# Matthew Yacavone

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## Experience

### Software Engineer / Researcher

2020-2024 | Galois, Inc.

Created, developed, and maintained powerful tools for formal verification.

- Was a core contributor to *SAW (Software Analysis Workbench)*, a large, decade-old suite of formal verification tools in active use as part of critical systems in US government and commercial clients.
  - Primarily designed, implemented, and maintained *Coq* automation for *Heapster*, a tool within *SAW* for analyzing unbounded programs. Spearheaded the development of its successor in *SAW*, *Mr. Solver*.
  - Co-authored two papers (publications [1], [3]) on *Heapster*, both of which use and rely on my automation for their core results.
  - Verified, with a colleague, the correctness of a software update mechanism developed for a DoD client using *Heapster's Coq* automation. Verified the top-level interface of Dilithum, a NIST-standard post-quantum signature scheme, with *Mr. Solver*.
- Audited a large Python codebase implementing differential privacy for a government client, resulting in authoring a 21-page document detailing the mathematical probability of two key algorithms failing. Updated their codebase to precisely predict and account for this.
- Co-designed a domain-specific programming language for feature modeling. Implemented the lexer, parser, type checker, and CLI.
- Lead the company's "Blue Sky Time" program, hosting twice-yearly sharing sessions and acting as a friendly face encouraging use of the program through periodic announcement and one-on-one meetings.

### Research in Knot Theory

2019-2022 | Haverford College

Developed and proved a novel result in Legendrian Knot Theory in collaboration with my former professor Joshua Sabloff. Co-authored and published a paper (publication [2]) in a major knot theory journal.

- Designed an interactive user interface in Python for exploring and collecting data on Legendrian knots, used to develop our result.

## Education

**B.S. Mathematics** from Haverford College, 2019

Included two semesters of graduate studies in mathematics at the University of Pennsylvania. Minor in Computer Science.

## Skills and Interests

**Languages:** Haskell, Python, Coq, Agda, Rust, Javascript, HTML/CSS

**Design:** Lighting designer for eight student-run musicals and plays over five years in high school and college. Created interactive visualizations for linguistics, judaism, music, and more.

**Music Theory:** Created xen-calc, a tool for making microtonal music

**Life:** Twisty puzzles, Baritone ukulele

## Publications

[3] Silver, L., Westbrook, E., Yacavone, M., & Scott, R. (2023). **Interaction Tree Specifications: A Framework for Specifying Recursive, Effectful Computations That Supports Auto-Active Verification.** In *37th European Conference on Object-Oriented Programming (ECOOP 2023)*. [PDF]

[2] Guadagni, R., Sabloff, J. M., & Yacavone, M. (2022). **Legendrian satellites and decomposable cobordisms.** *Journal of Knot Theory and Its Ramifications, 31* (13), Article 2250071. [PDF]

[1] He, P., Westbrook, E., Carmer, B., Phifer, C., Robert, V., Smeltzer, K., Ștefănescu, A., Tomb, A., Yacavone, M., & Zdancewic, S. (2021). **A type system for extracting functional specifications from memory-safe imperative programs.** *Proceedings of the ACM on Programming Languages, 5 (OOPSLA)*, Article 135, 1-29. [PDF]