Robert Lorch

Curriculum Vitae

Education

Present	**Ph.D. (Computer Science)**, *The University of Iowa*, *GPA − 4.25*.
2022	**M.C.S.**, *The University of Iowa*, *GPA − 4.33*.
2021	**B.A. (Computer Science)**, *Grinnell College*, *GPA − 3.94, Major GPA − 4.00*.

Research and Work Experience

2022–Present   Research Assistant, *The University of Iowa*, Iowa City, IA.

- I contribute to Kind 2, which is an open-source, multi-engine, SMT-based automatic model checker for safety properties of finite-state or infinite-state synchronous reactive systems expressed as an extension of the Lustre language. Below are some of the features I've implemented.
- *Feature 1:* Refinement types (predicate subtypes)
- *Feature 2:* Polymorphic nodes, functions, and contracts
- *Feature 3:* A nondeterministic choice operator that outputs an element of a given type satisfying a given predicate
- *Feature 4:* Imperative-style `if` blocks with dedicated syntax for frame conditions
- *Feature 5:* Open intervals for integer subrange types

2024   Applied Scientist Intern, *Amazon Web Services*, Portland, OR.

- More information TBD :)

2023–2024   Fellow Intern, *GE Global Research*, Niskayuna, NY.

- *Project 1:* Designed a formal requirements capture tool using LLMs to translate natural language requirements to statements in formal logic.
- *Project 2:* Developed a requirements capture DSL called TRACE (Toolkit for Requirements Analysis, Capture, and Elicitation), using formal methods techniques to automatically detect flaws in the requirements.
- *Project 3:* Formally modeled an automated vaccine production system in Cyber Resiliency Verifier to discover architectural and behavioral cyber vulnerabilities. Used this information to inform the further design and development of the system.
- *Project 4:* Formally modeled an abstract specification of a handshake protocol for use within a zero-knowledge proof workflow.

2021   Software Engineer Intern, *Principal Financial Group*, Des Moines, IA.

- Used Amazon Web Services infrastructure to store and process clients' financial data.
- Designed and implemented a website to market technology at Principal to potential employees, winning an award at the intern code jam.

2020–2021   Immersive Experiences Lab, *Grinnell College*, Grinnell, IA.

- Designed and implemented an interactive virtual reality experience using Unity and C# to assist in the teaching of linear transformations.

2020 **Graph Theory REU**, *Moravian University*, Bethlehem, PA.
- ○ Proved new theorems about the strong proper connection number of various graph classes, leading to a research paper.

2019 **Applied Math REU**, *IUPUI*, Indianapolis, IN.
- ○ Designed and implemented a mathematical cancer cell model using MATLAB in order to learn about cancer cell movement through the bloodstream.

Teaching Experience

2021–2022 **Teaching Assistant**, *The University of Iowa*, Iowa City, IA.
Led discussion sessions, prepared solutions, graded, and held office hours.
- ○ [CS:4420] Artificial Intelligence (Spring 2022)
- ○ [CS:5810] Formal Methods of Software Engineering (Fall 2021)
- ○ [CS:2640] Computer Organization (Fall 2021)

2021 **Peer Tutor**, *Grinnell College*, Grinnell, IA.
Led discussion sessions, prepared solutions, graded, and held office hours.
- ○ [CSC-161] Imperative problem solving and data structures (Spring 2021)
- ○ Conducted regular one-on-one tutoring sessions.

2021 **Class Mentor**, *Grinnell College*, Grinnell, IA.
Led discussion sessions, prepared solutions, graded, and held office hours.
- ○ [CSC-207] Object-oriented problem solving, data structures, and algorithms (Spring 2021)
- ○ Assisted with labs, answered questions, prepared course materials, and gave mentor sessions.

Publications

2024 **R. Lorch**, D. Larraz, C. Tinelli, O. Chowdhury, "A Comprehensive, Automated Security Analysis of the Uptane Automotive Over-the-Air Update Framework," **RAID** '24.

2024 **R. Lorch**, B. Meng, K. Siu, A. Moitra, M. Durling, S. Paul, S. Varanasi, "Formal Methods in Requirements Engineering: Survey and Future Directions," **FormaliSE** (colocated with ICSE) '24.

2023 D. Larraz, **R. Lorch**, M. Yahyazadeh, F. Arif, O. Chowdhury, and C. Tinelli, "CRV: An automated resiliency reasoner for system design models," **FMCAD** '23.

2022 B. Carrigan, D. Diaz, J. Hammer, J. Lorch, and **R. Lorch**, "Constructing $(3, b)$-sudoku pair Latin squares," **Australasian Journal of Combinatorics** '22.
https://ajc.maths.uq.edu.au/pdf/82/ajc_v82_p031.pdf

2021 B. Carrigan, J. Hammer, J. Lorch, **R. Lorch**, and C. Owens, "List colorings count rokudoku-pair squares," **Bulletin of the Institute of Combinatorics and its Applications** '21.
http://bica.the-ica.org/Volumes/92//Reprints/BICA2020-34-Reprint.pdf

Other Writing

2024 **R. Lorch**, D. Larraz, C. Tinelli, "A Lustre Primer for Kind 2 Users."
https://kind.cs.uiowa.edu/kind2_user_docs/lustre_primer.pdf

Projects

2021 **Symbolic Execution and Taint Tracking**.
Implemented an interpreter for a simple imperative programming language that is able to perform symbolic execution and dynamic taint tracking.

2021 **Grinnell CLS Funding Website**.
Worked on website for Grinnell College's Center for Careers, Life, and Service to help make funding opportunities more publicly available.

Presentations

2023 "CRV: Automated Resiliency Reasoning for System Design Models," *FMCAD*.

2023 "Using LLMs to translate natural language to formalism," *GE Research Intern Poster Session.*

2021 "Strong proper connection," *Joint Mathematics Meetings*.

2019 "Steady and near-steady state cancer cell model," *Indiana Undergraduate Mathematics Research Conference*.

2019 "Steady and near-steady state cancer cell model," *IUPUI Poster Symposium*.

Awards

2023 **Delivering with Focus**, *GE Global Research.*

2022 **Academic Excellence in the Master's Program**, *The University of Iowa.*

2021 **Outstanding Poster**, *Joint Mathematics Meetings.*

2021 **Code Jam Wow Factor**, *Principal Financial Group.*

Skills

Languages	Java, Python, C, OCaml
Formal Tools	Alloy, Kind 2, cvc5, Dafny, Lean
Other	Git, Unix command-line, AWS