

Jack Westbrook

Email: jackswestbrook@gmail.com Website: westbrookjack.github.io GitHub: [westbrookjack](https://github.com/westbrookjack)

Research interests: Arithmetic geometry; Galois/automorphic representations; elliptic curves (BSD, Selmer/III); p -adic Hodge/cohomology; mixed-characteristic commutative algebra

Education

Imperial College London, MSc in Pure Mathematics — *Expected September 2026*

MSc thesis (in progress): Introduction to p -adic Hodge Theory and Galois Representations, supervised by **G. Boxer**, Imperial College London.

University of Wisconsin–Madison, Bachelor of Arts in Mathematics — *May 2025*

Graduate Math GPA: 3.91/4.00 · Overall GPA: 3.63/4.00

Publications and Preprints

On Deformation of Perfectoid Purity in Gorenstein Domains, with Baily, Dovgodko, Simpson.

Submitted. Preprint ([arXiv:2504.02966](https://arxiv.org/abs/2504.02966)).

Some Applications of the Brenner–Monsky Quartic, with Dovgodko and Simpson. *In preparation (2025). Early draft.*

Examples of Lie Algebras with Specified Newton Polygons, with Alwan, K. Huang, T. Huang, Stovall. *In preparation (2025).*

Research Experience

Research Assistant (REU), University of Michigan–Ann Arbor Summer 2024

Supervisor: Dr. Austyn Simpson

– Produced the first *two-parameter family* with varying Hilbert–Kunz multiplicities by combining Monsky–Trivedi density methods with new Segre-product constructions; **co-authored** resulting paper.
– Initiated constructions toward lifting F -purity → perfectoid purity in mixed characteristic; **co-authored** a submission.
– Implemented Macaulay2 routines for Segre and Veronese presentations; groundwork for a future package release.

Research Assistant (REU), University of Wisconsin–Madison Summer 2022

Supervisor: Dr. Betsy Stovall

– Computed Newton polygons associated to vector fields in \mathbb{R}^n for $n \leq 14$.
– Developed combinatorial arguments giving bounds in all dimensions; presented results in three venues; **co-authored** a forthcoming paper.

Undergraduate Researcher, Madison Experimental Mathematics Lab Fall 2022

Supervisor: Dr. Feng Zhu

– Constructed explicit generators in $\mathrm{PSL}(2, \mathbb{R})$ for isometry subgroups of hyperbolic surfaces.
– Studied Teichmüller theory and presented a poster to students and faculty.

Selected Notes & Software

- **Solutions to *The Rising Sea*** — 150+ pages of original, comprehensive solutions and proofs. [Link](#)

- **Solutions to *The Arithmetic of Elliptic Curves*** — selected exercises and expanded proofs from the text. [Link](#)
- **A Proof of Quadratic Reciprocity by Galois Theory** — exposition based on a proof sketched by Prof. Ana Caraiani, expanded into a full Galois-theoretic derivation of quadratic reciprocity. [Link](#)
- **Macaulay2: Segre and Veronese Presentations** — prototype and companion packages for computing presentations of Segre products and Veronese subrings of graded rings. [Link](#)
- **Original Number Theory Problems** — authored 9 problems with full solutions on Diophantine and modular themes; one used for a UW–Madison Putnam Club meeting. [Link](#)

Selected Presentations

- “Exploring Notions of Curvature for Families of Curves,” *UNC Online Undergraduate Analysis and PDE Seminar*, 2022
- “Exploring Notions of Curvature in Higher Dimensions,” *UIC Undergraduate Mathematics Symposium*, 2022
- “Hilbert–Kunz Multiplicity in a Two-Parameter Family,” *University of Michigan REU*, 2024
- “The Isomorphism Theorems in Abelian Categories,” *UW–Madison Math Club*, 2024
- “Constructing Gödel’s Constructible Universe,” *Directed Reading Program*, 2023

Selected Graduate Coursework

Number Theory & Arithmetic Geometry: Algebraic Number Theory, Elliptic Curves, Galois Theory.

Algebra: Algebra I–II, Lie Algebras.

Geometry & Topology: Algebraic Geometry I, Topology I–II.

Analysis: Complex Analysis, Measure Theory.

Teaching and Mentorship

Directed Reading Program Mentor, Imperial College 2025–2026

– Led an undergraduate reading group on elliptic curves and Galois representations; designed tailored study plans and discussion materials.

Course Assistant, Math Learning Center, UW–Madison 2023–2025

– Supported MATH 340, 341, 421, 551 (Linear Algebra/Analysis/Topology); received strong student and faculty feedback.

Athletic Math Tutor, UW–Madison Summer 2023

– Tutored incoming student-athletes for placement exams; created custom study materials and practice sets.

Honors and Technical Skills

– Dean’s List, UW–Madison — Spring 2023, Fall 2023, Spring 2024.

Programming: Macaulay2 (package dev), PARI/GP, SageMath, Python, MATLAB, C++, Rust .

Tools: L^AT_EX, Git, HTML/CSS

Last updated: November 2025