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

VLSI & EDA: Analog Circuit Design, Network Analysis and Synthesis, Computer–Aided Digital Design, Digital VLSI, Computer Organization and Design, High Performance Computing

Quantum Track Electives: Quantum Computing and Quantum Entanglement, Chip–Level Photonics, Quantum Transport and Logic Gates, Non-Linear Optics and Quantum Technology

RESEARCH EXPERIENCE

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

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

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, Verilog, Haskell, Q#, LaTeX, SQL
Software Tools: Matlab, Ansys, 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 under KITS, Govt. of KTK (INR 1,20,000) Sept 2024
IISc Quantum Technology Initiative (Metasurface–based Quantum Computing)

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 (Undergraduate Fest), IISc

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, Wiley Systems Engineering

REFERENCES

Prof. Sumit K. Mandal
Assistant Professor, CSA, IISc
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Prof. Kaustav Bhowmick
Associate Professor, ECE, PES University
Email: kaustavbhowmick@pes.edu