Prathamesh Khole

Machine Learning Researcher | Ph.D. Student

Santa Cruz, CA | 831-295-9354 | pkhole@ucsc.edu | Prathamesh Khole | prathameshkhole.github.io

Education

University of California Santa Cruz — **June 2029**
Ph.D. in Computer Science and Engineering — *Santa Cruz, California*

University of California Santa Cruz — **August 2024**
Master of Science in Computer Science and Engineering — *Santa Cruz, California*

Pune Institute of Computer Technology (University of Pune) — **May 2021**
Bachelor of Engineering in Computer Science — *Pune, India*

Relevant Coursework

- **Advanced Machine Learning**
- Distributed Systems
- **Artificial Intelligence**
- **Machine Learning**
- **Deep Learning**
- Data Structures
- Analysis of Algorithms
- **Data Analytics**
- Operating Systems
- Robotics

Experience

University of California Santa Cruz — **January 2023 – Present**
Graduate Research Assistant — Machine Learning | Medical Imaging | Computer Graphics — *Santa Cruz, California*

- Working under guidance of Professor **Razvan Marinescu** as a part of his lab at **UCSC**.
- Worked with **python** frameworks including **PyTorch** and **Numba** to reverse diffusion Magnetic Resonance Imaging (MRI) simulation.
- Developed and implemented **physics based biomedical image simulators** replicating state of the art models in performance.
- Utilized medical image visualization tools like **Free Surfer**, **ITK Snap**, and **Paraview** to better understand and visualize results as well as fix implementation issues.

University of California Santa Cruz — **January 2025 – Present**
Teaching Assistant — Unix | Systems | C programming — *Santa Cruz, California*

- **Course Instruction:** Conducted discussions sessions for **CSE-13S Systems and C programming** ensuring comprehensive coverage of key concepts. Including data structures, syntax and shell scripting

University of California Santa Cruz — **January 2023 – June 2024**
Teaching Assistant — Logic Design | Assembly language — *Santa Cruz, California*

- **Course Instruction:** Conducted lab sessions for **CSE-12 Computer Systems and Assembly Language** ensuring comprehensive coverage of key concepts. Demonstrated the design and creation of intricate circuits using **Digital Logic** and **Boolean Algebra** principles.
- **RISC-V Assembly Instruction:** Delivered in-depth instruction on **RISC-V** Assembly Language, equipping students with the knowledge and skills to navigate and apply programming fundamentals to assembly language effectively.

ZS Associates — **August 2021 – June 2022**
Data Engineer — Data Analysis | Data Pre-processing — *Pune, India*

- **Efficient Data Preprocessing:** Leveraged **Python**, **PySpark**, and **HiveQL** to revolutionize the preprocessing workflow, **achieving over 90% time reduction**, ensuring data is correctly prepared for machine learning applications.
- **Enhanced Product Penetration:** Utilized advanced data analytics and refined **SQL** queries to derive insights into sales trends, enabling strategic expansion into untapped sales territories.
- **Enhanced Customer Engagement:** Through meticulous data analysis and refining **SQL** queries in workflow, crafted more targeted recommendation algorithms, resulting in an approximate **10% improvement in suggestion reach**.
- **Data Integration and Extraction:** Utilized **SQL** and **HiveQL** for efficient data extraction in production, ensuring seamless integration into the machine learning model.
- **Sales & Customer Engagement Dashboard:** Designed and integrated a dynamic dashboard to visualize sales and customer engagement metrics, providing actionable insights for client decision-making and strategy optimization.

Schneider Electric Systems Middle East — **June 2019 – August 2019**
Project Intern — *Al-Ahmadi, Kuwait*

- **Process Graphics Validation:** Conducted comprehensive testing initiatives to ensure Process Graphics functionality was in perfect alignment with project specifications and requirements.
- **Database Integrity Assurance:** Performed validations of the database, ensuring the Database configuration adhered strictly to input specifications, guaranteeing data accuracy and reliability.

Projects

Differentiable Diffusion Magnetic Resonance Imaging **March 2023 – Present**
University of California Santa Cruz

- Creating a framework to make the process of acquiring **diffusion MRI signals** from a given shape or mesh of brain **differentiable**.
- The framework would also be able to reverse the **diffusion MRI** process, such that we can obtain the mesh or **3D brain structure** given a **diffusion MRI signal**.
- Implemented a **physics based simulator** to simulate the core process of diffusion MRI signal acquisition in **Python** for any given mesh, replicating state of the art models.

Octo-Wumpus Protocol for Fair Scheduling **March 2024**
University of California Santa Cruz

- Designed an enhanced lottery scheduling algorithm to ensure fairness using a **queue-based scheduler** and **alpha-inflation** for dynamically boosting starved processes.
- Implemented in **Python** with multithreading to test on parallel tasks like merge sort, DFS, and file operations, achieving fairness without sacrificing efficiency.
- Improved fairness and reduced starvation in scheduling while maintaining the probabilistic nature of lottery algorithms.

Image Classification using Transfer Learning **December 2023**
University of California Santa Cruz

- Fine-tuned **Swin Transformers** (`swin_base_patch4_window7_224`, `swin_large_patch4_window7_224`) from the **timm library** to classify 1000 images across 100 classes, despite the challenge of having only 10 examples per class, achieving up to **73.7%** accuracy.
- Addressed overfitting caused by the limited dataset using **data augmentation** techniques such as CutMix, MixUp, Random Erase, and Random Crop; optimized using **SGD** and **Cosine Annealing**.
- Implemented in **Python** with **PyTorch**, leveraging advanced learning rate scheduling and balanced dataset splits to overcome data constraints and ensure robust performance.

Red-Black Tree Based Oblivious Random Access Machine **March 2023**
University of California Santa Cruz

- Developed an **Oblivious Random Access Machine (ORAM)**, based Path ORAM which conceals the users access pattern.
- The ORAM works by using a Red-Black tree as the logical tree in the background for faster information access of the stored data.
- The concealing of access patterns is done by performing a series of dummy reads for every access to data (read or write), so that the overall access pattern appears uniform or same for all operations to the observer.
- The implementation is slightly faster than previous implementations for deletions as Red-Black trees are faster than AVL trees for deletions, implemented in **C++** for speed.

Philanthropy on Blockchain (Ethereum Based DApp) **May 2021**
Pune Institute of Computer Technology (University of Pune)

- Engineered a **Ethereum blockchain** based **decentralized application** for donation management, aimed at transparency and vote based approval for donations.
- Ensuring a secure, trackable donation platform (pictures, receipts) without third-party involvement, with an option to rollback donations if trust voting falls below a threshold.
- Implemented using **Roptsten Ethereum Test network**, **Solidity** for writing and implementing smart contracts, using **nextJS, ReactJS** and **GraphJS** for frontend.

Document Reader & Extractor (Image Processing and OCR) **January 2020 – April 2020**
Pune Institute of Computer Technology (University of Pune)

- Developed a tool in **Python** using **image processing** libraries like **CV2** and **PIL**.
- Integrated with **PyTesseract for OCR** process to **extract text from documents**, and used **PIL** and **Pandas** to save the extracted text as csv or text document.
- Developed with a goal to allow for faster processing of handwritten or printed documents.

Technical Skills

Languages: Python, C/C++, MATLAB, SQL, RISC-V, HiveQL
Tools/Frameworks: PyTorch, Transformers, LLMs, Google Cloud, Kubernetes, AWS S3, GitHub, Linux, Gradescope.