Ariel E. Kellison

ak2485@cornell.edu | ak-2485.github.io | github.com/ak-2485

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

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

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

(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

(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

(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

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

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

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

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