(+91) 9113237754
pkulkarni2425@gmail.com
http://prateekpkulkarni.github.io

Prateek P. Kulkarni B.Tech.

Education

Department of ECE, PES University Bengaluru, India
B.Tech. in Electronics and Communication Engineering (VLSI) 2022 - 2026 *(expected)*
- Advisor: Prof. Kaustav Bhowmick
- Research area: Architectures for Quantum Machine Learning

Kendriya Vidyalaya Hebbal Bengaluru, India
Grade X and Grade XII 2020, 2022

Research Interests

Quantum computer architecture and coupling map design; quantum error correction and fault-tolerant computation; randomized and probabilistic algorithms for quantum systems; hardware–software co-design for scalable quantum processors; resource estimation and quantification of quantum *advantage*.

Internships

Predoctoral Fellow (SPARKS) | Dept. of CSA, IISc 2025.11 – Present
- Awarded one of the four predoctoral fellowships, to work on the intersection of theoretical computer science and quantum computer architecture, advised by Prof. Sumit K Mandal. The work will focus on problems in quantum compilation, scheduling and scalable error correction architectures.

Dept. of CSA, IISc | Advisor: Prof. Sumit K Mandal 2024.02 – 2025.10
- Developed analytical models to estimate quantum processor fidelity and execution time based on coupling maps and platform-specific hardware constraints, validated on real quantum hardware with >98% accuracy.
- Proposed an efficient algorithm to generate coupling maps that guarantee high fidelity, showing increment of upto 35% in circuit fidelity.
- This work won the **3rd Prize** in the ACM Student Research Competition at 58th MICRO in the UG category.

Publications

1. **Prateek P. Kulkarni** and Sumit K. Mandal. Near-Ramanujan Graphs are All You Need to Achieve Maximum Quantum Fidelity. *58th IEEE/ACM Annual International Symposium on Microarchitecture (MICRO), ACM Student Research Competition*, 2025. [3rd Place]
2. Ramaseshan R, **Prateek P. Kulkarni**, Sharanya Madhusudhan, Kaustav Bhowmick. A Theoretical Treatment of Optical Metasurfaces as an Efficient Basis for Quantum Correlations. *arXiv:2507.09517 [quant-ph]*, 2025. (Featured by **Quantum Zeitgeist**)
3. Ramaseshan R, Abhishek Kumar V S, Adith Rajeev, Prathik V, Aditya Aravind, **Prateek P. Kulkarni**, Kaustav Bhowmick. A Generalized Hamiltonian Approach for Designing Simple Single Photon-based Optical Quantum Devices. *J Supercomput 81, 1395*, 2025. [Springer Nature]

Selected Projects

SQLFormer: Declarative Transformer Inference Using Only SQL Queries
Github Repository 2025.06 – 2025.7
- Implemented the full Transformer forward pass using only SQL queries, expressing attention and normalization via JOINs, aggregations, and window functions.
- Benchmarked across PostgreSQL, DuckDB, and PyTorch, providing correctness and performance analysis in an accompanying paper.

Selected Projects

PipSim: Real-Time RISC-V Pipeline Simulator with Visualization for Instruction Hazards
Github Repository 2025.02 – 2025.02

- Developed a Python-based simulator with real-time visualization of instruction flow, hazards, and pipeline behavior for 5-stage RISC-V.
- Integrated data forwarding and branch prediction; Currently extending with advanced features such as superscalar execution and deeper pipeline support.

RegDyno.Ai: High-Accuracy Time-Series Prediction using Custom Distribution Modeling
Patent Published, Journal No. 1/2025 2023.12 – 2024.06

- Built a custom distribution-based model achieving 15–25% improvement over state-of-the-art forecasting methods (ARIMA, LSTM, Prophet).
- Deployed a production-ready pipeline with automated noise reduction; novel methodology led to patent publication.

surface2cirqit: Automated Surface Code to Quantum Circuit Conversion with Optimization
Github Repository 2024.06 – 2024.08

- Created an automated pipeline for Surface Code to Quantum Circuit conversion with syndrome extraction and optimization.
- Reduced gate count by 20–40% and enabled seamless integration with Qiskit, Cirq, and other error correction frameworks.

Skills

Programming: `Python`, `Julia`, `C`, `MATLAB`.
Tools/Platforms: `Vivado`, `gem5`, `Qiskit`, `QuNetSim`, `Cirq`, `PennyLane`.
Languages: English, Kannada, Hindi

Selected Talks

Systems Day 2025 | Computer Science and Automation, IISc 2025.01
- Selected among ~20 researchers nationwide to present a poster; presented on multi-core quantum computing with superconducting qubits.

Workshop on Automata and Games for Synthesis | 45th FSTTCS 2025.12
- Selected to present a short talk on: *Quantum Communication Exponentially Speeds-up Circuit Synthesis*

Awards and Honors

- **Pre-Doctoral Fellowship**, SPARKS Programme, CSA, IISc (~1/4 positions) 2025.10
- **3rd Place Globally**, ACM SRC at MICRO 2025, UG Category 2025.10
- **Student Travel Grant**, MICRO 2025 – $580 for ACM SRC presentation 2025.09
- **Q-Pragathi Funding**, KITS, Govt. of Karnataka – 1.2L INR 2024.09
- **Funded Internship**, ISFCR Long-Term Internship (declined), PES University 2024.01
- **National Runner-up**, Explain The Concept, Pravega (Undergrad Fest), IISc 2019.02

Academic Services

Teaching Assistant for: *Quantum Transport and Logic Gates*,
PES University, Spring 2025, *(Credits: 4, Class size: ~90)*
Program Committee for: *HPCA 2026 - AE (Artifact Evaluation)*
Reviewer for: *IEEE Transactions on Quantum Engineering (TQE)*

References

Prof. Sumit K. Mandal
Assistant Professor, Dept. of CSA
Indian Institute of Science (IISc), Bangalore
Email: `skmandal@iisc.ac.in`

Prof. Kaustav Bhowmick
Associate Professor, Dept. of ECE
PES University, Bangalore
Email: `kaustavbhowmick@pes.edu`