Alapan Chaudhuri

Undergraduate Researcher, CQST & CSTAR, IIITH

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Education

International Institute of Information Technology, Hyderabad
B.Tech. and M.S. in Computer Science and Engineering
CGPA: *9.08 (in-major), 8.63 (overall)* *July 2019 - Present*

Teaching Assistant: Automata Theory (Monsoon '21 and '22), Linear Algebra (Spring '22)
Positions of Responsibility: Student Moderator at NQSTS 2021 (July 2021 - Aug 2021), Literary Club Coordinator (Apr 2020 - June 2022)

Experience

Quantum Research Intern
QunaSys, Tokyo *Aug 2022 - Present*

Working on building a framework for quantum chemistry focused on efficient simulation of Hamiltonians using both hybrid heuristics (like effective grouping for Pauli strings), standard Trotter methods (or qubitization) and machine learning.

Collaborator, Ayers Lab
McMaster University, Canada *June 2022 - Present*

Working with Prof Paul Ayers and his group on optimization algorithms for solving the positive semi-definite Procrustes problem, and extending the Procrustes python library. This project is also a part of Google Summer of Code (GSoC) 2022 and I have been accepted as a contributor to the same.

Research Assistant
Centre of Quantum Science and Technology, Hyderabad *Dec 2021 - Present*

Adiabatic Quantum Computing: Working with Prof Shantanav Chakraborty on algorithms to predict avoided crossings for quantum systems under adiabatic evolution.

Entanglement Detection: Working with Prof Indranil Chakrabarty on identifying the degree of entanglement within a given quantum state (which is classically NP-Hard), using convex optimization and unsupervised learning. Also, working on generating robust datasets to be used for experimental purposes within quantum information theory.

Compiler Engineering Intern
Qualcomm Innovation Center *May 2022 - June 2022*

Worked with the LLVM team at Qualcomm on using QEMU decodetree for Hexagon target. The aim was to improve the Hexagon target by transitioning from building its own decodetree to the Python infrastructure provided by QEMU for creating instruction decoders.

Data Analyst Intern
Trivedi Center for Political Data *Dec 2020 - Jan 2021*

Worked on the data set of Indian Governors to produce representations and visualizations to identify trends and outliers. Furthermore, performed large scale web scraping and data cleaning to ensure correct and standardized data.

Awards

- Ranked 17^{th} (across country) in the ICPC India Preliminary Round 2021-22.
- Accepted as a Google Summer of Code 2022 contributor to Open Chemistry.
- **Ranked 9^{th}** in **ICPC Asia Regionals** 2020-21 (Gwalior-Pune).
- **Winner** of the **Quantum Chemistry Challenge** at QHack 2022 by Xanadu.
- Nominated for the 2022 ICPC Training Camp powered by Huawei.
- Ranked 1^{st} (world) in the Grand Prix of Kyoto at Open Cup (Div 2) 2022.

- **Winner** of the **Goldman Sachs Challenge** at Texas A&M Datathon 2021.
- Certificate of Merit (top 1%) for the 2019 Indian Olympiad Qualifier in Physics.
- Rated 2022 (5 star) on Codechef
- Top 2% (national) in Google HashCode 2022.
- Perfect score at zonal round of the Indian Computing Olympiad 2018, organized by IARCS.
- Won 1^{st} place (overall) at Kent Hack Enough 2020
- Won Best Web Application at Hack At Home 2020

Projects & Open Source

Racket Compiler
Racket Compiler *2022*

- Developed a nano pass compiler for a subset of racket language. Optimised register allocation in assembly using graph coloring and implemented tail call optimization.
- **Technologies:** Racket, Compiler Engineering

PauliZee
PauliZee *2022*

- Implemented a framework that can simulate any general Hamiltonian for quantum computing systems using optimized trotter methods and Szegedy quantum walks.
- Benchmarked our framework to be better than the default implementation used in Qiskit for simulating the Heisenberg Spin Chain Hamiltonian on a 7-qubit IBM quantum computer.
- **Technologies:** Python, Qiskit

Nostradamus: Weathering Worth
Nostradamus *2021*

- Explored correlations using statistical learning between volatility and behavior of NYSE stocks against environmental factors, weather conditions, natural disasters.
- Closely studied 28 stocks across 5 major sectors and monitored behavior of total 10913 tickers.
- **Technologies:** Python, Yahoo Finance API

Canswer
Dcode Care *2021*

- Worked with Dcode Care on a mobile application for patient engagement and remote connected care amongst people battling with cancer.
- Published in Google Play with 500+ downloads (as of Aug 2022).
- **Technologies:** JavaScript, Firebase, React JS, Python.

Benchmarking Algorithms for Graph Classification
How Powerful are Graph Neural Networks? *2021*

- Designed a provably maximally powerful GNN under the neighborhood aggregation framework.
- Compared our implementation with that of Graph Isomorphism Networks (GINs) and the Weisfeiler-Lehman Test.
- **Technologies**: PyTorch, Datasets for Graph Classification (PROTEINS, MUTAG)

Cirq
Google QuantumAI (cirq) *2021*

- Implemented rotation gate, serial concatenation of Kraus Operators and minor structural updates (with Zeeshan Ahmed).
- **Technologies:** Python, Scientific Programming (scipy and numpy), Cirq.

Rogue One: a Game
Rogue-One *2021*

- Implemented a space-ship battle game using WebGL and designed an animated trailer for the game using Blender.
- **Technologies:** JavaScript, WebGL, Blender.

Christine
Christine *2020*

- Discord-bot that moderates online harassment along with toxicity and depressive behavior. Used 1.6 million tweets for constructing a scale to measure depression from text messages.
- **Technologies:** Python, NLTK, Google Cloud, JavaScript, Perspective AI.

Synopsys
Synopsys *2020*

- Discord-bot that summarizes conversations and records them for future use.
- It extracts data from a chain of conversation, summarizes it and allows the user to have easy access to these stored summaries (via website) for future reference.
- **Technologies Used:** Python, nltk, Firebase and Firestore, Google Cloud, React JS.

Dotabase
Dota2 Analyzer *2020*

- Analyzer for professional matches in the popular game Dota 2. Implemented a fully functioning DBMS based on data scraped from OpenDota and built a suitable CLI using Python.
- **Technologies:** MySQL, Pymysql, Python.

Mariam: a Linux Shell
Mariam *2020*

- Basic shell/terminal implemented from scratch in C using Linux system calls. Includes piping, redirection, signal handling as well as extensive error handling.
- **Technologies:** C, Linux, Operating Systems.

Skills

Primary Languages: C, C++, Python, Haskell
Other Languages: LaTeX, Bash, x86, Racket
Quantum Computing: Cirq, Q#, Qiskit
Machine Learning: Tensorflow, PyTorch
Quantum ML: Tensorflow Quantum, Pennylane
Web: JavaScript, React, HTML/CSS
Databases: MySQL, MariaDB, Firebase
Misc: Linux, Git

Pre-prints & Publications

Games and Computational Complexity
2020 | arXiv:2012.07678

Interests

Quantum Computing
Machine Learning
Algorithms and Optimization
Computational Biology
Quantitative Finance