

Eliot Heinrich

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eliotheinrich.github.io

Summary

Graduating PhD candidate in computational physics. Skilled in designing and optimizing high-performance C++ software, scalable simulations in distributed environments, HPC infrastructure, and parallelized code. Seeking to apply these skills to a role in software engineering and available to start work before graduation.

Education

Boston College <i>Physics (PhD, MS)</i> , GPA: 3.96	Sept. 2020 – Expected May 2026
University of Vermont <i>Computer Science (BS), Physics (BA), Mathematics (BS)</i> , GPA: 3.91	Sept. 2016 – May 2020

Experience

PhD Candidate, Quantum Simulation Research, Boston College	Sept. 2020 – Present
- Designed object-oriented C++ simulation library for composable quantum simulations, achieving 3-10x performance gains over standard libraries by leveraging SIMD instructions, circuit transpilation, asynchronous instruction execution, and algorithmic optimization.	
- Authored five first-author publications related to statistical mechanics, quantum information, large-scale numerical studies, and classical algorithms for simulating and characterizing quantum systems.	
HPC Research Assistant, Boston College Research Services	Jan. 2023 – Present
- Systems administrator for Boston College's Linux HPC cluster (284 nodes, ~500 users).	
- Assisted 35+ interdisciplinary research groups to design, deploy, and utilize scientific software.	
- Developed Python-based automated tools for job scheduling, cluster usage data aggregation/visualization, and performance monitoring, improving processes and infrastructure.	
- Authored documentation/best-practice guides for parallel computing, OpenMP, MPI, Linux, and Python.	
Quantum Theory & Software Intern, MIT Lincoln Laboratory	June 2022 – Aug. 2022
- Extended a C++ quantum simulator to support higher-dimensional systems (qutrits) and added new error/noise channels, requiring modifications of core state representation and operator implementations.	

Projects / Publications

Full list of publications available at eliotheinrich.github.io/publications

More projects, including interactive WebGL applets, available at eliotheinrich.github.io/projects

qutils (C++/Python API)	github.com/eliotheinrich/qutils
- Modular quantum simulation library supporting simulator backends representing various simulable subtheories of quantum mechanics (i.e. stabilizer states, tensor networks, free fermion dynamics).	
- Flexible backend-agnostic circuit abstractions representing symbolic quantum/classical instructions, enabling multiple efficient and scalable simulation strategies under a unified API.	
- Authored extensive unit tests to validate numerical accuracy and benchmark performance.	

Distributed filesystem (C)	github.com/eliotheinrich/spool
- Wrote distributed FUSE filesystem in C using process (MPI) and thread (pthread) level parallelism.	

dataframe (C++/Python)	github.com/eliotheinrich/dataframe
- Built a multiprocessing Python pipeline for efficient parameter-sweep simulations of arbitrary models.	

Skills	
Tools: C++, C, Python, Rust, CMake, Git/GitHub, Linux, LaTeX, PyTorch, SQL, Docker, CI/CD, Jira	
Techniques: High-performance parallel computing, object-oriented programming, advanced numerical methods, designing numerical experiments, data visualization, API design, debugging, optimization, profiling, scalable code design, technical communication, machine learning, deep learning	