

# Ariel E. Kellison

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I am a Postdoctoral Researcher at Sandia National Laboratories working on formal methods, programming languages, and computer arithmetic. I design foundational tools with rigorous guarantees that make it convenient for programmers to reason about correctness and numerical accuracy. I have seven years of experience working in formal methods research groups and have an active security clearance.

## Education

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### Cornell University

PhD in Computer Science

Aug. 2020–Dec. 2024

- Dissertation: *Type-Based Approaches to Rounding Error Analysis*
- Committee: David Bindel, Andrew Appel, Adrian Sampson, Alexander Vladimirsky

### University of California Santa Cruz

BSc in Astrophysics | Honors in the Major

Aug. 2007– June 2010

## Employment

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**Sandia National Labs** | Digital Foundations & Mathematics Dept.

June 2021–Present

- **Postdoctoral Researcher** Dec. 2024–Present
- **Formal Methods Intern** June 2021–Dec. 2024  
*Supervisor:* Heidi Thornquist

**Cornell University** | Department of Computer Science

Jan. 2020–Aug. 2020

- **Lecturer**, Intro. to Computing Using Python June 2020–Aug. 2020
- **Head Graduate Teaching Assistant**, Intro. to Computing Using Python Jan. 2020–May 2020

**Cornell University** | NuPRL Research Group

July 2016–Jan. 2020

- **Research Support Specialist I** July 2018–Jan. 2020
- **Research Aide IV** July 2016–July 2018  
*Principal Investigator:* Professor Robert Constable

**Santa Cruz City Schools** | Harbor High School | Santa Cruz, CA, USA

Aug. 2014–June 2016

- **Mathematics Teacher** Aug. 2015–June 2016
- **Mathematics Teacher in Training** Aug. 2014–Aug. 2015

## Refereed Publications

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- (1) *Numerical Fuzz: A Type System for Rounding Error Analysis*

Ariel E. Kellison, Justin Hsu

45th ACM SIGPLAN Conference on Programming Language Design and Implementation (**PLDI 2024**)

- (2) *VCFloat2: Floating-point Error Analysis in Coq*

Andrew W. Appel, Ariel E. Kellison

13th ACM SIGPLAN International Conference on Certified Programs and Proofs (**CPP 2024**)

- (3) *LAProof: A Library of Formal Proofs of Accuracy and Correctness for Linear Algebra Programs*  
**Ariel E. Kellison**, Andrew W. Appel, Mohit Tekriwal, David Bindel  
 30th IEEE International Symposium on Computer Arithmetic (**ARITH 2023**)
- (4) *Verified Correctness, Accuracy, and Convergence of a Stationary Iterative Linear Solver: Jacobi Method*  
 Mohit Tekriwal, Andrew W. Appel, **Ariel E. Kellison**, Jean-Baptiste Jeannin, David Bindel  
 16th International Conference on Intelligent Computer Mathematics (**CICM 2023**)
- (5) *Global Stochastic Optimization of Stellarator Coil Configurations*  
 Silke Glas, Misha Padidar, **Ariel E. Kellison**, David Bindel  
 Journal of Plasma Physics, Volume 88 (2), 2022
- (6) *Verified Numerical Methods for Ordinary Differential Equations*  
**Ariel E. Kellison**, Andrew Appel  
 15th International Workshop on Numerical Software Verification (**NSV 2022**)
- (7) *A Machine-Checked Direct Proof of the Steiner-Lehmus Theorem*  
**Ariel E. Kellison**  
 11th ACM SIGPLAN International Conference on Certified Programs and Proofs (**CPP 2022**)
- (8) *Towards Verified Rounding Error Analysis for Stationary Iterative Methods*  
**Ariel E. Kellison**, Mohit Tekriwal, Jean-Baptiste Jeannin, Geoffrey Hulette  
 6th IEEE/ACM International Workshop on Software Correctness for HPC Applications (**Correctness 2022**)
- (9) *Implementing Euclid's Straightedge and Compass Constructions in Type Theory*  
**Ariel E. Kellison**, Mark Bickford, Robert Constable  
 Annals of Mathematics and Artificial Intelligence, Volume 85, Pages 175-192, 2019

