

Kunal Pai

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EDUCATION

University of California, Davis

M.S. in Computer Science

Davis, CA

Sep 2023 – Present

University of California, Davis

B.S. in Computer Science and Engineering

Davis, CA

Sep 2019 – Jun 2023

PUBLICATIONS

Ahmed, T., Pai, K., Devanbu, P., & Barr, E. (2024).

Automatic Semantic Augmentation of Language Model Prompts (for Code Summarization)

ICSE 2024.

Shah, P., Pai, K., Patel, H., & Ali, A. (2023).

gem5 Vision

ISCA 2023: gem5 Workshop.

Pai, K., Qiu, Z., & Lowe-Power, J. (2023).

Validating Hardware and SimPoints with gem5: A RISC-V Board Case Study

ISCA 2023: gem5 Workshop.

RESEARCH EXPERIENCE

Graduate Student Researcher

DArchR Lab @ University of California, Davis

Sep 2023 – Present

Davis, CA

- Working with Prof. Jason Lowe-Power on computer architecture research.
- Leading a project to research cryogenic computing and superconducting electronics, including developing models for them in gem5.
- Collaborating with a team of 3 researchers to validate hardware and sampling techniques with gem5.
- Mentoring 5 undergraduate students in the Davis Computer Architecture Lab.

TECHNICAL SKILLS

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

Tools & Technologies: Git, Docker, MongoDB, Django, React, Next.js, TensorFlow, PyTorch, gem5

PROJECTS

Automated Frameworks of Semantic Augmentation to Improve MWP Solving

Machine Learning Project

Apr 2024 - June 2024

Python, NLP, Prompt Engineering

- Developed a framework leveraging digit-level semantics to improve language model performance in solving mathematical word problems (MWPs) by incorporating context-aware prompt generation techniques.
- Utilized BLEU scores and Levenshtein distance in a demonstration selection algorithm and a prompt selection model to identify the most similar equations for one-shot examples, optimizing prompt accuracy.
- Fine-tuned TinyLlama and prompted PaLM2 with prompt-enhanced GSM8K questions, resulting in improved accuracy on the SVAMP dataset and uncovering insights into the varying context requirements of different mathematical operations.
- Completed as part of ECS 271 : Machine Learning & Discovery at UC Davis.

Effects of Toxicity on Disengagement in Open Source Projects

Software Engineering Project

Jan 2024 - Mar 2024

Python, GitHub mining, scikit-learn

- Analyzed factors contributing to developer disengagement in open-source projects, focusing on the impact of toxic communications on contributor retention and project sustainability.
- Utilized sentiment analysis to quantify toxicity within open-source communities and examined its correlation with developer engagement across various programming communities and corporate/non-profit projects.
- Proposed community-driven policies and practical implications for project maintainers, aiming to mitigate negative interactions and enhance collaborative practices in open-source environments.

- Completed as part of ECS 260 : Software Engineering at UC Davis.

Behavior of Spectre in Different Branch Predictors in gem5

Oct 2023 - Dec 2023

Computer Architecture Project

C++, gem5

- Investigated susceptibility of x86-based in-order and out-of-order processors to Spectre V1 attacks using gem5 v23.0, revealing correlations between Spectre effectiveness and branch predictor characteristics.
- Suggested features for a Spectre-resistant branch predictor, emphasizing extended training periods and mitigation of biased branches to improve processor security against speculative execution attacks.
- Completed as part of ECS 235A : Computer & Info Security at UC Davis.

gem5 Vision

Jan 2023 – June 2023

Framework

Next.js, Python, MongoDB, JSON Schema

- Implemented advanced search functionality to enhance resource discovery within the gem5 ecosystem.
- Introduced semantic versioning and built upon a comprehensive resource categorization system for easy access to newer resource versions under specific categories.
- Expanded gem5's database support by integrating local and remote JSON files and MongoDB, improving efficiency and user accessibility.

UNify - Course Assistant

Jan 2022 – Jan 2022

Hackathon Project

Python, JavaScript, Discord API

- Utilized the UC Davis Schedule Builder API to extract class timings and professors.
- Formulated a class-based hierarchized dictionary to maintain schedules of over 100 server members in five Discord servers.
- Extracted data from APIs of Rate My Professor and Google Calendar to add additional features to the bot.

WORK EXPERIENCE

Teaching Assistant

Sep 2023 – Dec 2023

University of California, Davis

Davis, CA

- Assisted 180 students in understanding course material and assignments for ECS 132: Probability & Statistical Modeling for Computer Science.
- Conducted weekly office hours and provided feedback on student assignments.

Software Developer Intern & Tech Lead

Jan 2022 – June 2022

humanID

Davis, CA

- Coordinated project task completion with global teams, delivering 10 completed projects.
- Co-created documentation on the implementation of a Discord bot that combats spam and fake users.
- Algorithmically hierarchized 100 users and their associated permissions in a Django-based web application.

Technical Product Marketing Intern

July 2021 – Sep 2021

SiTime Corporation

Santa Clara, CA

- Co-authored a product requirements document for a newly-released timing chip in the semiconductor industry.
- Conducted a market survey on optical transceivers and studied potential applications of MEMS timing chips.
- Presented strategy to hierarchize distributors and maximize stakeholders' earned profits by \$250,000.