Harikrishna Vardhineedi

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Education

University of California, Irvine Sep 2022 - Dec 2025
BS in Computer Science, Algorithm Theory Specialization *Irvine, CA*

Research Interests

Structural analysis in quantum information theory; entanglement theory; resource selection in quantum communication; fault-tolerant quantum computation.

Research Experience

Undergraduate Researcher, Quantum Computing Jun 2025 – Present
Advisors: Dr. Shion Fukuzawa, Ph.D.; Professor Sandy Irani *University of California, Irvine*

NSF GRFP Proposal: Approximate Classification of Entangled Mixed-States *Nov 2025 - Present*

- Proposed a polynomial-time approximation scheme for classifying mixed-state entanglement using convex-geometry relaxations of purified entanglement polytopes.
- Developed support-function–based techniques enabling polynomial-time pre-processing and logarithmic-time approximate membership queries.
- Identified implications for real-time entanglement management in quantum networks (purification, swapping, routing under noise).

Predicting Optimal Entanglement Type for Quantum Protocols using Nonlocal Games *Jun 2025 - Present*

- Developed a structural framework for predicting which multipartite entanglement class (GHZ vs. W) optimally supports a nonlocal game, replacing expensive numerical search with interpretable coordination signatures.
- Analyzed 953 quantum nonlocal games, revealing sharp separation: GHZ states dominate in pairwise coordination regimes, while W states excel in triple-interaction regimes.
- Implemented optimization + simulation pipeline (NumPy, Python, Qiskit) achieving sub-10-second strategy optimization across hundreds of CHSH-style games using COBYLA.
- Preparing results for publication with Prof. Irani; extending framework toward general structural classification of entanglement resources in scalable quantum networks.

Undergraduate Researcher, Computer Science Education Jan 2025 – Present
Advisor: Associate Professor of Teaching Michael Shindler *University of California, Irvine*

- Co-designed a randomized controlled trial (50+ students) measuring how active journaling affects retention of randomized algorithm concepts.
- Built a full-stack research platform (Next.js, MongoDB, Amazon Transcribe) delivering randomized assessments and automatically collecting student reasoning traces.
- Initial analysis indicates significant benefits of structured journaling for problem-solving performance; drafting paper for SIGCSE submission.

Teaching Experience

Discrete Mathematics Lead Undergraduate Grader Sep 2023 – Apr 2025
University of California, Irvine

- Managed a 20-member teaching team using Agile Sprint methodology across 5 quarters; coordinated grading for 4 exams and 20+ assignments per term.
- Built automation tools (Pandas, LaTeX, NumPy, UCI Photo Roster API) for seat assignment, ID verification, and exam distribution, cutting logistics time in half.
- Provided mentorship and technical guidance to course staff while supporting 400+ students each term.

Undergraduate Learning Assistant
University of California, Irvine

- Sep 2025 - Dec 2025 – Data Structures and Algorithms

- Apr 2025 - Jun 2025 – Formal Languages, Automata, and Complexity Theory
- Apr 2025 - Jun 2025 – Data Structures and Algorithms
- Jan 2025 - Mar 2025 – Principles in System Design (Introduction to Systems)
- Apr 2023 - Jun 2023 – Discrete Mathematics

Professional Experience

Software Engineer Intern Jun 2023 – Aug 2023
Pickaxe

- Built a generative-AI Twitter automation platform integrating GPT-4, FastAPI, LangChain, and the Twitter API—reducing manual posting time significantly while sustaining engagement.
- Developed end-to-end unit testing and CI workflows achieving 99% coverage for long-term reliability.

Web Developer Jun 2022 - Feb 2023
Niche Cloudware

- Modernized company website using React + SCSS; improved UI/UX and increased user session duration.
- Implemented Firebase analytics (1,000,000+ impressions) and Cloudflare-based performance optimizations, boosting SEO and organic traffic.

Projects

CHSH Game Web Simulator

- Implemented a full-stack simulator with React.js and FastAPI to calculate the win-rate of arbitrary bipartite CHSH strategies in an average of 4.52ms, enabling high-throughput CHSH strategy experimentation for 100+ quantum computing students.

QuPyt: Quantum Computing Visualization Tool

- Deployed a lightweight python library to visualize custom quantum algorithms on a classical computer, supporting up to 20 qubits and enabling rapid mockups of research concepts while staying lighter and simpler than other leading software.

Relevant Coursework

CS 161: Design and Analysis of Algorithms (Prof. Ioannis Panageas)	Apr 2024 - Jun 2024
CS 162: Formal Languages and Automata Theory (Prof. Michael Shindler)	Apr 2024 - Jun 2024
CS 164: Computational Geometry (Prof. David Eppstein)	Sep 2025 - Dec 2025
CS 165: Project in Alg. & Data Str. (Prof. Michael Goodrich)	Apr 2025 - Jun 2025
CS 166: Quantum Computing and Information (Prof. Shion Fukuzawa)	Jan 2025 - Mar 2025
CS 280: Algorithmic Game Theory (Prof. Ioannis Panageas)	Sep 2025 - Dec 2025
ICS 6B: Boolean Logic and Discrete Structures (Prof. Irene Gassko)	Jan 2023 - Mar 2023
ICS 6D: Discrete Mathematics for Computer Science (Prof. Irene Gassko)	Apri 2023 - Jun 2023
ICS 46: Data Structure Implementation and Analysis (Prof. Michael Shindler)	Jan 2024 - Mar 2024

Technical Skills

Quantum Computing: Qiskit, QuTiP, Cirq, Amazon Braket, PennyLane, Stim (stabilizer simulation), OpenFermion, TensorFlow Quantum
Scientific Computing: NumPy, SciPy, SymPy, CVXPY (semidefinite & convex optimization), JAX, Numba, quimb (tensor networks), Pandas, Matplotlib
Programming Languages: Python, C++, C, Java, Go, Julia, MATLAB, R, Lean
Software Engineering: Docker, Git/GitHub, GitHub Actions (CI), FastAPI, React, Linux, HDF5, Conda/virtual environments