Kunal Pai

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Education

M.S., Computer Science, University of California, Davis (GPA: **4.0/4.0**) Expected: June 2026

B.S., Computer Science & Engineering, University of California, Davis (GPA: **3.8/4.0**) June 2023, *with Honors*

Relevant Skills

Languages: Python, C++, C, JavaScript, Java

ML/AI: TensorFlow, PyTorch, scikit-learn, LLMs, Prompt Engineering, Ollama, Hugging Face, Multi-agent Systems

Web/Data: React, Next.js, Django, Flask, MongoDB, pandas, NumPy, Matplotlib

Tools: Git, Docker, Unix/Linux, gem5, Jupyter, LLVM, Clang

Work Experience

Graduate Student Researcher, *DavSec Lab @ UC Davis* Apr 2025 – Present

Research Project *Python, LLMs, C++, Rust, Compiler Analysis*

- Built automated C-to-Rust transpilation pipeline using LLMs with 5 prompt variations, benchmarking state-of-the-art models across 746 programs and achieving 70.2% functional accuracy
- Identified Halstead vocabulary as strongest predictor of translation difficulty; validated ensemble semantic augmentations (e.g., filename context) improving accuracy by 5%
- Developed cross-layer analysis framework combining compiler metrics with hardware performance counters to expose semantic and optimization gaps in LLM-translated, syntax-directed and manually-written Rust translations

Graduate Student Researcher, *DECAL Lab @ UC Davis* Sept 2022 – Dec 2024

Research Project *Python, LLMs, Machine Learning, Code Analysis*

- Developed a 4,500-sample dataset for pairwise code-documentation alignment from 200 open-source Python projects, enabling future research in software maintenance
- Engineered a pipeline for measuring calibration and correctness of large language models for code repair, using Defects4J
- Collaborated in validating efficacy of semantic augmentation of language model prompts for code summarization using precision and recall metrics like ROUGE and METEOR

Teaching Assistant, *University of California, Davis* September 2023 – December 2023

- Assisted 180 students in a senior-level Probability & Statistical Modeling class.

Publications (Selected)

SPECTRA: Understanding Hardware–Compiler Interplay in C-to-Rust Transpilation, Pai, K., et. al., *Object-Oriented Programming, Systems, Languages and Applications (OOPSLA) 2026 (under review)*

Calibration and Correctness of Language Models for Code, Spiess, C., Gros, D., Pai, K., et. al., *International Conference on Software Engineering (ICSE) 2025*

Automatic Semantic Augmentation of Language Model Prompts (for Code Summarization), Ahmed, T., Pai, K., Devanbu, P. & Barr, E. T., *International Conference on Software Engineering (ICSE) 2024*

CoDocBench: A Dataset for Code-Documentation Alignment in Software Maintenance, Pai, K., Devanbu, P. & Ahmed, T., *Mining Software Repositories (MSR) 2025: Data and Tool Showcase Track*

HASHIRU: Hierarchical Agent System for Hybrid Intelligent Resource Utilization, Pai, K., Shah, P. & Patel, H., *arXiv preprint*

Implications of Full-System Modeling for Superconducting Architectures, Pai, K., Samani, M., Nand, A. & Lowe-Power, J., *Workshops of the International Conference for High Performance Computing, Networking, Storage and Analysis (SC Workshops '25)*

Validating Hardware and SimPoints with gem5: A RISC-V Board Case Study, Pai, K., Qiu, Z. & Lowe-Power, J., *gem5 Workshop at International Symposium on Computer Architecture (ISCA) 2023*

Project Experience

HASHIRU: Hierarchical, Resource-Aware Multi-Agent Framework March 2025 – Present
Research Project *Python, LLMs, Multi-Agent Systems*

- Designed and deployed a multi-agent architecture enabling dynamic, LLM-driven collaboration across diverse tasks
- Implemented task decomposition with intelligent agent delegation based on resource cost models and task specialization
- Engineered autonomous generation of tools and APIs for task execution
- Developed a robust evaluation framework for agent performance across complex, multi-step tasks

SuperNOVA: Superconducting Graph Accelerator in gem5 Jan 2024 – Present
Research Project, DArchR Lab @ UC Davis *C++, Python, gem5, Hardware Simulation*

- Modeled a superconducting graph accelerator and interconnect in gem5, achieving up to 24× speedup and 73× energy efficiency
- Integrated cryogenic/superconducting cores, caches, and interconnects to evaluate bottlenecks for realistic workloads
- Mentored undergraduates on modeling, benchmarking, and research writing; one co-authored a ModSim 2024 poster

MARS: Multi-Agent Review System for Academic Papers Jan 2025 – Mar 2025
Research Project *Python, LLMs, Multi-Agent Systems*

- Built a multi-agent LLM pipeline that simulates peer review with specialized agents for novelty, grammar, and critical questioning
- Achieved high accuracy on ICLR 2023 reviews, outperforming *o3-mini* and *NotebookLM* baselines
- Deployed privacy-preserving, local LLM evaluations using Ollama on consumer-grade hardware

gem5 Vision Jan 2023 – Jun 2023
Resource Discovery Framework *Next.js, Python, MongoDB, JSON Schema*

- Accelerated resource discovery 20× for 1,200+ gem5 artifacts by optimizing search and categorization logic
- Implemented categorization and semantic versioning across 20+ resource types to streamline retrieval
- Integrated local and remote JSON schemas with MongoDB, improving accessibility for 500+ users

Awards and Honors

Provost Award, UC Davis 2019–2023

Dean's List, UC Davis College of Engineering Fall 2019, Fall 2020, Winter 2022, Spring 2022

Service

Program Committee Member, 23rd International Conference on Mining Software Repositories: Data and Tool Showcase Track