

# Raghav Gupta

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## EDUCATION

### UNIVERSITY OF CALIFORNIA, BERKELEY | BS IN ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Expected May 2023 | GPA: 3.96/4.0

Dean's List | Honors to Date | EECS Outstanding TA Award | Edward Frank Kraft Award

#### COURSEWORK:

Computer Architecture and Engineering • Advanced Topics in Computer Systems • Introduction to Digital Design and Integrated Circuits • 22nm SoC for IoT • Great Ideas in Computer Architecture • Operating Systems and System Programming • Introduction to Robotics • Quantum Mechanics • Efficient Algorithms and Intractable Problems • Signals and Systems • Designing Information Devices and Systems I, II • Discrete Mathematics and Probability Theory • Teaching Techniques for Computer Science • Social Implications of Computer Technology

## WORK/RESEARCH EXPERIENCE

### ADEPT/Slice Lab at UC Berkeley | Undergraduate Student Researcher

Jan 2021 – Present | Berkeley, CA | Website

Working on computer architecture topics with graduate students in Prof. Krste Asanovic and Prof. Borivoje Nikolic's groups.

#### FIREMARSHAL

- A software workload management tool for reliable and reproducible RISC-V based full-stack hardware development and research
- Automates workload generation, development, and evaluation on FireSim, QEMU, and Spike.
- Implemented running multi-node workloads concurrently in QEMU
- Implemented a network interface using Virtual Distributed Ethernet for multi-node workloads emulated in QEMU

#### FIREPERF

- An FPGA-accelerated full-system hardware/software performance profiling utility built on top of FireSim
- Provides high-fidelity out-of-band introspection with call stack reconstruction and automatic performance counter insertion
- Working on extending FirePerf to support userspace profiling

#### RPC Accelerator for a Hyperscale SoC

- Working on initial design space exploration to accelerate remote procedure calls as part of a datacenter SoC for a leading cloud provider

### NVIDIA | Power Architect Intern

May 2022 – Aug 2022 | Santa Clara, CA

#### CPU Power Modeling for Gaming Workloads

- Developed a strategy for application-specific CPU power modeling on production silicon
- Targeted characteristics of gaming workloads and isolated static and dynamic power costs
- Automated data collection, processing, visualization, modeling and summary statistics

#### RESEARCH INTERESTS: COMPUTER ARCHITECTURE

Hardware/Software Co-design • Profile-Guided Architecture/Microarchitecture • Domain-Specific Architectures and Accelerators • High-Performance/Hyperscale Computing • Cache and Memory Structures

## TEACHING EXPERIENCE

### EECS 151/251A - Introduction to Digital Design and Integrated Circuits | Teaching Assistant

Aug 2022 – Present | Website

- Teaching 1 weekly office hour and 1 weekly lab section using Xilinx PYNQ FPGAs for Berkeley's upper division VLSI course catered towards undergraduates and graduates
- Helping students learn hardware design methods and principles using Verilog, VCS, and waveforms as they implement FSMs, audio synthesis circuits, UART modules and FIFOs on FPGAs
- Supporting students in applying architectural and microarchitectural concepts to design a 3+ stage pipelined RISC-V datapath with L1 data cache, UART/MMIO and optimize it for timing
- Designed a memory controller lab with specification and testbenches as an introduction to working with synchronous memories

## **EECS16A - DESIGNING INFORMATION DEVICES AND SYSTEMS I | LAB TEACHING ASSISTANT AND HEAD LAB CONTENT/DEVELOPMENT**

Jun 2020 – May 2022 | Website

- Taught a weekly lab section of 50+ engineering undergraduates for Berkeley's introductory EECS course for 5 semesters
- Assisted students in building a single pixel camera, resistive and capacitive touchscreens, and an acoustic positioning system
- Trained lab staff and managed lab content for 1000+ students, revamped existing labs, developed new labs and managed the shift to online labs while achieving the requisite learning goals.

