Jacob Zweifler

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Education

New York University, Courant Institute of Mathematical Sciences — New York, NY
Master of Science in Mathematics — *Sep 2023 – May 2025*

The University of Chicago — Chicago, IL
B.S. in Mathematics, with Honors; B.S. in Computer Science; Machine Learning Specialization — *Sep 2019 – Jun 2023*
Honors: *summa cum laude* (GPA: 3.95/4.00), Dean's List (2019–2020, 2021–2022), Elected to Phi Beta Kappa (2022)

Technical Skills

Languages: Proficient in Python (PyTorch, Qiskit, SymPy), C, Java, Haskell, SML, OCaml, Coq, F*, Z3, JavaScript, Magma

Research Experience

Enabling Practical-scale Quantum Computing (EPiQC) — **Chicago, IL**
Researcher - Chicago Quantum and Programming Languages Lab — *Aug 2020 – Sep 2023*
- Authored and maintained over 100k lines of high-quality code in Coq and Lean, demonstrating expertise in formal verification
- Created QuantumLib, a linear algebra library for quantum computing, which is now widely adopted across EPiQC
- Participated in weekly category theory seminar led by Peter May, deepening expertise in advanced mathematical concepts

UChicago Math Research Experience for Undergraduates (REU) — **Chicago, IL**
Researcher — *Jun 2020 – Aug 2020, Jun 2021 – Aug 2021*
- Papers: Elliptic Curves and Complex Multiplication (2020), Algebraic Geometry and Divisors (2021)
- Discussed the theory of elliptic curves, complex multiplication, and a generalization to the Kronecker–Weber theorem for $\mathbb{Q}(i)$

Projects, Talks, Posters

QuantumLib: A Quantum Computing Library in Coq | *Coq* — *Aug 2021 – Present*
- Created extensive linear algebra library (∼50k lines) in Coq for the purposes of formally verifying quantum computing programs
- Presented the QuantumLib library at the 2022 Coq Workshop, part of FLoC 2022 in Haifa, Israel

The λ-Q# Project | *OCaml, Menhir, Dune, Z3, Q#* — *Jan 2022 – Sep 2023*
- Formulated grammar for λ-Q#, a functional core of Microsoft's Q# language, to ensure safe quantum programs
- Gained valuable hands on experience working alongside postdoc Kartik Singhal on new research projects

Verifying Gottesman's Semantics | *Coq* — *Oct 2020 – Jun 2021*
- Formulated two different semantics of Gottesman's type system, bridging a conceptual framework with applicable methodology
- Presented a poster at the 2021 Quantum Physics and Logic conference (QPL)

Mathematics Engagement

NYU Algebraic geometry and analytic geometry (GAGA) Seminar — **New York, NY**
Founder and Principal Speaker — *Sep 2024 – Present*
- Organize weekly meetings with 8 graduate students and lead discussions on Serre's GAGA paper

NYU Algebraic Topology Seminar — **New York, NY**
Founder and Principal Speaker — *Feb 2024 – May 2024*
- Organized weekly meetings with 4 graduate students and taught about applications of Whitehead torsion in manifold theory

UChicago Directed Reading Program (DRP) — **Chicago, IL**
Student — *Jan 2020 – Aug 2022*
- Met weekly with a graduate student to discuss advanced topics in Math, specifically Galois theory and algebraic number theory
- Spent 10 hours weekly studying from Milne's *Algebraic Number Theory* and Milne's *Class Field Theory* textbooks
- Presented two talks to other participants on p-adic analysis and applications of class field theory

Teaching Experience

Courant Institute, New York University — **New York, NY**
Course Assistant: Math for Economics 1, 2 (Intro to Calculus), Complex Analysis 282 — *Sep 2023 – Present*
- Teach two weekly recitation sections, grade quizzes and exams, conduct weekly office hours

University of Chicago Math Department — **Chicago, IL**
Grader: Calculus 161, Calculus 162, Analysis 205; Course Assistant: Discrete Mathematics 271 — *Sep 2021 – June 2023*
- Graded assignments weekly, conducted office hours, taught weekly lessons for a class of 30 students
- Met and assisted students who need help in the above classes (in person and virtual)

Ross Mathematics Program — **Columbus, OH**
Instructor — *Jun 2020 – Aug 2020, Jun 2024 – Aug 2024*
- Led daily number theory discussions with 6 high school students and met individually to discuss problem sets
- Taught advanced course on algebraic topology, introducing the fundamental group, simplicial homology, and singular homology
- Graded ∼ 75 problem sets and led multiple lectures for students regarding introductory topics in number theory

Volunteer Work

NYU Courant Mentor **New York City, NY**
Mentor *Oct 2024-Present*
- Meet with two first year master's students at NYU to discuss transitioning to graduate school and PhD applications

Boost Tutors and Mentors **New York City, NY**
Instructor *Jan 2023-Present*
- Work with gifted yet underprivileged high school students to learn advanced mathematics material and study habits
- Train a group of 5 students for math competitions such as AMC and Yale Math Contest.

Hall High School Tutoring Service **West Hartford, CT**
Tutor Chair *Aug 2018-Jun 2019*
- Created an algorithm and website that would automatically pair up tutors with students to help improve tutoring system
- Tutored students in math, science, and English through high school's tutoring service

Machine Learning Projects

Variational Autoencoder (VAE) for Image Classification | *Python, PyTorch* *Apr 2023 – June 2023*
- Designed and coded a VAE, implementing a custom loss function combining binary cross-entropy and KL divergence to optimize both image reconstruction and latent space distribution
- Enhanced model efficiency by tailoring convolutional neural networks in the encoder-decoder architecture

Metaphor Detection using LSTM and BERT | *Python, PyTorch* *Jan 2022 – Mar 2022*
- Implemented an LSTM model with ELMo and GloVe embeddings for nuanced text sequence processing and a fine-tuned BERT model for contextual interpretation, aiming to optimize metaphor detection in sentence classification
- Presented poster on project at UChicago natural language processing workshop