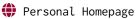
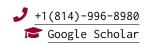
# Koustubh Phalak









#### **Research Interests**

Quantum Computing, Quantum Algorithms, Machine Learning, Generative AI

# **Work Experience**

Jun – Aug, 2024

- **Quantum Algorithms Scientist,** Rigetti Computing.
  - Worked on implementing novel qubit efficient QAOA algorithm for large scale combinatorial optimization problems.
  - Built multi-qubit gates for QAOA circuit from scratch while taking hardware constraints into account.
  - Ran qubit efficient QAOA circuits on Rigetti Ankka-9Q-3 QPU.

#### **Education**

2020 - · · · ·

■ Ph.D. Computer Science, Penn State University in Quantum Machine Learning, Quantum Security.

2016 - 2020

■ Undergrad., Electrical & Electronics Engineering, BITS Pilani Hyd Campus

# **Research Publications**

### **Journal Articles**

- **K. Phalak**, J. Li, and S. Ghosh, "Dataset distillation for quantum neural networks," *arXiv preprint arXiv:2503.17935*, 2025.
- S. Upadhyay, **K. Phalak**, J. Lee, K. M. Hill, and S. Ghosh, "Quantum computing and cybersecurity education: A novel curriculum for enhancing graduate stem learning," *ASEE*, 2025.
- C. Beaudoin, **K. Phalak**, and S. Ghosh, "Predicting side effect of drug molecules using recurrent neural networks," *IEEE TETCI*, 2024.
- **K. Phalak**, A. Ghosh, and S. Ghosh, "Optimizing quantum embedding using genetic algorithm for qml applications," *arXiv preprint arXiv:2412.00286*, 2024.
- **K. Phalak**, A. Chatterjee, and S. Ghosh, "Quantum random access memory for dummies," *Sensors*, vol. 23, no. 17, p. 7462, 2023.
- **K. Phalak** and S. Ghosh, "Shot optimization in quantum machine learning architectures to accelerate training," *IEEE Access*, vol. 11, pp. 41 514–41 523, 2023.
- **K. Phalak**, J. Li, and S. Ghosh, "Trainable pqc-based qram for quantum storage," *IEEE Access*, vol. 11, pp. 51 892–51 899, 2023.
- **K. Phalak**, M. Alam, A. Ash-Saki, R. O. Topaloglu, and S. Ghosh, "Optimization of quantum read-only memory circuits," *arXiv preprint arXiv:2204.03097*, 2022.

- **K. Phalak**, J. Li, and S. Ghosh, "Approximate quantum random access memory architectures. arxiv 2022," *arXiv preprint arXiv:2210.14804*, 2022.
- **K. Phalak**, A. Ash-Saki, M. Alam, R. O. Topaloglu, and S. Ghosh, "Quantum puf for security and trust in quantum computing," *IEEE JETCAS*, vol. 11, no. 2, pp. 333–342, 2021.

## **Conference Proceedings**

- **K. Phalak** and S. Ghosh, "Qualiti: Quantum machine learning hardware selection for inferencing with top-tier performance," in *IEEE VLSID*, 2025, pp. 296–301.
- C. Beaudoin, **K. Phalak**, and S. Ghosh, "Altgraph: Redesigning quantum circuits using generative graph models for efficient optimization," in *GLSVLSI*, 2024, pp. 44–49.
- **K. Phalak** and S. Ghosh, "Non-parametric greedy optimization of parametric quantum circuits," in *IEEE ISQED*, 2024, pp. 1–7.
- D. Bhattacharjee, A. Saha, J. Li, *et al.*, "Software flow for quantum computing," in *Springer ICCTE*, Springer, 2023, pp. 206–227.
- A. Chatterjee, **K. Phalak**, and S. Ghosh, "Quantum error correction for dummies," in *IEEE QCE*, vol. 1, 2023, pp. 70–81.
- A. A. Saki, M. Alam, **K. Phalak**, A. Suresh, R. O. Topaloglu, and S. Ghosh, "A survey and tutorial on security and resilience of quantum computing," in *IEEE ETS*, 2021, pp. 1–10.

# **Key Research Projects**

### Optimal Quantum Embedding Search Problem

GENETIC ALGORITHM, QML

ISQED 24



- Developed a **novel genetic algorithm** for searching optimal state preparation circuit **for Quantum Neural Networks**
- Finds optimal angle embedding permutation that yields best inferencing performance
- Competitive results with current State-of-the-Art methods

#### Greedy Parametric Quantum Circuit optimization

GREEDY ALGORITHM , QML

ISQED 23



- Proposed a novel greedy algorithm to optimize the post-transpilation circuit depth and gate count of Parametric Quantum Circuit of a QNN
- Used Hilbert-Schmidt distance as main metric to **convert parametric 1Q ro- tation gates to equivalent non-parametric representations**
- Observed upto 14% and 48% reduction in circuit depth and gate count respectively

# **Key Research Projects (continued)**

### **Quantum Random Access Memory for Storage**

QUANTUM STORAGE , CLASSIFICATION

IEEE Access 23

- Designed a novel trainable Parametric Quantum Circuit-based Quantum Random Access Memory to store classical data
- Stored two types of data: image data and binary data
- QRAM Storage yielded faster convergence for image data for classification task and error-free storage for upto 4-bit binary data
- · Additional results from IBM Oslo and IBM Jakarta hardware for image data classification task shows **competitive results** with state-of-the-art methods

### **Shot Optimization for QML Algorithms**

QUANTUM CIRCUIT EXECUTIONS |, QML



- Proposed a gradient-free methodology to reduce total shot usage in QML algorithms
- Presented **two methods** where the number of shots are function of the iterations completed, one linear and one step function
- Incorporated the methodology for classification task and molecular property prediction task, where linear works better for first and step function performs better for later

### **Technical Skills**

Languages

English, Hindi, Marathi (Mother tongue)

Programming-

Languages

Python, MySQL, MATLAB, LTFX, C++ (beginner), Unix Shell

Machine Learning/ -

**Deep Learning Tools** 

PyTorch, Numpy, Pandas, SciPy, Matplotlib

**Quantum Tools** 

Qiskit, Pennylane

# **Miscellaneous Experience**

2025

- Alumni Award nomination, Nominated for BITS 30 under 30 alumni awards (ongoing)
- Podcast talk, Invited to Physics Frontiers Podcast to give a talk on QRAM (upcoming later this year)
- Quantum Hackathon, Participated in BlueQubit Quantum Hackathon and finished at rank 17