Joshua Clune

Reachable by email at jclune@andrew.cmu.edu

EDUCATION

Pursuing PhD in Computer Science, Carnegie Mellon University
Advisor: Professor Jeremy Avigad Sep 2021-Present

B.S. in Computer Science, Carnegie Mellon University
Computer Science major, Philosophy additional major (GPA: 3.86/4) Sep 2017-May 2021

RESEARCH

Duper: An Automatic Theorem Prover for Dependent Type Theory
Advisors: Alexander Bentkamp and Jeremy Avigad Jun 2022-Present

- 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
Advisor: Jeremy Avigad Sep 2021-Sep 2022

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

A Polymorphic Logical Framework
Advisor: Karl Crary Sep 2020-Jul 2021

- Developed an extension to the LF logical framework that includes polymorphic types
- Main goals included proving identity expansion and cut elimination, and subsequently formalizing said proofs with Coq

Program Equivalence for Assisted Grading of Functional Programs
Advisors: Umut Acar and Ruben Martins May 2019-Nov 2020

- Developed a technique for describing the equivalence of purely functional programs with SMT formulas
- Implemented the technique to cluster thousands of Standard ML homework submissions from an introductory functional programming course
- Proved the soundness of the technique so that if the technique identifies two programs as equivalent, it is necessarily the case that the two programs exhibit identical behavior

TEACHING

Logic and Mechanized Reasoning Spring 2024

- Served as a TA; Filled in as a lecturer and assisted in assignment and exam development

Constructive Logic Fall 2022

- Served as a TA; Individually lead weekly recitations

Mathematical Concepts and Proofs Fall 2019

- Served as a TA; Lead recitations twice a week; Gave two supplemental lectures

Mathematical Foundations for Computer Science Fall 2018

- Served as a TA; Lead recitations twice a week

WORK EXPERIENCE

Applied Scientist Intern
Amazon Jun 2023-Sep 2023
Mentor: Leonardo de Moura

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

Software Engineering Intern
Bloomberg L.P. Sep 2016-Aug 2017, Jun-Aug 2018
Lead and completed the following development projects for the Bloomberg Terminal:

- Created a Terminal function to help sales representatives monitor how effectively their customers engaged in various workflows, both at the aggregate level to discover widespread trends and the individual level for closer monitoring
- Created a Terminal function to display specific Terminal user information while simultaneously running internal checks to ascertain the consistency of the displayed data

General Coding Intern
Readorium June 2016-Aug 2016
Worked with a team of interns to complete various development projects:

- Migrated Readorium's main product from Flash to HTML5
- Developed a system of recording user transactions that can be used both to identify bugs and to determine whether a user improperly bypassed certain security features. I personally served as the lead developer for this system

PUBLICATIONS/AWARDS

- Joshua Clune, Yicheng Qian, Alexander Bentkamp, and Jeremy Avigad. 2024. Duper: A Proof-Producing Superposition Theorem Prover for Dependent Type Theory. To appear in ITP 2024.

- Joshua Clune. A Formalized Reduction of Keller's Conjecture. Proc. ACM SIGPLAN International Conference on Certified Programs and Proofs. January 2023, Pages 90-101, https://doi.org/10.1145/3573105.3575669
- Joshua Clune, Vijay Ramamurthy, Ruben Martins, and Umut A. Acar. 2020. Program Equivalence for Assisted Grading of Functional Programs. Proc. ACM Program. Lang. 4, OOPSLA, Article 171 (November 2020), 29 pages. https://doi.org/10.1145/3428239
- Received Honorable Mention for 2021 CRA Outstanding Undergraduate Researcher Award