

Chaithanya Naik

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RESEARCH INTERESTS

Quantum Computing, Deep Learning, Reinforcement Learning, Scalable systems and Automated Reasoning

EDUCATION

University of Wisconsin-Madison 2022-present
PhD student in Computer Sciences
Advisor: Prof. Swamit Tannu

Indian Institute of technology Bombay 2016-2021
M.Tech & B.Tech in Computer Science and Engineering
Minor in Physics | Minor in AI and Data Science
Advisors: Prof. Sai Vinjanampathy, Prof. Ashutosh Gupta, Prof. Amit Sethi

PUBLICATIONS

- Scaling Qubit Readout with Hardware Efficient Machine Learning Architectures.**
Satvik Maurya, **Chaithanya Naik Mude**, William D. Oliver, Benjamin Lienhard, Swamit Tannu.
50th International Symposium on Computer Architecture (ISCA), 2023, Orlando, Florida, USA.

SELECTED RESEARCH PROJECTS

Adaptive Leakage Detection for Surface Code *Spring 2024 - Ongoing*
Advisor: Prof. Swamit Tannu *R&D Project, UW-Madison*

- Designing leakage speculation strategies to improve logical error rate by detecting and mitigating leakage errors
- Adaptive strategy to minimize unwanted usage of leakage reduction units for various quantum architectures
- Developing a light-weight probability-based analysis tool to determine the efficacy of the speculation strategies

Understanding Security Risks on Multi-Tenant Quantum Computers *Fall 2023*
Advisors: Prof. Swamit Tannu *Submitted to USENIX '24*

- Designed an attack to deduce confidential user data by exploiting crosstalk-based side channel on quantum hardware
- Experimented with 7-qubit IBM machines to witness the information leak through the side channel attack

ML for Quantum Circuit Optimization *Summer 2023 - Ongoing*
Advisor: Prof. Swamit Tannu *R&D Project, UW-Madison*

- Designing unified adaptive ML model to optimize quantum compilation for varied dynamic hardware configurations
- Leveraging RL techniques for adaptability and LLMs for reasoning and encoding compilation problem as a DSL

Effects of Leakage in Superconducting Systems *Summer 2023*
Advisor: Prof. Swamit Tannu *R&D Project, UW-Madison*

- Experimented on IBM systems to analyze the impact of leakage errors on efficacy of QEC, mainly surface codes
- Leveraged Qiskit Pulse to understand leakage errors and designed 3-level readout discriminator with 94% accuracy

Scaling Qubit Readout using ML *Fall 2022*
Advisor: Prof. Swamit Tannu *Published at ISCA '23*

- Achieved 16% relative improvement in readout accuracy by identifying relaxations that occur during qubit readout
- Designed efficient architecture using matched filters for qubit readout that used less than 8% resources on FPGA

PROFESSIONAL EXPERIENCE

VMware Inc. *July 2021 - August 2022*
Avi NSX-T load-balancer | Mentor: Anurag Palsule *Bangalore, India*

- Enhanced the performance of load balancer to manage heavy workloads through kubernetes operator
- Worked on an open source project for a kubernetes operator, catering to needs for NSX-T and openshift platforms

Amazon Development Centre India Pvt. Ltd *May - July 2019*
Auto Trouble Ticket Manager | Mentor: Archit Agrawal *Hyderabad, India*

- Designed **runtime compilation** module using **Java Compiler API** to implement dynamic code execution
- Developed a **generic framework** to plug-in their models for information retrieval and auto-suggesting resolution

OTHER RESEARCH EXPERIENCE

Qubit Mapping and Routing with Formal Methods

Fall 2023

- Analyzing existing methods that employ heuristics & SAT/SMT solvers to decipher efficient DSL & specification
- Probing for relatively simpler abstraction that can solve for dynamically re-configurable qubit systems

Robust Quantum Optimal Control

Spring 2021

Part of work presented at APS March meeting 2022

- Designed encoder-decoder based Seq2Seq learning model to generate noise-resistant optimized control sequences

Controller Synthesis

Spring 2021

- Synthesised a controller for real-time system, based on data-driven RL and algorithmic SMT/SAT approaches

Interactive Image Segmentation

Fall 2020

- Automated the generation of markers required to segment desired object in image with minimal user intervention

ACADEMIC PROJECTS

- **Quantum Divide & Conquer** | Analyzed possible extensions to the paradigm | Quantum Algorithms *Spring 2023*
- **UnrealSynthesisEngine** | Proof Verifier for Unrealizability Logic | Program Synthesis *Fall 2022*
- **Gomoku RL Playing Agent** | Fundamentals of Intelligent agents *Fall 2020*
- **Depth Map Prediction From Single Image** | Computer Vision *Spring 2019*
- **Compiler for C-like language** | Implementation of Programming Languages *Spring 2019*
- **Fake News Detection by Crowdsourcing** | Database and Information Systems *Fall 2018*
- **Micro-architectural Attacks** | FLUSH+RELOAD, DRAMA Template | Computer Architecture *Fall 2018*
- **3D Modelling and Animation** | Computer Graphics *Fall 2018*

AWARDS & ACHIEVEMENTS

- Secured **2nd** position in HCL HACK IITK, the country's largest hackathon in **cybersecurity**, by IIT Kanpur *2022*
- Honourable Mention in **NSUCrypto-2021**, 8th International Olympiad in Cryptography *2021*
- Awarded **Gold Medal** in **Bosch's Route Optimization** challenge at the 8th Inter IIT Tech Meet *2019*
- Secured All India Rank **340** in IIT-JEE Advanced | All India Rank **90** in JEE Main Paper-II *2016*
- Amongst **Top 300** students in the country qualified for **INPhO** (for two straight years) and **INMO** *2015,14*
- Awarded **KVPY** Fellowship by IISc Bangalore | Recipient of **NTSE** Scholarship by NCERT *2014,12*

PROFESSIONAL RESPONSIBILITIES

Teaching Assistant

- Data Science Programming I | Prof. Michael Doescher *Fall 2022*
- Quantum Computing and Information | Prof. Sai Vinjanampathy *Spring 2021*
- Python programming lab | Prof. Sai Vinjanampathy *Fall 2020*

Mentor

Quantum Computing, Computer Vision: Maths and Physics Club *April - June 2020*

- Mentored a group of 4 students for the project, Spoof-Resistant Facial Recognition using Deep Learning
- Mentored a group of 6 students for designing Rubik's Cube Solver using Reinforcement Learning
- Mentored a group of 6 students for creating star hopping guide & creating astronomy website using Django
- Helped a total of 12 students in pursuing their interests in Quantum Computing, Astronomy & Computer Vision

Department Academic Mentor | CSE Department, IIT Bombay

June 2020 - July 2021

Department General Secretary | CSE Department, IIT Bombay

April 2019 - July 2020

TECHNICAL SKILLS

Programming & Tools C/C++, Python, Bash, Go-Lang, Qiskit, Git, pennylane
Deep Learning PyTorch, TensorFlow, Keras, TensorFlow Quantum

MISCELLANEOUS

- Part of the Inter IIT contingent securing **Runner's Up Position** at Inter IIT Tech Meet held at IIT Bombay *2018*
- Attended **Vijyoshi Science Camp** organized by Indian Institute of Science (**IISc**), Bengaluru, India *2015*