Krishna Narasimhan **Agaram**

kagaram@cse.iitb.ac.in
github.com/mathismusic
mathismusic.github.io
krishna-agaram-1729

Education

Indian Institute of Technology Bombay (Nov. 2021 - Jun. 2025)
B.Tech. with Honors in Computer Science and Engineering (CPI/GPA: 9.87/10, ranked 2/194)
Minor in Mathematics (CPI/GPA: 10.0/10)

Scholastic Achievements

- Department **rank 2** in a class of 194 students in the Computer Science and Engineering department (2024)
- Awarded the **Institute Academic Prize** twice for stellar academic record (**top 1.5%** of class) (2022,2024)
- Placed **8th** overall, East Division (**thrice**) at the Simon Marais Mathematics Competition (SMMC) (2022, 2023, 2024)
- Conferred with the **AP** (Advanced Performer) grade (**top 2%**) for exceptional performance **seven** times, including in **Compilers** Lab, **Logic** in Computer Science, **Discrete** Structures and **Data** Analysis (2021, 2022, 2023, 2024)
- Secured **All India Rank 40** & 122 in **JEE Advanced** and JEE Main among 140K+ & 1M+ aspirants respectively (2021)
- Invited to the **International Mathematics Olympiad Training Camp** (IMOTC) after clearing INMO (2020, 2021)
- Among the **top 47** eligible for the **International Olympiad on Astronomy & Astrophysics** (IOAA) Selection Camp (2020)
- Secured **Global Rank 1** in the Southeast Asian Mathematical Olympiad (**SEAMO**) 2020 (2020)
- Awarded the **NTSE** and **KVPY** (twice) scholarships by the Government of India (2019, 2020, 2021)
- Stood **1st** in India at the Technothlon 2019 Mains conducted by IIT Guwahati (2019)

Internship Experience

Complexity of Positional Interactive Proof Systems
Summer@EPFL, EPFL, Switzerland
Guide: Prof. Nick Spooner, Dept. of Computer Science, Cornell University (Jun. 2024 - Present (ongoing))

- Formalized multi-prover positional interactive proofs (PMIPs) and **characterized the complexity** of classical PMIPs
- Proved that **quantum** PMIPs recognize a larger complexity class using **information-theoretic** techniques

Provable generalization for quantum state preparation
AScI summer research program, Aalto University
Guide: Prof. Vikas Garg, Dept. of Computer Science, Aalto University (May 2023 - Nov. 2024)

- Designed a **reinforcement-learning** pipeline and novel problem-inspired reward for preparing quantum states
- Proved via concentration that the trained agents are **guaranteed** to prepare at least **95%** of all 9-qubit states with a worst-case circuit size at least **50% shorter** than existing baselines, despite seeing 10^{-8}% of all states during training
- Accepted to the APS Global Physics Summit 2025 (**oral**) and currently under review at **ICML 2025**

Key Projects

Compiler for a subset of C
Course Project: Compilers Lab
Guide: Prof. Uday Khedker (Jan. 2024 - Apr. 2024)

- Wrote a full **compiler** for a subset of C handling control structures, loops, nested scoping, **functions** and arbitrary **arrays**
- Implemented a top-down **random program generator** for testing correctness and benchmarking; our compiler compiles **80,000** lines of code in under **10** seconds, over 4x faster than the course baseline

Video Style Transfer
Course Project: Machine Learning
Guide: Prof. Preethi Jyothi (Aug. 2023 - Nov. 2023)

- Implemented **style transfer** for **videos** via gradient descent on convolutional-net representations following Ruder et al
- Enforced temporal coherence of the output videos using **optical flow**, preserving moving objects' style across frames

FastChat
Course Project: Software Systems Lab
Guide: Prof. Kavi Arya (Oct. 2022 - Dec. 2022)

- Built a chat service with a **load-balanced** server-client architecture, **end-to-end** encryption and client-side databasing, supporting direct and group conversations, admin privileges, and support for **arbitrarily large** file attachments
- Encoded messages using standard **message protocol** along with a message buffer to ensure messages are **not lost**

Quantum Computation and Quantum Machine Learning
Web and Coding Club, IIT Bombay
Seasons of Code, 2022 (Apr. 2022 - Jul. 2022)

- Analyzed and implemented several algorithms that are sped up on quantum hardware, e.g. **factoring** integers in $\mathcal{O}(n^3)$ time via Phase estimation/Shor's algorithm and **SAT solving** in $\mathcal{O}(2^{n/2})$-time with Grover search
- Implemented a paper computing the **ground-state molecular geometry** of simple molecules via alternately optimizing geometry and the parameters of a variational quantum circuit representing the state in a way that reduces energy

Miscellanous Development Projects

Self Projects

INSPIRED BY VARIOUS COURSES (Apr. 2022 - Dec. 2023)

- **AutoLib**: Wrote a library to work with finite **automata**, supporting unions, joins, DFA **minimization**, transformations from ε-NFAs to DFAs; also supports context-free grammars and the **CYK** algorithm for language membership
- **LinAlg**: Built a C++ linear algebra library supporting vector operations, matrix row operations, reduction to **echelon** form, Gram Schmidt & **QR** decompositions, determinant and **inverse**, and a **system-of-equations** solver
- **Minute-learn**: Authored a small python library **implementing** portions of the **scikit-learn** & **PyTorch API**s; includes API support for regression, clustering, decision trees, PCA, computational graph backprop & neural networks

Replacement Policies for Graph Algorithms

Course Project: Computer Architecture

GUIDE: PROF. BISWABANDAN PANDA (Mar. 2023 - Apr. 2023)

- Analysed various LLC **replacement policies** for graph algorithm workloads and compared the LLC miss rate with that of the optimal Belady policy, using the **ChampSim** simulator and a from-scratch cache simulator to run Belady's algorithm

Linear Cryptanalysis of the DES Cipher

Course Project: Cryptography and Network Security

GUIDE: PROF. MANOJ PRABHAKARAN (Mar. 2023 - Apr. 2023)

- Explored linear cryptanalysis of DES, following Matsui 1994; wrote tests to verify the **S-box weakness** in DES and presented a **key recovery** attack for reduced-round DES using graph shortest paths & single-round weaknesses

Technical Skills

Languages/Tools	C/C++, Python, Java, Bash, x86 Assembly, JavaScript, Git, LaTeX, PostgreSQL, Wireshark
Libraries	NumPy, Pandas, Matplotlib, PyTorch, TensorFlow, scikit-learn, stable-baselines, OpenAI Gym, IBM Qiskit, PennyLane, Stim, Manim

Miscellaneous

- Worked with **Vizuara** in developing short animated videos to **motivate concepts** in school-level Mathematics for use in schools, using the Python animation library **Manim** (Oct. 2022 - Dec. 2022)
- Writing a book in the spirit of an adventure novel meant to serve as a primer for **enumerative combinatorics** for students in middle/early high school; currently covers counting principles, permutations and combinations (Jul. 2023 - Nov. 23)
- Delivered four olympiad **math lectures** on Projective Geometry, Barycentric Coordinates, Generating Functions and Symbolic Combinatorics to interested high-school students as staff of the Online Math Club (Nov. 2021 - Dec. 2022)
- Selected to the **Monsoon Math Camp** organized by students from MIT, Berkeley, IISc etc; studied topics such as Knot Theory, Analytical Number Theory, Topology & Automated theorem proving with Lean (Jul. 2020, Jul. 2021)
- Passed the Trinity College London **Piano** Grade 6 examination (Sep. 2018)