



Krishna Narasimhan Agaram

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Education

Indian Institute of Technology Bombay

B.TECH. WITH HONORS IN COMPUTER SCIENCE AND ENGINEERING
MINOR IN MATHEMATICS

(Nov. 2021 - Jun. 2025)

(GPA: 9.87/10, rank 2/194)
(GPA: 10.0/10)

Research Interests

Complexity Theory, Quantum Information, Machine Learning Theory, Probabilistic Proofs, Reinforcement Learning, Formal Verification for Deep Learning

Research Experience

Complexity of Positional Interactive Proof Systems (ongoing)

[Summer@EPFL, EPFL, Switzerland](#)

GUIDE: PROF. **NICK SPOONER**, DEPT. OF COMPUTER SCIENCE, CORNELL UNIVERSITY
HOSTED BY COMPSEC LAB, EPFL (PROF. ALESSANDRO CHIESA)

(Jun. 2024 - Present)

- Formalized the notion of multi-prover positional **interactive proof** systems in the classical and quantum regimes
- Characterized **expressivity** of classical PMIPs as a function of party locations, which exhibit a **phase transition**
- Working on a generalization to the **quantum** setting, with a focus on the power of **entangled** provers

Efficient Stabilizer State Preparation with Immediate Inference

[ASCI research program, Aalto, Finland](#)

GUIDE: PROF. **VIKAS GARG**, DEPT. OF COMPUTER SCIENCE, AALTO UNIVERSITY

(May 2023 - Nov. 2024)

- Designed a problem-inspired and theoretically sound novel **reward function** to train sample-efficient agents, needing under **5 hours** of training before being able to prepare arbitrary stabilizer states of up to 9 qubits **on the fly**
- Generated circuits **50%** shorter than baselines, all states prepared **exactly**, across the entanglement spectrum
- Proved via **concentration** that each agent generalizes to at least 4×10^{16} unseen states after being trained on only 2.3×10^7 states, corresponding to preparing at least 95% of all states after seeing only $10^{-8}\%$ during training

Lower bounds on testing 3-colorability

[RnD II, CS Honors, IIT Bombay](#)

GUIDE: PROF. **AKASH KUMAR**, DEPT. OF COMPUTER SCIENCE, IIT BOMBAY

(Jan. 2024 - Apr. 2024)

- Established a **linear** lower-bound for 1-sided testing of 3-colorability on $(1/3 - \alpha)$ -far vs 3-colorable **expander** graphs
- Studied various **lower-bound techniques** to prove a 2-sided lower bound for 3-colorable vs $(1/3 - \epsilon)$ -far graphs

Publications, Conferences and Talks

- Oral talk, *Quantum state preparation with reinforcement learning*, APS Global Physics Summit 2025 (Mar. 2025)
- Train once and generalize: Zero-shot quantum state preparation with RL* [🔗](#) (Oct. 2024)
Krishna Agaram, Siddhant Midha, Adrian Müller and Vikas Garg [accepted to **QIP 2025**, under review at **ICLR 2025**]
- Invited to and participated in the **Cornell-Maryland-Max Planck Pre-doctoral Research School** (Aug. 2024)
- Attended Foundations of Software Technology and Theoretical Computer Science (**FSTTCS**) 2023 (Dec. 2023)

Scholastic Achievements

- Department **rank 2** in a class of 194 students in the Computer Science department (2024)
- Placed **8th** overall, East Division (thrice) at the **Simon Marais Mathematics Competition** (2022, 2023, 2024)
- Among the **top 35** students selected for the **International Mathematics Olympiad Training Camp** (2020, 2021)
- Secured All India Rank **40** & 122 in **JEE Advanced** and JEE Main among 140K+ & 1M+ aspirants respectively (2021)
- Among the **top 47** eligible for the International Olympiad on **Astronomy and Astrophysics** Selection Camp (2020)
- Secured **Global Rank 1** in the Southeast Asian Mathematical Olympiad (SEAMO) 2020 (2020)
- Conferred with the **AP** (Advanced Performer) grade for exceptional performance in **Compilers** Lab, **Logic** in CS, **Discrete** Structures, **Data** Analysis, **Quantum** Physics, **Physical** Chemistry and **Differential** Equations (2021-2024)

Scholarships and Recognition

- Awarded the **Institute Academic Prize** awarded to the **top 3** out of 194 students in the department (2024)
- Received the **Institute Academic Prize** given to the **top 20** out of 1300+ students for stellar academic record (2022)
- Conferred with the *Kishore Vaigyanik Protsahan Yojana (KVPY)* scholarship with All India Rank **23** (2020)
- Granted the *National Talent Search Examination (NTSE)* scholarship, ranked **2nd** in Stage 1 (2019)

Key Projects

Compiler for a subset of C

GUIDE: PROF. UDAY KHEDKER

Course Project: Compilers Lab

(Jan. 2024 - Apr. 2024)

- Wrote a **compiler** for a subset of C with parsing, syntactic-semantic analysis and code generation phases; handles expressions, control structures, loops, **nested scoping** and shadowing, **functions** and **arrays** of any dimension
- Proposed **extensions** to the code for type inference, pre-processing, **pointers** and support for structures & **methods**
- Implemented a top-down **program generator** for the language to serve as **testbed** for compiler speed & correctness
- Beat the reference implementation in speed by more than **4x**, compiling **80,000** lines of code in under **10** seconds

Video Style Transfer

GUIDE: PROF. PREETHI JYOTHI

Course Project: Machine Learning

(Aug. 2023 - Nov. 2023)

