of the real locus and the intermediate Jacobian torsor obstruction, we also gave a non-trivial characterizations of the rationality types of these real conic bundles for 4 out of the 6 isotopy classes.

Work Experience

Brown University Grading/Teaching Assistant

Math 2510 - **Graduate Algebra I** (Grader)

MATH 1530 - **Abstract Algebra** (Undergraduate TA)

MATH 1040 - **Fundamental Problems of Geometry** (Undergraduate TA)

Math 1260 - **Complex Analysis** (Grader)

MATH 0100 - **Introductory Calculus, Part II** (Grader)

CSCI 1550/2540 - **(Advanced) Probabilistic Methods in Computer Science** (Head TA)

CSCI 1450 - **Advanced Introduction to Probability for Computing and Data Science** (Head TA)

CSCI 1952Q - **Algorithmic Aspects of Machine Learning** (Head TA)

CSCI 1951A - **Data Science** (Undergraduate TA)

CSCI 1450 - **Advanced Introduction to Probability for Computing and Data Science** (Undergraduate TA)

Providence, RI

Fall 2023, Fall 2022

Fall 2023, Fall 2022

Spring 2022

December 2022

Spring 2022

October 2023 - PRESENT

March 2023 - PRESENT

October 2022 - May 2022

Spring 2022

Fall 2021

Lockheed Martin Corporation

Fort Worth Aeronautics Digital Transformation Team - **Cloud Engineering Intern**

Remote
June 2020 - December 2020

- Migrated the **JDI (Just-Do-It) Event Toolbox** (an integrated service where over **100** Lockheed Martin Teams had received guided JDI walk-throughs on problems they'd encountered in software engineering) to AWS Cloud.
- Created and maintained an automated **Cloudcheckr cost optimization system** that monitored Lockheed-Martin-internal AWS accounts and created plans to lower the cost of projects, saving over **\$200,000** of unnecessary costs as of September 2021.
- Created and maintained a **serverless statistics tracker** for over **20+** teams on their performance per the DevOps principles.
- Documented and developed **curriculums and tutorials on AWS services**.

Honors and Awards

2024 Runner-up for the Alice T. Schafer Mathematics Prize

International award to undergraduate women for excellence in mathematics by the Association for Women in Mathematics (AWM).

Anonymous Head UTaship (2023)

Brown CS UTA Endowments to distinguished head teaching assistants in the department.

Sandra Galejs '80 UTaship for Women in CS (2022)

Brown CS UTA Endowments to distinguished undergraduate teaching assistants in the department.

Graduate Directed Reading Programs

Harmonic Analysis

Brown University MATH DRP, advised by Tainara Gobetti Borges.

- Text: Piotr Hajłasz, **Harmonic Analysis**.

Providence, RI

September 2023 - PRESENT

Category Theory In Context

Brown University MATH DRP, advised by Megan Change-Lee.

- Text: Riehl, **Category Theory in Context**.

Providence, RI

September 2021 - December 2022

Chaos in Discrete Dynamical Systems

Brown University APMA DRP, advised by Tim Roberts.

- Text: Kuznetsov, **Elements of Applied Bifurcation Theory**; Holmgren, **A First Course in Discrete Dynamical Systems**; Peitgen, Jürgens, and Saupe, **Chaos and Fractals: New Frontiers of Science**.

Providence, RI

September 2021 - December 2022

Turing Computability: Theory and Applications

Brown University MATH DRP, advised by Tom Stone.

- Text: Soare, **Turing Computability: Theory and Applications**.

Virtual

September 2020 - December 2020

Talks Given

Euler Calculus of Definable Sublevel Sets with Applications to Topological Data Analysis

[Upcoming] January 2024

Joint Mathematics Meeting 2024

On the Geometry of a Fake Projective Plane with 21 Automorphisms

[Upcoming] January 2024

Joint Mathematics Meeting 2024

Euler Characteristics and Homotopy Types of Definable Sublevel Sets

October 2023

Brown University Math Colloquium

[Link](#)

Computing explicit equations of fake projective planes

July 2023

DIMACS REU Seminar

[Link](#)

Local Rational Formulae for Computing Topological Invariants

March 2023

ACM Massachusetts Gender-Inclusive Computing Celebration

[Link](#)

Local Rational Formulae for Computing Topological Invariants

Brown Student Undergraduate Mathematics Seminar

March 2023

[Link](#)

Local Rational Formulae for Computing Topological Invariants

Brown Student Undergraduate Mathematics Seminar

March 2023

[Link](#)

Rationality of Real Conic Bundles with Quartic Discriminant Curve

Joint Mathematics Meeting 2023

January 2023

[Poster](#)

Seifert–Van Kampen Theorem: A Categorical Perspective

Brown Math DRP Conference

December 2022

[Link](#)

Algebraic Connectivity and Spectral Clustering

Brown APMA 2812G Lecture

December 2022

[Link](#)

Rationality of Real Conic Bundles with Quartic Discriminant Curve

Brown University Math Colloquium

October 2022

[Link](#)

Rationality of Real Conic Bundles with Quartic Discriminant Curve

Young Mathematician's Conference

August 2022

[Link](#)

Conic Bundles over the Real Projective Plane

University of Michigan Mathematics REU Seminar

June 2022

[Link](#)

Yoneda Lemma and Tensor Products

Brown Math DRP Conference

May 2022

[Link](#)

Levi-Civita Connections and the Fundamental Theorem of Riemannian Geometry

Brown Math 1140 Lecture

May 2022

[Notes](#)

Skills

Programming Proficiency in C/C++, Python, Java, Javascript. and R; Experience with Go, Pyret, Racket, Haskell.

CAS Proficiency in Sage, Magma, Macaulay2, and Mathematica; Experience with Julia, MATLAB, and GAP.

Tools Proficiency in Git VCS, Linux systems, Python data science libraries; Experience with Machine/Deep Learning frameworks, Javascript Front-/Back-end frameworks (Node, Angular, React).

Public Cloud Amazon Web Service VPC, EC2, S3, DynamoDB, MongoDB, Lambda, API Gateway, IAM, CloudFront, CloudFormation.