

# 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 Vladimirovsky

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://H.Barxiv.H.Borg/H.Babs/H.B2501.H.B>

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## 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
- FPTalks 2024 Annual Workshop (invited virtual talk)

July 2024

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