Om Swostik Mishra

3rd year, BS Mathematics, IIT Bombay

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Education

Indian Institute of Technology Bombay *India*

Bachelors in Mathematics with minor in Computer Science and Engineering (CPI - $8.83/10$) *2021 - 2025 (Expected)*

Scholastic Achievements

2023 **Institute Academic Prize 2023**, Awarded for being the top ranker in Mathematics

2023 **Department Rank 1**, Out of 24 students in the BS Programme, Mathematics

2022 **Simon Marais Maths Competition**, Among the top 30 participants in the individual category

2021 **Indian Statistical Institute BMath Test**, All India Rank 1 among 40,000+ candidates

2020 **Indian National Math Olympiad**, Cleared INMO with a rank in the top 30 among 150,000+ candidates

2020 **International Math Olympiad Training Camp**, Selected among the top 30 in India

2020 **Asian Pacific Maths Olympiad**, Qualified for APMO, among the top 80 in India

2020 **Regional Mathematical Olympiad**, Qualified RMO, top 500 among 150,000+ candidates

2019 **Kishore Vaigyanik Protsahan Yojana**, All India Rank 740 out of 100,000+ candidates

Interests

Computer Science Formal Methods, Logic, Automata Theory, Algorithms, Computational Complexity Theory, Game Theory

Research Projects

QUERIES ON GRAPH DATABASES

Guides: Krishna S, CSE, IITB and Diego Figueira, LaBRI, Univ. of Bordeaux *Feb 2023 - Ongoing*

- Worked on the boundedness problem for queries on graph databases.
- Studied results on the query containment problem and the general problem of boundedness of UC2RPQs.
- Analyzed and proved results on the complexity of boundedness of queries on restricted language fragments, (a, a^*) and (w, w^*).
- Working to establish complexity of boundedness of queries over other restricted language fragments.

CONTEXT-BOUNDED MODEL CHECKING

Guides: Krishna S, CSE, IITB, Rupak Majumdar, MPI-SWS and Khushraj Madnani, MPI-SWS *Aug 2023 - Ongoing*

- Read and presented a paper on Context-Bounded Model Checking.

RAMSEY QUANTIFIERS

Guides: Krishna S, CSE, IITB, Georg Zetzsche, MPI-SWS and Khushraj Madnani, MPI-SWS *Aug 2023 - Ongoing*

- Read and presented a paper on Presburger Arithmetic.

Other Projects

SZEMERÉDI REGULARITY LEMMA *Survey project*

Polymath Jr *June 2023 - Aug 2023*

- Working with a group of three PhD mentors to write a survey on the regularity lemma.
- Studied the lemma and its proof along with Gowers' lower bound construction.
- Analyzed the Max-Cut problem along with some hardness results on the complexity.
- Exploring the application of regularity lemma on approximating max-cut in dense graphs.

ALGEBRAIC NUMBER THEORY *Reading project*

Guide: Ravi Raghunathan, Math department, IITB *May 2023 - July 2023*

- Studied the first part of **A Course in Arithmetic** by Serre.
- Analyzed the existence and uniqueness theorem for finite fields, quadratic reciprocity theorem, p-adic fields $\mathbb{Z}_p$ and $\mathbb{Q}_p$ and solutions of equations over them, Hilbert Symbol and Quadratic forms over $\mathbb{Q}_p$ and $\mathbb{Q}$.

REPRESENTATION THEORY OF FINITE GROUPS

Reading project

Summer of Science

May 2023 - July 2023

- Explored representation theory under the mentorship of a PhD student.
- Studied about group representations, Maschke's theorem, Orthogonality relations, characters, class functions, regular representations, representation of abelian groups, fourier analysis on finite groups, Burnside's theorem.
- Delivered a short presentation on the topics covered in the project under the guidance of the PhD mentor.

THEORY OF COMPUTATION

Reading project

Guide: Krishna S, CSE, IITB

Dec 2022

- Explored Turing machines, the Halting problem, Church-Turing thesis, Multitape Turing machines, Nondeterministic Turing machines, Multistack machines, Counter Machines.
- Explored recursive-enumerable languages, diagonalization method, notion of reductions, Rice's theorem, concept of undecidability and undecidability of PCP.
- Investigated the complexity classes P and NP, NP-completeness of SAT and 3SAT along with reductions to show NP-completeness of other problems.

GENERAL TOPOLOGY

Reading project

Guide: Rekha Santhanam, Math department, IITB

Aug 2022 - October 2022

- Explored basic definitions of topological spaces, basis, order topology, product topology, subspace topology, Hausdorff spaces.
- Studied connectedness, path-connectedness, normal spaces, Urysohn's lemma, Tietze's extension theorem, second countable spaces, Urysohn's metrization theorem, Tychonoff's theorem.

Teaching

TEACHING ASSISTANT

- Entrusted with the responsibility of being a Teaching Assistant for the following courses:
  1. **CS 228 - Logic for Computer Science (Minor)** *Aug 2023-Ongoing*
  2. **CS 228 - Logic for Computer Science** *Jan 2023-April 2023*
  3. **MA 109 - Calculus I** *Aug 2022-Nov 2022*
- These involved:
  1. Conducting an hour long tutorial session every week for a tutorial batch of over 40 students.
  2. Presenting solutions to the tutorial problems and addressing doubts of the students related to topics taught in the course.
  3. Grading answer sheets for the quizzes and tests.
  4. Conducting a 90 minute long revision session before the mid-semester and end-semester tests for the courses.

POPULARIZING HIGHER MATHEMATICS IN SCHOOL

SURP Project

Guide: Rekha Santhanam, Math department, IITB

May 2022-Jan 2023

- Aim of the project was to introduce a concept of undergraduate mathematics at school level, in the form of stories.
- Visited schools to introduce group theory and concept of symmetry to kids in grades 8-10.
- Wrote a short book, explaining basics of group theory with the help of a story setting.

Skills

Languages Python, C++, MATLAB, LaTeX, Markdown

Softwares Git, Github, Visual Studio

Key Courses Undertaken

Mathematics Calculus-I, Calculus-II, Linear Algebra, Differential Equations, Real Analysis, Basic Algebra, Combinatorics, Probability, Complex Analysis, Numerical Analysis, Multivariable Calculus, Extremal graph theory

Computer Science Computer Programming and Utilization, Logic for CS, Game Theory, Data Structures and Algorithms, Design and Analysis of Algorithms, Foundations of verification and automated reasoning

Extracurricular Activities

FIDE RATING Actively playing chess since 8th grade and have a FIDE rating of 1202

Freshers Rapid Third place in the Freshers Rapid Chess Competition organised by the Dark Knight Chess Club, IITB 2022

NSO Completed a year long course in yoga under National Sports Organization (NSO), IITB 2022

MENTAL MATH Selected for national level test in mental math under **UCMAS** abacus 2016

SPELLING BEE Qualified for international level of **MaRRS spelling bee** 2010