Cameron Durbin

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EDUCATION

University of Oregon — Eugene, OR
Ph.D. Computer Science — September 2022 – Present
- Research Advisor: Allen Malony
- Discipline in Machine Learning; High Performance Computing; Computer Architecture

University of Oregon — Eugene, OR
Bachelor of Science, Mathematics and Computer Science — September 2017 – June 2021
- Organizations: President of Cyber Security Club; Theta Chi Fraternity
- International Study: Computer Science at National University of Singapore

WORK EXPERIENCE

Research and Development Intern — Albuquerque, NM
Sandia National Laboratories — June 2023 – Present
- Built a custom Analog MLIR dialect with operations for Torch-MLIR integration, enabling ResNet workloads on hybrid analog/digital systems.
- Developed a RISC-V co-processor simulation component in Structural Simulation Toolkit (SST) that dispatches matrix-vector multiply operations through RoCC to a CrossSim-modeled analog array.
- Extended the LLVM RISC-V backend with the new instructions and developed a C++ intrinsic library for streamlined analog co-processor support.
- Created a Dockerized toolchain bundling LLVM/MLIR (with Torch-MLIR), CrossSim, and SST, with full reproducibility and documentation.
- Developed an end-to-end simulation pipeline connecting compiler, analog simulator, and multicore infrastructure for hardware/software co-design.

HPC Software Applications Intern — Portland, OR
Intel Corporation — June 2024 – September 2024
- Migrated the CUDA-based drug discovery application GNINA to SYCL, enabling efficient execution on Intel GPUs and CPUs through OneAPI.
- Developed and optimized SYCL kernels to accurately replicate CUDA functionality, ensuring correctness and achieving high performance.
- Conducted detailed performance analysis of CUDA and SYCL implementations, identifying bottlenecks and optimizing execution across diverse hardware.
- Created comprehensive documentation of the migration process and performance findings to support future SYCL adoption efforts.

HPC Software Engineer — Eugene, OR
ParaTools Inc. — August 2020 – June 2023
- Developed an LLVM compiler frontend to insert performance analysis hooks at critical process points, enabling advanced system analysis and optimization.
- Migrated kernel code from CUDA to ROCm, ensuring compatibility and performance on AMD GPUs.
- Containerized massively parallel programs for seamless deployment on Summit supercomputers, ensuring efficient execution across multiple nodes.
- Constructed Spack containers to streamline and optimize system package management for high-performance computing environments.
- Contributed C++ programs to the Department of Energy's Exascale Computing Project testsuite, ensuring code stability and reliability.

Publications and Presentations

- **Paper** C. Durbin, J. Flores, B. Feinberg. "Simulating Hybrid Analog + RISC-V Systems for HPC Applications" SuperComputing 2025 RISC-V for HPC Workshop
- **Presentation** "LLVM+MLIR: Enabling Machine Learning on Emerging RISC-V Architectures", LLVM Meetup, 2025
- **Poster** "Low-Power Hybrid Analog-Digital Acceleration on Edge-Class RISC-V Platforms", MVAPICH User Group Conference, 2025
- **Poster** "Analog + Digital Hybrid System Library and Compiler Stack", NNSA RadEdge, 2025
- **Poster** "System Simulation for Analog + Digital Hybrid Systems", NNSA RadEdge, 2024

Projects

- **Resource-Efficient Performance Monitoring on Edge Devices**: Developed a Kubernetes-based performance monitoring application for NVIDIA Xavier NX devices, tracking CPU, memory, and power metrics. Leveraged virtual filesystems for lightweight monitoring and optimized sampling frequency to balance accuracy and computational overhead. Integrated data into application schedulers to enhance resource allocation in the Sage Continuum framework for geohazard monitoring.

- **Parallel 3D Grid Relaxation and Shortest Path Algorithm**: Designed a parallel Bellman-Ford shortest path algorithm for 3D grids using MPI. Implemented grid relaxation techniques to improve solution accuracy and convergence, showcasing expertise in parallel computing and numerical methods.

- **High-Performance Solvers for Physics Simulations**:
  - Developed a 2D Heat Equation solver using MPI and OpenMP for grids up to 1024x2048, configured for multi-process runs over 100 timesteps.
  - Developed a Poisson's 2D Equation solver using cuBLAS/cuSPARSE with the Conjugate Gradient method, achieving efficient discretization and parallel computation.

- **Semiconductor AI Podcast:** Created a Python-based application to scrape semiconductor news, summarize articles via OpenAI's API, and generate audio podcasts using text-to-speech models. Automated daily execution via cronjobs, delivering real-time news updates.

SKILLS & INTERESTS

Programming Languages: C, C++, Python, CUDA, SYCL, Assembly
Frameworks & Tools: LLVM, MLIR, RISC-V, MPI, OpenMP, Docker, Kubernetes, Structural Simulation Toolkit, PyTorch
Specializations: Compilers, GPU Programming, High Performance Computing, Machine Learning, Computational Science, System Simulations, Computer Architecture
Personal Hobbies: Skiing, Reading, Biking, Chess, Running, Tennis, Hiking