ADITYA DAS SARMA

Curriculum Vitae

aditya.41200@gmail.com ◇ github.com/adi666-png ◇ adi666-png.github.io (Visit for recent CV, clear browser cache)

EDUCATION

Jadavpur University   2019 - Exp. 2023
Bachelor of Engineering, Electronics & Telecommunications
CGPA: 9.56/10 (till 6th Sem)

TECHNICAL SKILLS

• C/C++ • Python • Qiskit • PennyLane • DWave Ocean SDK • MATLAB • PyTorch • Bash

DOMAIN INTERESTS

- Solving problems in machine learning and optimization using quantum gate based and annealing approaches
- Optimizing software stack for quantum computers & Optimal synthesis and compilation of Quantum Circuits
- Architectures for Quantum Computing & Efficient simulation of quantum circuits using Tensor representations

RESEARCH EXPERIENCE

Tensor Ring Representations for Quantum Circuits   Sep '22 - Present

Supervised by Dr. Debanjan Konar & Dr. Vaneet Aggarwal
CLAN Labs, Purdue University   *West Lafayette, USA*

- Working on using Tensor Rings to **compress input quantum state** for mitigating scalability issues.
- We show that this **approximation scales linearly** with storage and computational time required.

Quantum Kernel Ridge Regression   Jun '22 - Sep '22

Supervised by Dr. Attila Cangi
Helmholtz-Zentrum Dresden-Rossendorf Labs   *Dresden, Germany*

- Developed **quantum kernels** for predicting density and total energy of Beryllium atoms.
- Proposed **quantum kernel outperformed RBF kernel** by two orders of magnitude and gave comparable results to the state of the art neural network models.

Efficient Implementation of Shor's Algorithm   Mar '22 - Present

Supervised by Dr. Anupam Chattopadhyay
Temasek Labs, Nanyang Technological University   *Singapore*

- Implementing an alternate version of the Ekera-Hastad Algorithm by proposing a novel **genetic algorithm** based approach to the Bounded Distance Decoding Problem.
- Working on potential optimizations to the quantum modular exponentiation circuits.

Hybrid Quantum Spiking Neural Networks   Jun '21 - May '22

Supervised by Dr. Debanjan Konar & Dr. Attila Cangi
Center for Advanced Systems Understanding   *Görlitz, Germany*

- Implemented novel hybrid model by integrating VQCs with spiking neural networks in **Pennylane**.
- Reported **increased noise robustness** of this model against classical SNNs and CNNs.
- Extended this work to create a **hybrid quantum model of Random Neural Networks**.

Quantum Enhanced Techniques for Communication Systems

Dec '21 - Oct '22

Supervised by *Dr. M Girish Chandra*

TCS Innovation Labs(Research)

Bangalore, India

- Extended **QUBO formulation with a classical post-processing strategy** for decoding LDPC codes in **AWGN & Rayleigh Fading Channel** scenarios.
- Implemented a complete simulation of a communication system in **Python** under different channel noises.
- Achieved **lower BER** using new formulation in **Ocean SDK** than classical algorithms in **MATLAB**.
- Worked on a **QUBO for quantum enhanced SVM for detecting BPSK symbols** and ran it on DWave Annealer, which gives **slightly improved results** over classical SVM.

Explorations in Quantum Applications & Simulation

Sep '20 - Present

Supervised by *Dr. Amlan Chakrabarti*

A.K.Choudhury School of Information Technology, University of Calcutta

Kolkata, India

- Utilized **Grover Adaptive Search**,implemented in **Qiskit**, to successfully arrive at correctly decoded codewords with high probability.
- Worked on **fixing bugs** and **pipelining issues** in a boolean logic based quantum simulator (written in **C++**) under the co-supervision of Prof Kenneth W Regan of SUNY Buffalo.
- Recently started working on **implementing modules for tensor computations for simulation of quantum circuits** as part of an indigenous quantum simulator project.

PUBLICATIONS   (* DENOTES ORAL PRESENTATION GIVEN BY ME)

[1] **On Quantum-Assisted LDPC Decoding Augmented with Classical Post-Processing***
<u>Aditya Das Sarma</u>; Utso Majumder; Vishnu Vaidya; M Girish Chandra; A Anil Kumar; Sayantan Pramanik
(Accepted at the 14th International Conference on Parallel Processing and Applied Mathematics)

[2] **A Shallow Hybrid Classical-Quantum Spiking Feedforward Neural Network for Noise-Robust Image Classification**
Debanjan Konar; <u>Aditya Das Sarma</u>; Soham Bhandary; Siddhartha Bhattacharyya; Vaneet Aggarwal; Attila Cangi
(Conditionally Accepted at Elsevier Applied Soft Computing)

