

Omar Muhammad

+91 9495941889 | omarmuhammad@iisc.ac.in

Profile

B.Tech student specializing in Mathematics and Computing at the Indian Institute of Science with a strong interest in Formal Methods, machine learning, and algorithm design. Actively engaging with formal reasoning, program verification, applied machine learning, and abstract algebra in recent project work.

Eager to apply rigorous mathematical and computational approaches to solve problems in a challenging environment.

Education

All courses were conducted in English

B-TECH IN MATHEMATICS AND COMPUTING | 2023 - 2027 | INDIAN INSTITUTE OF SCIENCE, BENGALURU | CGPA 9.4/10.0

STD 12 (CBSE) | 2022-2023 | SARASWATHI VIDYANIKETHAN, ERNAKULAM | 98.4% | SCHOOL TOP

STD 10 (CBSE) | 2020-2021 | RAJAGIRI PUBLIC SCHOOL, ERNAKULAM | 98%

Research & Internship Experience

- **Research Intern, Enhancing Formal Verification with LLMs | University of Virginia, USA (Remote) | Aug 2025 – Present:** Under the guidance of Prof. Wenxi Wang, developed **ACPRO**, a framework that uses a multi-agent LLM pipeline to transform low-level Z3 proofs into interpretable, high-level Verus verification steps. This work also produced the **VSVerus** dataset, a new resource for studying fine-grained LLM reasoning in formal verification.
- **Research Intern, Scaling Automated Verification with LLMs | IISc | UIUC | UW-Madison | May 2025 – July 2025 :** In a collaboration with Prof. D. D'Souza (IISc), Prof. M. Parthasarathy (UIUC), and Prof. A. Murali (UW-Madison), contributed to a framework for verifying programs by automatically synthesizing library contracts using LLMs and ICE-learning algorithms. Designed and built the core LLM pipeline responsible for generating specifications from logical rules and integrated it into a feedback loop with formal verifiers and testing engines to ensure correctness.
- **Summer Research Fellow, Formalization and Verified Implementation of Group Theoretic Algorithms | Krea University, Andhra Pradesh (Onsite) | May 2025 – July 2025 :** Collaborating with Dr. Rishi Vyas and Dr. T.V.H Prathamesh to formalize proofs for decision problems in geometric group theory (including the word, conjugacy, and subgroup membership problems) using the Lean 4 proof assistant. Key contributions include formalizing two definitions of the Dehn function and proving their equivalence and verifying the algorithm for the conjugacy problem in free groups. Current work focuses on the computability of the Dehn function for hyperbolic groups.
- **Intern | National Payments Corporation of India (NPCI) | Dec 2024 – June 2025 :** Working in a small team to develop an internal tool to enable NPCI employees to query databases and generate data visualizations via natural language prompts. Designing and implementing a pipeline that translates natural language queries to SQL queries, fetches data, determines correct visualization types, and renders visual output.

- **Intern | Applied Research Capability Network (ARC-Net), IISc Campus | July 2024 – Jan 2025:** Fine-tuned LLMs with Tool Integrated reasoning for solving math and physics problems. Used proof assistants and symbolic solvers to verify the chain of thought of the models.

Projects

- **Research Project, Image Denoising Algorithms | UMC203 Project, IISc | March 2025 – April 2025:** Implemented and evaluated various frameworks for image restoration without clean data. Designed and conducted experiments to analyze the hyperparameter sensitivity of Zero-Shot Noise2Noise implementation.
- **Formalization Project, Rubik's Cube Solvability Conditions | Feb 2025 – May 2025:** Modeled the $n \times n \times n$ Rubik's Cube as a group, formalized proof of validity of solvability conditions of the $4 \times 4 \times 4$ Rubik's Cube and formulated the solvability conditions for the $n \times n \times n$ cube.
- **Robotic Arm Motion Planning Lead | Vicharaka – IISc Robotics Team (URC 2025) | Dec 2024 – March 2025:** Responsible for motion planning for the robotic arm of the rover using MoveIt2 and ROS 2.
- **Reading project, Differential Topology and Knot Theory | May 2024 – July 2024:** Explored topics in Differential Topology and Knot Theory under the guidance of Professor Subhojoy Gupta, Department of Mathematics, Indian Institute of Science.
- **Developer | DataBased (CS club at IISc) | Oct 2023 – Dec 2023:** Utilized Generative AI to develop components for an automated Refute Problem Generation system.

Achievements and Recognitions

- JEE Advanced Examination: 646th rank
- JEE Mains Examination: 99.95 percentile, 654th rank
- KVPY (Kishore Vaigyanik Protsahan Yojana) Scholar
- NTSE (National Talent Search Examination) Scholar
- NSEP (National Standard Examination in Physics, IAPT) Qualified, National Top 1%
- NSEA (National Standard Examination in Astronomy, IAPT) Qualified
- NSEC (National Standard Examination in Chemistry, ACT) Qualified
- IOQM (Indian Olympiad Qualifier in Mathematics) Qualified
- Team Shortlisted in the I-4AM 2024 (Industry 4.0 and Advanced Manufacturing) Robotics Challenge
- CBSE Regional Science Exhibition (2020) - Project got selected for Nationals under 'Mathematical Modelling' category
- FIRST Lego League (2020):
 - Team won State Championships
 - Innovation Project shortlisted for Internationals (Global Innovation Award)

Technical Skills

- Python, C, SQL & Lean 4
- MoveIt2 and ROS2
- Algorithms and Data Structures
- Machine Learning: Supervised, Unsupervised and Reinforcement Learning
- Generative AI: Prompt Engineering and Fine-tuning
- Statistics and Probability
- Linear Algebra and Abstract Algebra
- Real Analysis and Multivariable Calculus
- Graph Theory and Number Theory
- Combinatorics
- Automata Theory and Logic

Extracurricular Activities

- Mentored underprivileged students in STEM concepts through the Notebook Drive Mentorship Outreach Program, IISc.
- Active Member of DataBased (Computer Science Club at IISc)
- Designed competitive programming problems for the RevCoding Contest as a Volunteer for Pravega 2025 (IISc UG Fest).
- Presented on 'Online Decision-Making Algorithms' at Algorithm Festival 2024, IISc.
- Enthusiastic participant in MUN (Model United Nations) conferences and debate competitions.