PRATEEK P. KULKARNI

BTech (Electronics and Communications Engineering)

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EDUCATION

PES University 2022–2026 (Expected)
BTech in Electronics and Communications Engineering (VLSI)
Thesis: Photonic FPGA for Variational Quantum Algorithms

Kendriya Vidyalaya, Hebbal 2021–2022
Grade 12

RESEARCH INTERESTS

Quantum Computing, Electronic Design Automation, Systems Architecture, Industry Analysis

SELECTED COURSEWORK

Analog Circuit Design, Computer - Aided Digital Design, Digital VLSI, Computer Organization and Design, High Performance Computing, Chip – Level Photonics, Quantum Computing and Quantum Entanglement, Quantum Transport and Logic Gates, Non-Linear Optics and Quantum Technology

RESEARCH EXPERIENCE

Research Assistant Aug. 2024–Dec. 2025 (Expected)
Photonics and Quantum Tech Lab, PES University
Advisor: Prof. Kaustav Bhowmick
Quantum Machine Learning (*Undergraduate Thesis*)

Visiting Research Student Feb. 2024–Present
Future Computing Systems Lab, Indian Institute of Science
Advisor: Prof. Sumit K. Mandal
Distributed Quantum Computing and Quantum Complexity Theory

PUBLICATIONS

Journals:

1. Ramaseshan R, Abhishek Kumar V S, Adith Rajeev, Prathik V, Aditya Aravind, Prateek P. Kulkarni and Kaustav Bhowmick. **A Generalized Hamiltonian Approach for Designing Simple Single Photon-based Optical Quantum Devices**. *The Journal of Supercomputing, Springer*, 2025.

Conferences:

1. Prateek Kulkarni. **RAPID: Row-Access Pattern-aware In-DRAM Prefetching**. *International Conference on Emerging Technologies for Intelligent Systems*, 2025.
2. Prateek Kulkarni. **A Low-Latency Memory Architecture using 3D XPoint and Memristor Technologies**. *5th International Conference on Communication, Computing and Industry 6.0*, 2024.

Peer-Reviewed Posters:

1. Prateek P. Kulkarni. **DIRECT: Enabling Scalable Processing-In-Memory via DPU-to-DPU Communication**. *6th India ESD Workshop*, 2025.

Preprints:

1. Ramaseshan R, Prateek P. Kulkarni, Sharanya Madhusudhan and Kaustav Bhowmick. **A Theoretical Treatment of Optical Metasurfaces as an Efficient Basis for Quantum Correlations**. *arXiv:2507.09517 [quant-ph]*, 2025

TECHNICAL SKILLS

Programming Languages: Python, R, Julia, Verilog, Haskell, Q#, LaTeX, SQL
Software Tools: Matlab, Lumerical, Cadence, Vivado Suite, gem5, Qiskit, Cirq, Pennylane

SELECTED PROJECTS

SQLFormer: Transformer Inference in Pure SQL (Github Repository)

- Designed and implemented a full Transformer forward pass using only standard SQL queries over relational databases, expressed matrix multiplication, multi-head attention, softmax, and layer normalization declaratively using JOINs, aggregations, and window functions.
- Authored a comprehensive paper (available on GitHub) analyzing correctness, complexity, and performance across PostgreSQL, DuckDB, and PyTorch baselines.

PipSim: RISC-V Pipeline Simulation Framework (Github Repository)

- Developed Python-based RISC-V pipeline simulator with real-time visualization for instruction flow and hazard detection. The framework enables comprehensive performance analysis for 5-stage pipeline architectures.
- Implemented data forwarding and branch prediction mechanisms achieving educational tool adoption across multiple computer architecture courses.

RegDyno.Ai: Time-Series Prediction Framework (Patent Published, Journal No. 1/2025)

- Developed custom distribution modeling framework for satellite communication data, achieving 15%-25% improvement in prediction accuracy over state-of-the-art forecasting methods including ARIMA, LSTM, and Prophet models.

- Successfully deployed production-ready ML pipeline with automated noise reduction capabilities, resulting in patent publication for novel prediction methodology.

surface2cirqit: Quantum Circuit Conversion Package (Github Repository)

- Developed automated Surface Code to Quantum Circuit conversion pipeline with syndrome extraction protocols, achieving 20%-40% gate count reduction through circuit optimization.
- Created scalable Python package enabling seamless integration with existing quantum computing frameworks for error correction implementation.

AWARDS AND RECOGNITION

Q-Pragathi Funding (INR 1,20,000) Sept 2024
IISc Quantum Technology Initiative - Surface-based Quantum Information Processing

Workshop Selection Jan 2024
Present and Future Computing Systems, IISc (80 participants selected)

Funded Internship Jan 2024
ISFCR Long-Term Internship, PES University (10 recipients, declined)

National Runner-up Feb 2019
Explain The Concept, Pravega 2019, Indian Institute of Science

TEACHING EXPERIENCE

Teaching Assistant: Quantum Transport and Logic Gates Spring 2025
Teaching Assistant: Quantum Entanglement and Quantum Computation Fall 2025

PROFESSIONAL SERVICE

Reviewer: IEEE CONECCT 2025, IEEE DMC 2025, IEEE TQE

REFERENCES

Prof. Sumit K. Mandal
Assistant Professor, CSA, IISc
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Prof. Kaustav Bhowmick
Associate Professor, ECE, PES University
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