[3] **On Quantum-Enhanced LDPC Decoding for Rayleigh Fading Channels***
Utso Majumder; <u>Aditya Das Sarma</u>; Vishnu Vaidya; M Girish Chandra
(Accepted at ACM/IEEE International Workshop on Quantum Computing)

[4] **LDPC Decoding with Ensembles of Quantum-enhanced Annealing-based Support Vector Machines (Poster)***
<u>Aditya Das Sarma</u>; Utso Majumder; M Girish Chandra
(Accepted at the 26th Conference on Quantum Information Processing(QIP))

[5] **Random Quantum Neural Networks (RQNN) for Noisy Image Recognition**
Debanjan Konar; Erol Gelenbe; Soham Bhandary; <u>Aditya Das Sarma</u>; Attila Cangi
(Conditionally Accepted at IEEE Transactions on Emerging Topics in Computational Intelligence(TETCI))

[6] **Maximum Likelihood LDPC Decoding Using Grover Adaptive Search-based Quantum Optimization**
Partha Acharya; <u>Aditya Das Sarma</u>; Utso Majumder; Amlan Chakrabarti
(Awaiting decision at 2023 IEEE International Conference on Communications (ICC))

[7] **Quantum Kernel-integrated Ridge Regression for Workflow Modelling of Kohn-Sham Density Functional Theory (DFT)**
<u>Aditya Das Sarma</u>; Soham Bhandary; Lenz Fiedler; Debanjan Konar; Attila Cangi
(Under manuscript finalization stage)

[8] **Ekera-Hastad Algorithm: An alternate approach with full scale implementation**
<u>Aditya Das Sarma</u>; Utso Majumder; Pratyusha Rakshit; Anupam Chattopadhyay
(Under manuscript finalization stage)

PROJECTS

Quantum Machine Learning & Optimization for Finance *Sep '22 - Present*
Supervised by: Dr Sergio Gago
Moody's Analytics, New York, USA

- Working on **portfolio optimization** using both analog and digital annealing strategies.

- Working on **pricing swaps** and **derivatives** and exploring **efficient encoding techniques**.

- **Successfully orchestrated a Memorandum Of Understanding(MOU)** between Moody's Analytics and University of Calcutta for establishing long term research relations.

A machine learning model to predict various properties of quantum particles *Jan '21 - May '21*
Supervised by: Prof. Prasanta K Panigrahi
Indian Institute of Science Education and Research(IISER), Kolkata, India

- Developed a **machine learning tool in PyTorch** to predict various quantum properties like entanglement, concurrence, discord,negativity and coherence.

- Analyzed this tool under **different kinds of channel noise**, including Amplitude Damping noise, Phase Damping noise, Bit Flip noise and Phase Flip noise.

A cloud-based distributed intelligent color measurement system for predicting the color purity of any object *Feb '21 - May '21*
Supervised by: Dr Vaclav Snasel
VSB − Technical University of Ostrava, Czech Republic

- Aims to detect color purity of objects, especially crops to detect any infections. A neural network, trained and tested using **PyTorch** and hosted on **Heroku**, makes the prediction once the Raspberry Pi Zero device sends the color readings.

- Finalizing terms with a firm to **commercialize** the product.

- This work has been approved by the **German Patent Office** as a **Utility Model**.

SCHOLASTIC ACHIEVEMENTS

- **Selected to attend HZDR Summer School** as one of the 30 successful interns out of 350 global applicants.

- Clinched an All India Rank of **208** in West Bengal JEE among 100k canditates

- Ranked **150** at state level to qualify for **final round of National Talent Search Examination**

LICENSES & CERTIFICATIONS

- **Utility Model license certification from German Patent Office**

  - **Link**: https://drive.google.com/file/d/1aCajEXhxrn1s5VYueDwMfJN5O6ofzJDk/view?usp=sharing

  - **Link to Issuing Authority**: https://www.dpma.de/english/utility_models/index.html

- **C1000-112-ENU: Fundamentals of Quantum Computation Using Qiskit v0.2X Developer**

  - **Link**: https://drive.google.com/file/d/13Vx07biEvscA-leGxuSfwWn4JBrGze5D/view?usp=sharing

  - **Link to Issuing Authority**: https://www.ibm.com/training/certification/C0010300

RELEVANT COURSES UNDERTAKEN

- **Computer Science**: Pattern Analysis and Machine Intelligence*, Data Structures & Algorithms, Digital Image Processing*, Computer Architecture & Organisation, C Programming & Numerical Methods

- **Mathematics**: Calculus - I & II, Vector Calculus, Linear Algebra, Linear Transformations & Matrices, Special Functions, Abstract Algebra, Complex Analysis, Advanced Probability & Stochastic Process, Ordinary & Partial Differential Equations

* indicates that the course is presently being undertaken or is scheduled for an upcoming semester