

# Gopal Ramesh Dahale

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🌐 Gopal-Dahale

## Education

### Indian Institute of Technology, Bhilai

BTech in Electrical with Honors in Computer Science, 9.08/10.00

Chhattisgarh, India

2018–2022

### Kendriya Vidyalaya, ONGC Panvel

High School, CBSE, 95.6%

Navi Mumbai, India

2016–2018

## Experience

### Google Summer of Code with ML4SCI

Open Source Contributor, Advisor: Sergei V. Gleyzer

Devising a Quantum Graph Neural Network for identifying particle images.

Remote

May 2023–Present

- Improving the existing architectures using a Data Re-uploading scheme for the Quantum Circuit. Expanded it to incorporate both hybrid and fully-quantum models.
- Leveraged Knowledge of PyTorch Geometric, PennyLane, JAX and Jraph.

### Quantum Open Source Foundation Cohort 7

Open Source Contributor/Mentee, Mentor: Radoica Draškić

Inspecting measurement-based imaginary time evolution.

Remote

March 2023–Present

- Implementing a deterministic measurement-based imaginary time evolution algorithm to find the ground state of a Hamiltonian.
- Leveraged Knowledge of Qiskit, PennyLane (Catalyst), CUDA Quantum, Numpy and Scipy.
- Github Repository

### Deloitte's Quantum Climate Challenge 2023

Runner-up

Designed a quantum-hybrid solution that calculates the minimum of the potential energy surface of combinations of gas molecules and ions. Conceptualized a quantum or hybrid solution to scale the calculation from one binding site to a 3D unit cell of Metal Organic Frameworks.

Remote

Jan 2023–April 2023

- Explored the min of PES of  $CO_2$  with metal ions (Mn(II) and Cu(I)) using Hardware-efficient Ansatzes and VQE algorithm.
- Investigated the potential of Amines for carbon-capture with  $CO_2 + CH_3NH_2$  with Ideal and Noisy simulations.
- Modelled  $H_2O + Cu-MOF-74$  using Density Matrix Embedding Theory (DMET). Performed resource estimation for using VQE.
- Leveraged Knowledge of Qiskit, PennyLane and AWS Braket.
- Github Repository.

### Xanadu's QHack 2023

Winner of Quantum Chemistry Challenge, Runner-up in Amazon's Braket Challenge

Investigated the minimum of the Ground Potential Energy Surface (PES) of the  $BeH_2$  molecule. Developed an algorithm that efficiently calculates the minimum of the PES for systems related to  $CO_2$  capture using MOFs.

Remote

Feb 2023–March 2023

- Implemented and tested a de-parameterisation approach to reduce parameters for simplifying the energy landscape.
- Extended this approach for simulating  $CO_2$  and metal ions achieving a relative error within  $10^{-5}$  Ha with Ideal simulation.
- Executed the algorithm on QPUs and obtained a relative error within 0.074 Ha.
- Leveraged Knowledge of Qiskit, PennyLane and AWS Braket.
- Github Repository.

### Qiskit Advocate Mentorship Program, Fall 22 Cohort

Open Source Contributor/Mentee, Mentor: Alberto Maldonado Romo

Designing Tensor networks and analysing their performance over a different set of parameters.

Remote

Sept 2022–Dec 2022

- Investigated tensor network architectures in quantum circuits and tested various data encoding schemes.
- Evaluated gradient-based and gradient-free optimizers using different datasets like MNIST and Iris.
- Achieved 93.5 test accuracy on binary classification MNIST within a few epochs and 80 train samples.
- Devised Hybrid-QCNN for multi-class classification with generalization on test data using few training data points (80 per class). Achieved train/test accuracy of 0.85/0.80.
- Leveraged Knowledge of Qiskit, PyTorch and Quantum Machine Learning.
- Github Repository.

## Atonarp Micro-Systems

Data Scientist

Bangalore, India

Sept 2022–Nov 2022

Contributed to the algorithms and analytics division by analysing data for revolutionary miniaturized spectroscopy.

- Preprocessed and analysed data obtained from Coherent Anti-Stokes Raman (CARS) Spectroscopy. Improved the signal-to-noise ratio of obtained spectra.
- Trained machine learning models to predict the chemical compositions using spectroscopic data.
- Implemented a CARS UI to support the Bio team in analysing data.
- Leveraged Knowledge of Python, Machine Learning, Data Analytics and Visualization and PyQt.

## Google Summer of Code with ML4SCI

Remote

Open Source Contributor, Advisor: Sergei V. Gleyzer

June 2022–Sept 2022

Investigated the potential of Quantum Convolutional Neural Networks for the classification of particle images from high-energy physics events.

- Designed and tested data encoding schemes including amplitude, angle and basis with various ansatzes.
- Trained hybrid and fully-quantum CNNs. Summarized the results.
- Achieved an AUC of 0.77 on HEP datasets with only 538 trainable parameters in hybrid model.
- Benchmarked classical CNNs and analysed the performance of QCNNs. Classical CNNs saturates at 0.76.
- Leveraged Knowledge of Cirq, TensorFlow Quantum, PennyLane, JAX and cuQuantum SDK.
- Github Repository.

## University Projects

### Grover on Quantum Cryptanalysis

Advisor: Dr. Dhiman Saha

March 2022–May 2022

Evaluated Grover's Search algorithm on various block ciphers including SAES, AES, SIMON and PRESENT. Summarized the findings.

- Surveyed research papers and implemented Simplified AES as a quantum circuit to search the key with 72 qubits followed by an optimized version with 32 qubits. Simulated on IBMQ Simulators.
- Examined the complexity and parallelization of Grover's algorithm based on NIST requirements.
- Implemented the BHT algorithm based on Grover's search for finding claws in pair of functions.
- Leveraged Knowledge of Qiskit, LIGHTER-R tool and Quantum symmetric-key cryptanalysis.
- Github Repository.

## Skills

**Quantum Programming:** Qiskit, TensorFlow Quantum, Cirq, PennyLane, AWS Braket, ProjectQ

**Programming Frameworks:** PyTorch, TensorFlow, Scikit-Learn, JAX

**Programming Languages:** Python, C, C++

## Achievements

- Qiskit's Quantum Explorers: Certificate of Quantum Excellence (February 2023)
- Rank 21/793 in QHack Coding Challenge (February 2023)
- Rank 19/429 in PennyLane Code Camp (November 2022)
- IBM Quantum Challenge Fall 2022 Achievement - Advanced (November 2022)
- Qiskit Global Summer School 2022 - Quantum Excellence (August 2022)
- Qiskit Advocate (July 2022)
- IBM Certified Associate Developer - Quantum Computation using Qiskit v0.2X (July 2022)
- IBM Quantum Spring Challenge 2022 Achievement (June 2022)

## Volunteering

### OpenLake

Community Member and Mentor

May 2021–April 2022

Managed open-source projects and mentored 50+ juniors as a team of 10 in areas including Data Science and Machine Learning.

(References available on request)