Yufei Shi

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Research Interests

Computer Architecture, Computer Systems

Education

Carnegie Mellon University . . . . . **Pittsburgh, PA**
B.S. in Electrical and Computer Engineering . . . . . Expected May 2024

Research Experience

CMU ABSTRACT Research Group (Prof. Brandon Lucia) . . . . . **Jan 2023 — Present**

- **Research on the memory consistency model of Pipestitch**, an energy-minimal CGRA with lightweight threads. Extended the dataflow execution simulator to support Pipestitch by adding new processing elements and implementing thread dispatch synchronization. Developed programs with diverse memory access patterns and analyzed their execution traces on the simulator. Identified violations of sequential consistency among the traces and the root cause. Currently working on enforcing sequential consistency automatically at low cost with no memory fences using microarchitectural support in a Pipestitch-like architecture.
- **Research on asynchronous programming for energy-minimal dataflow architectures**.
  Problem: Excessive operation reordering and synchronization is required for applications with irregular memory access patterns to run on resource-constrained CGRAs.
  Goal: Explicitly express parallelism amenable to dataflow execution and the underlying CGRA architecture.
  Wrote applications with irregular memory access patterns (graph, image processing, sparse) using existing parallel programming techniques, identified the limitations of the implementations, and proposed the dataflow programming alternatives.

Publications

Ripple: Asynchronous Programming for Energy-Minimal Extreme-Edge Devices . . . . . **ASPLOS'24**
. . . . . **submission-to-be**
Souradip Ghosh, Nathan Serafin, **Yufei Shi**, Nathan Beckmann, Brandon Lucia

Presentations

MCD: Mesh Collision Detection with Parallel Acceleration . . . . . **May 2023**
Carnegie Mellon University, Pittsburgh, PA

Teaching Experience

18–344 Computer Systems and the Hardware-Software Interface . . . . Teaching Assistant, **CMU, Fall 2023**

18–213/613 Introduction to Computer Systems . . . . . Teaching Assistant, **CMU, Summer 2023**

18–213/613 Introduction to Computer Systems . . . . . Teaching Assistant, **CMU, Fall 2022**

18–213/613 Introduction to Computer Systems . . . . . Teaching Assistant, **CMU, Summer 2022**

18–213/613 Introduction to Computer Systems . . . . . Teaching Assistant, **CMU, Spring 2022**

Selected Courses

15–410 Operating System Design and Implementation . . . . . **CMU, Fall 2023**
Designed and implemented an Unix-like x86 OS kernel that supports multiple virtual memory address spaces via paging, preemptive multitasking, and a small set of important system calls as well as device drivers.

18–447 Introduction to Computer Architecture . . . . . **CMU, Spring 2023**
Designed and implemented an RV32I processor featuring a 2-way superscalar in-order 5-stage pipeline. Optimized design for both IPC and IPC-per-Watt and achieved a ranking in the first quartile among the class-wide competition.

15–418 Parallel Computer Architecture and Programming . . . . . **CMU, Spring 2023**
Developed an application to accurately determine the minimum distances between convex meshes for robotic arm motion planning by leveraging both CUDA and OpenMP acceleration.

18–344 Computer Systems and the Hardware-Software Interface . . . . . **CMU, Fall 2022**
Implemented a memory hierarchy simulator supporting two levels of cache, each fully configurable. Used the simulator to conduct design space exploration to find the Pareto optimal design for a set of workloads.

18–330 Introduction to Computer Security . . . . . **CMU, Fall 2022**
Crafted x86 binary application attacks, cryptographic attacks and web attacks.

Skills

Programming Languages: C, C++, Python, Rust, Shell, x86 Assembly
Hardware Design Tools: SystemVerilog, Synopsys VCS, Synopsys Design Compiler, Intel Quartus, gem5
Developer Tools: GDB, Git, Vim, VS Code, Valgrind, Make, Regex, Anaconda, Various Linux Distros, Pin Tool
Technologies: MATLAB, SOLIDWORKS, NumPy, Matplotlib, OpenMP, MPI, CUDA, OpenGL, HTML, LaTeX

Leadership / Activities

Plaid Parliament of Pwning (CTF Team), Carnegie Mellon University . . . . . **Sep 2022 — Present**
General Member

cmuTV, Carnegie Mellon University . . . . . **Sep 2021 — Present**
General Member, Buggy 2022 Cameraman

Chinese Students and Scholars Association, Carnegie Mellon University . . . . . **Sep 2021 — Present**
General Member, Director of Design during 2022