## **CS61C - GREAT IDEAS IN COMPUTER ARCHITECTURE | TEACHING ASSISTANT**

Jun 2021 – Aug 2021 | Website

- Taught 2 discussion sections and 1 office hour weekly for Berkeley's introductory computer architecture and systems course
- Developed content and infrastructure for projects on C programming and Logisim datapath design
- Helped design labs on Logisim datapath design, pipelining, and caches

## **EE290C - 22NM SOC FOR IOT | COURSE CONTENT DEVELOPER**

Aug 2022 – Present

- Working with Prof. Borivoje Nikolic on an Intel supported project to develop teaching resources for RISC-V SoC tapeout in Intel 16 technology that will eventually be shared as part of Intel's University Shuttle Program
- Developing 2 labs on using the Chipyard framework for SoC development, with a focus on the use of RTL generators (especially custom accelerators), verification in simulation, and the VLSI flow (especially dealing with DRC and LVS)
- Will potentially develop an open-source version with Skywater 130 to function as an asynchronous Chipyard tutorial

## **PROJECTS**

### **BEARLY ML: SOC FOR MACHINE LEARNING | EE290C**

Jan 2022 – May 2022 | Report

- Designed, verified, and taped-out a RISC-V SoC with ML/DSP accelerators in Intel 16 technology using the Chipyard environment
- Member of team developing a sparse-dense matrix multiplication accelerator using the Rocket Custom Coprocessor (RoCC) interface
- Tightly-coupled with a 5 stage, in-order Rocket core with 16KB L1D\$, 4KB L1I\$
- Wrote Chisel RTL, performed verification in functional simulation with unit-testing and integration testing with bare-metal C tests, and resolved floor-planning Design Rule Violations
- Maximum frequency: 500 MHz, Achievable Throughput: 2.6 GOPS

### **RISC-V CORE ON FPGA | EECS151**

Oct 2021 – Dec 2021 | Report

- Designed a 3-stage RISC-V core with UART/MMIO, polyphonic audio synthesizer and BHT-based branch predictor in Verilog
- Won class-wide Apple design contest for performance at a frequency of 70 MHz with a CPI of 1.16 on the matrix multiplication kernel

### **BRANCH PREDICTOR | LAB PROJECT FOR CS152**

Mar 2021 – Apr 2021 | Report

- Designed and analyzed an 8192-entry tournament predictor using a Gshare predictor, a bimodal predictor, and an arbiter
- Implemented using the C++ branch predictor framework in BOOM out-of-order core
- Performed >25% better than baseline bimodal predictor

### **PINTOS | PROJECTS FOR CS162**

Jan 2022 – May 2022

- Implemented the following features in an x86-based educational OS running as a VM in QEMU/Bochs with extensive debugging in GDB
- Supported user program execution with syscall argument passing, process control syscalls (halt, exec, wait, exit), basic file operation syscalls, and a floating point unit
- Implemented multithreading with an efficient sleep timer, strict priority scheduler with priority donation, and a simplified version of the user-level pthread library and user-level synchronization
- Implemented a Unix FFS-like filesystem with buffer cache, extensible files and support for subdirectories and relative paths

## **CS61CPU | PROJECT FOR CS61C**

Nov 2020

- Designed a 2-stage pipelined RISC-V Datapath in Logisim
- Optimized control logic by simplifying boolean expressions for each signal
- Won class-wide Apple design contest for minimal transistor use

## **ORGANIZATIONS**

### **ETA KAPPA NU | EECS HONOR SOCIETY**

Jan 2021 - Present

#### **TUTORING OFFICER**

Responsible for managing activities of the tutoring committee, such as organizing and running exam review sessions, planning daily office hours, and supporting learning resources, in Spring 2022.

#### **DECAL ASSISTANT OFFICER**

Responsible for facilitating "Going Down the EECS Stack", a course that explores the different fields within the EECS major, in Fall 2021.

### **CURIOSITY | TUTOR AND CO-FOUNDER**

May 2020 - Aug 2020

Raised ₹15,000 in funds for COVID-19 and flood relief by tutoring high school students and SAT aspirants during Summer 2020.

## **SKILLS**

Python • C/C++ • Git • Verilog • Chisel • Java • Linux/Bash • GDB • RISC-V • CUDA • Parallel Programming • Vivado • ROS • Machine Learning • Deep Learning • Computer Vision