Joshua Clune

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Education

Carnegie Mellon University, Pursuing PhD in Computer Science — Sept 2021 – Present

Advisor: Jeremy Avigad

Carnegie Mellon University, B.S. in Computer Science — Sept 2017 – May 2021

Additional major in Philosophy, GPA: 3.86/4

Research Projects

LeanHammer — Jan 2024 - Present

- Developed a tactic to translate Lean goals to TPTP and SMT-LIB formats and subsequently reconstruct proofs found by external automatic theorem provers

QuerySMT: Hint-Based SMT Proof Reconstruction — Jan 2024 - Present

- Developed a new "hint-based" approach to reconstructing SMT proofs
- Implemented the approach as a Lean tactic which leverages cvc5 to discover standalone proof scripts

Duper: An Automatic Theorem Prover for Dependent Type Theory — June 2022 - Sept 2024

- Developed an automatic proof-producing superposition theorem prover in Lean 4
- Extended the prover to perform higher-order reasoning and handle problems which include dependent types

A Formalized Reduction of Keller's Conjecture — Sept 2021 - Sept 2022

- Formalized the connection between Keller graphs and Keller's original conjecture on cube tilings in Lean 3
- Produced the first verified proof that Keller's conjecture is false in eight dimensions

A Polymorphic Logical Framework — Sept 2020 - July 2021

- Developed an extension to the LF logical framework that includes polymorphic types

Program Equivalence for Assisted Grading of Functional Programs — May 2019 - Nov 2020

- Developed a technique for expressing the equivalence of functional programs with SMT formulas
- Implemented the technique to cluster Standard ML homework submissions from an introductory course

Professional Experience

Research Intern - Microsoft — May 2025 - Aug 2025

- Contributed to the formal verification of a Rust ML-KEM implementation using Aeneas and Lean
- Developed proof automation for the Aeneas toolchain to streamline the verification of cryptographic code

Applied Scientist Intern - Amazon — June 2023 - Sept 2023

- Created a package for creating and reasoning about CNF formulas in Lean 4
- Implemented a verified LRAT checker to support reasoning about the unsatisfiability of CNF formulas in Lean

Software Engineering Intern - Bloomberg L.P. — Sept 2016 - Aug 2017, June - Aug 2018

- Created a Terminal function to help monitor how customers engaged in various workflows
- Created a Terminal function to ascertain the consistency of user data across

General Coding Intern - Readorium — June 2016 - Aug 2016

- Migrated Readorium's main product from Flash to HTML5
- Developed a system of recording user transactions used to identify bugs and validate security features

Skills

Experience with: Interactive Theorem Proving, Automatic Theorem Proving, Formal Methods, Program Analysis

Languages: Lean, Standard ML, OCaml, C, Python, JavaScript, C++, SQL, Bash