## Reports & Position Papers

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- (1) *Report on the First Tri-Lab Workshop on Formal Verification (SAND2024-02142)*  
 Samuel D. Pollard, Jon M. Aytac, **Ariel E. Kellison**, Ignacio Laguna, Srinivas Nedunuri, Sabrina Reis,  
 Matthew J. Sottile, Heidi K. Thornquist. Feb. 2024
- (2) *Real(istic) Specifications of Software (SAND2021-14778C)*  
 Samuel D. Pollard, **Ariel E. Kellison**, John Bender, Geoffrey C. Hulette. U.S. Department of Energy ASCR  
 Workshop on the Science of Scientific-Software Development and Use. Dec. 2021
- (3) *Formal Methods Based Certification Frameworks for Scientific Computing Applications (SAND2021-13614C)*  
**Ariel E. Kellison**, Geoff C. Hulette, John Bender, Samuel D. Pollard, Heidi K. Thornquist. U.S. Department  
 of Energy ASCR Workshop on Cybersecurity and Privacy for Scientific Computing Ecosystems. Nov. 2021

## Ongoing Work

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- (1) *Bean: A Language for Backward Error Analysis*  
**Ariel E. Kellison**, Laura Zielinski, David Bindel, Justin Hsu  
*Under Review (submitted November 2024)*, see <https://arxiv.org/abs/2501.14550>

## Selected Academic Talks

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### Designing Type Systems for Rounding Error Analysis

- FPBench Community Meeting (invited virtual talk) Sept. 2024

### Type-Based Approaches to Rounding Error Analysis

- Department of Energy CSGF Annual Program Review July 2024
- FPTalks 2024 Annual Workshop (invited virtual talk) July 2024

## A Type System for Numerical Error Analysis

- Cornell Programming Languages Discussion Group (invited seminar talk) Mar. 2024
- New Jersey Programming Languages and Systems Seminar Nov. 2023

## LAProof: A Library of Formal Proofs of Accuracy and Correctness for Linear Algebra Programs

University of Michigan | Midwest Programming Languages Summit Oct. 2023

## Verified Numerical Methods for Ordinary Differential Equations

Cornell University | Cornell Programming Languages Retreat Dec. 2022

FPBench Community Meeting (virtual contributed talk) Jan. 2022

## A Machine-Checked Direct Proof of the Steiner-Lehmus Theorem

Cornell University | Cornell Programming Languages Retreat Dec. 2021

## Awards and Honors

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### Department of Energy Computational Science Graduate Fellowship

A highly-competitive graduate fellowship program providing, for four years, an annual \$45,000 living stipend, an annual \$1,000 professional development allowance, and full university tuition and fees. The program requires substantial (six courses total) graduate level coursework in science & engineering, mathematics & statistics, and computer science, as well as a minimum of one graduate level course in high-performance computing.

### North Coast Math and Science Initiative Scholarship

A \$2,000 award for mathematics and science teachers training in Northern California schools.

### UCSC Physics Department Honors

Awarded to students with a grade point average above 3.5 in the major.

### California Space Grant Consortium

A competitively awarded program supporting undergraduate students in aero/space-related research.

## Academic Service

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**Program Committee**, PLDI 2025

46th ACM SIGPLAN Conference on Programming Language Design and Implementation

**Artifact Evaluation Committee**, POPL 2025

52nd ACM SIGPLAN Symposium on Principles of Programming Languages

**External Reviewer**, POPL 2025

52nd ACM SIGPLAN Symposium on Principles of Programming Languages

**External Reviewer**, CADE 2023

29th International Conference on Automated Deduction

**External Reviewer**, CSL 2022

30th EACSL Annual Conference on Computer Science Logic

## Student Project Advisement

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Max Fan (Cornell, CS PhD student) Fall 2025 – current

Zack Cheslock (Cornell, UGrad in CS) Summer 2024 – current

Luis Hernandez (Cornell, UGrad in CS) Summer 2024 – current

Andrew Mata (Cornell, UGrad in CS) Summer & Fall 2019