

# Om Swostik Mishra

3rd year, BS Mathematics, IIT Bombay

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## Education

### Indian Institute of Technology Bombay (English)

BACHELORS IN MATHEMATICS WITH MINOR IN COMPUTER SCIENCE AND ENGINEERING (CPI - 8.83/10)

India

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**, Eligible to appear 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

**Mathematics** Graph Theory, Analytic Methods in Combinatorics, Abstract Algebra, Probability, Topology, Representation Theory

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

GUIDE: KRISHNA S, CSE, IITB [🔗](#)

Aug 2023 - Ongoing

- Read and presented papers on Presburger Arithmetic and Context-Bounded Model Checking [🔗](#).

### RAMSEY QUANTIFIERS

GUIDE: KRISHNA S, CSE, IITB [🔗](#)

Aug 2023 - Ongoing

- Read and presented papers on Ramsey quantifiers and Well-Structured Transition systems.

## Other Projects

### SZEMERÉDI REGULARITY LEMMA

POLYMATH JR [🔗](#)

Survey project

June 2023 - Ongoing

- 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

GUIDE: RAVI RAGHUNATHAN, MATH DEPARTMENT, IITB

Reading project

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, Multi-stack 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)**
  2. **CS 228, Logic for Computer Science**
  3. **MA 109, Calculus I**
- This 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. Conducted a 90 minute long revision session before the mid-semester and end-semester tests for the courses.

Aug 2023-Ongoing

Jan 2023-April 2023

Aug 2022-Nov 2022

## 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 Activity

**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