- Implemented a convolution-based **style transfer** algorithm for **videos** following Gatys et al and Ruder et al
- Enforced temporal coherence of output videos using **optical flow**, preserving style of moving objects across frames
- Tuned parameters affecting **occlusion detection**, reconstruction and style losses with **wandb** to improve quality

FastChat

GUIDE: PROF. KAVI ARYA

Course Project: Software Systems Lab

(Oct. 2022 - Dec. 2022)

- Built chat service with a **distributed** server-client architecture, **end-to-end** encryption and dedicated **load-balancer**
- Users can choose to chat **privately** or in a **group**, and apart from text, one can also send arbitrarily large **files**
- Encoded messages using standard **message protocol** and a message buffer ensures messages are **not lost**

An Introduction to Quantum Computation and QML

SEASONS OF CODE, 2022

Web and Coding Club, IIT Bombay

(Apr. 2022 - Jul. 2022)

- Analysed **quantum algorithms** such as Quantum Teleportation, Phase Estimation, **Shor's Algorithm** and Search with **scratch** implementations in IBM Qiskit following a study of Linear Algebra, Quantum Mechanics and Circuits
- Built a SAT solver with optimal gate complexity $\mathcal{O}(2^{n/2})$ using **Grover's** Algorithm for unstructured search
- Implemented a **paper** on finding the **ground-state molecular geometry** of simple molecules using the **Jordan-Wigner** transform for encodings and a variational quantum circuit for the optimization, with **PennyLane**

Miscellaneous Development Projects

INSPIRED BY VARIOUS COURSES

Self Projects

(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 APIs**; includes API support for regression, clustering, decision trees, PCA, computational graph backprop & neural networks

Verifying neural net robustness to local perturbation

GUIDE: PROF. SUPRATIK CHAKRABORTY

Course Project: Formal methods in ML

(Oct. 2024 - Nov. 2024)

- Built a Linear Relaxation-based Perturbation Analysis (LiRPA) verifier on top of AutoLiRPA to verify robustness of image recognition models to spatially local ℓ_p perturbations applied to an arbitrary region of the image

Linear Cryptanalysis of the DES Cipher

GUIDE: PROF. MANOJ PRABHAKARAN

Course Project: Cryptography and Network Security

(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

Reading Projects

Probabilistic Proof Systems

(May. 2024 - Jun. 2024)

- Studied the complexity-theoretic foundations of **probabilistic proof systems** from *Proofs, Arguments, and Zero-Knowledge* by Justin Thaler, covering interactive proofs, succinct arguments (SNARGs), PCPs and IOPs

Fast Algorithms for PageRank

(Jul. 2023 - Nov. 2023)

- Explored **fast algorithms** for single-node PageRank and presented a **simple theory** (report in the link above) for PageRank vectors that brings out similarities between some algorithms, also **implemented** this **very fast algorithm**

Analytic Combinatorics

(Nov. 2022 - Dec. 2022)

- Examined **symbolic specifications** arising from Pólya's enumeration theorem for combinatorial structures; applied them to enumeration and **asymptotics** of random structures, from *Analytic Combinatorics* by Flajolet & Sedgewick

Service

Teaching Assistantships

(Jan. 2023 - Present)

Responsible for conducting weekly/bi-weekly **problem solving sessions** for a batch of **40+** students

- MA110** - Linear Algebra and Differential Equations (Spring 2024)
- MA106** - Linear Algebra (Spring 2023)
- Responsible for setting **assignments, labs**, preparing exams and **grading** for a batch of 200 students
- CS215** - Data Analysis and Interpretation (Fall 2024)
- CS213** - Data Structures and Algorithms (Fall 2023)

Department Academic Mentor

(Jun. 2023 - Jun. 2024)

- Guided six sophomores of the department in navigating coursework, research, internships and other opportunities as well as personal development during their second undergraduate year

Technical Mentorships

- Summer of Science**. Mentored **six** students in a self-study of probability and statistics (May. 2024 - Jul. 2024)
- Summer of Science**. Guided **four** students in a self-study of modern cryptography (May. 2023 - Jul. 2023)
- Season of Code**. Co-mentored **eight** students studying Quantum Computing foundations (May. 2023 - Jul. 2023)

High School Tutoring

(May. 2024 - Jul. 2024)

- Taught high-school Physics & Chemistry **one-on-one** as part of the **National Service Scheme** (NSS), IIT Bombay

Book: In A Nutshell

GUIDE: PROF. REKHA SANTHANAM, IIT BOMBAY

(Jul. 2023 - Nov. 23)

- Writing a **book** in the spirit of an adventure novel meant to serve as a primer for **enumerative combinatorics** for students in early high school; covers permutations, inclusion-exclusion, the twelve-fold way, generating functions

Staff, Online Math Club

(Nov. 2021 - Dec. 2022)

- Delivered **lectures** covering topics in *Symbolic Combinatorics*, *Barycentric Coordinates*, *Generating Functions* and *Projective Geometry* to interested high-school students

Selected Coursework

Computer Science	Logic & Automata Theory, Approximation Algorithms, Statistical Learning Theory, Quantum Information, Cryptography, Formal Methods in ML, Operating Systems, Robotics
Mathematics	Analysis, Abstract Algebra, Discrete Math, Spectral Graph Theory, Numerical Analysis

Technical Skills

Languages/Tools	C/C++, Python, Bash, $\LaTeX$, x86 Assembly, Rust, JavaScript, Git, 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)
- 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, 2021)
- Passed the Trinity College London **Piano** Grade 6 examination (Sep. 2018)