Ariel Kellison

Postdoctoral Associate at Sandia National Laboratories
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Current Position

Postdoctoral Associate, Sandia National Laboratories Dec. 2024 – current
I am developing novel static analysis tools for core numerical components of simulation software central to Sandia's mission. My work combines rich type systems with dynamic analysis techniques to ensure numerical accuracy and stability while also improving code maintainability.

Education

Cornell University
PhD in Computer Science, Fall 2020 – Fall 2024
Thesis: Type-Based Approaches to Rounding Error Analysis
Advisement: co-advised by David Bindel (Cornell) & Andrew Appel (Princeton)

University of California Santa Cruz
BSc in Astrophysics with Honors in the Major

Work Experience

Sandia National Labs | Digital Foundations & Mathematics Department June 2021 – current

- **Postdoctoral Research Associate** Dec. 2024 – current
- **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: 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) *Bean: A Language for Backward Error Analysis*
Ariel E. Kellison, Laura Zielinski, David Bindel, and Justin Hsu
Conditionally accepted to the 46th ACM SIGPLAN Conference on Programming Language Design and Implementation **(PLDI 2025)**

(2) *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)**

(3) *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)**

(4) *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)**

(5) *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)**

(6) *Global Stochastic Optimization of Stellarator Coil Configurations*
Silke Glas, Misha Padidar, **Ariel E. Kellison**, David Bindel
Journal of Plasma Physics, Volume 88 (2), 2022

(7) *Verified Numerical Methods for Ordinary Differential Equations*
Ariel E. Kellison, Andrew Appel
15th International Workshop on Numerical Software Verification **(NSV 2022)**

(8) *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)**

(9) *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)**

(10) *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

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.

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.

Selected 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

- Midwest Programming Languages Summit, University of Michigan — Oct. 2023

Verified Numerical Methods for Ordinary Differential Equations

- Cornell Programming Languages Retreat, Cornell University — Dec. 2022
- FPBench Community Meeting (virtual contributed talk) — Jan. 2022

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

- Cornell Programming Languages Retreat, Cornell University — Dec. 2021

Service

Program Committee, PLDI — 2025
46th ACM SIGPLAN Conference on Programming Language Design and Implementation

External Reviewer, CAV — 2025
37th International Conference on Computer Aided Verification

External Reviewer, ICALP — 2025
52nd EATCS International Colloquium on Automata, Languages, and Programming

Journal Article Reviewer, TACO — 2025
ACM Transactions on Architecture and Code Optimization

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

Laura Zielinski (Cornell, CS PhD student)	Fall 2025 – current
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