

# Mudit Aggarwal

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## EDUCATION

**INDRAPRASTHA INSTITUTE OF INFORMATION TECHNOLOGY**  
BACHELOR OF TECHNOLOGY | COMPUTER SCIENCE AND ENGINEERING

**NEW DELHI, INDIA**  
EXPECTED MAY 2023

- Cumulative GPA: 9.18/10

## PUBLICATIONS AND PREPRINTS

- [1] Mudit Aggarwal and T Aaron Gulliver. A New Self-Shrinking Generator (submitted). 2022. URL: <https://www.researchsquare.com/article/rs-2348688/v1>, doi:10.21203/rs.3.rs-2348688/v1.
- [2] Mudit Aggarwal and Samrith Ram. Generating Functions for Straight Polyomino Tilings of Narrow Rectangles. *J. Integer Seq.*, 26(1):Art. 23.1.4, 12, 2023. URL: <https://cs.uwaterloo.ca/journals/JIS/VOL26/Ram/ram3.pdf>.

## RESEARCH EXPERIENCE

### REED SOLOMON CODES AND THEIR VARIANTS | Undergraduate Thesis

ADVISOR: DR. ANURADHA SHARMA

IIIT DELHI, INDIA

August 2022 - Present

- Working on generalising and finding variants to Reed-Solomon Codes, particularly **Twisted RS Codes**, that can be used to detect and correct **Insertion-Deletion errors** during transmission.
- Aiming to use the variants being developed to give error correcting codes for **DNA Sequences**.
- Using techniques from **Algebraic Coding Theory**, as well as Combinatorics, Finite Fields, Number Theory, Modern Algebra, and Linear Algebra.

### GENERATING FUNCTIONS FOR TILING RECTANGLES

ADVISOR: DR. SAMRITH RAM

IIIT DELHI, INDIA

May 2021 - November 2022

- Worked on finding **multivariate generating functions** for the number of ways to tile an  $m \times n$  rectangle with an unlimited number of  $k \times 1$  and  $k \times k$  tiles, allowing for free rotations.
- Also worked on finding the generating functions for the number of tilings with constraints on the number of tiles.
- Using topics and techniques from **Combinatorics, Generating Functions, Recurrences, and Number Theory**.
- A paper [2] has been published in the Journal of Integer Sequences.

### SHRINKING GENERATORS FOR CRYPTOGRAPHY | Mitacs Globalink Research Internship

ADVISOR: DR. AARON GULLIVER

UNIVERSITY OF VICTORIA, CANADA

May 2022 - November 2022

- Worked on finding new **Self-Shrinking Generators** for cryptography, while also generalising the notion of **LFSRs** by introducing **non-linearities** in them. This ensures **better security guarantees** in both theory and practice.
- Compared multiple types of such generators like LFSRs, Cellular Automata, Shrinking Generators, Modified Generators, etc. Additionally, analysing the security of these both **theoretically** as well as **practically**.
- A paper [1] has been submitted and is currently under review.

### BOUNDED ARBORICITY GRAPH STREAMING

ADVISORS: DR. SAKET SAURABH & DR. AKANKSHA AGRAWAL

IMSC CHENNAI & IIT MADRAS, INDIA

Jan 2021 - May 2021

(Remote)

- Worked with Sameep Dahal, Savit Gupta, and Agastya Vibhuti Jha on finding **small-space approximation algorithms** for graphs with a given bounded arboricity, in the streaming model.
- Proved results and small-space algorithms for **Vertex Cover, b-Matching, and Capacitive Matching** for weighted graphs under the streaming model, and unweighted graphs under the dynamic model.

### SUNFLOWER LEMMA AND LIFTING THEOREMS

ADVISOR: DR. SAJIN KOROTH

UNIVERSITY OF VICTORIA, CANADA

May 2022 - September 2022

- Worked on improving the **gadget-size** guarantees of **lifting theorems** in communication complexity using the recent improvements in the **Erdos-Rado Sunflower Lemma**.

- Conversely, also used **randomised lifting theorems** and **decision tree complexity** to further the lower bounds on the size in the sunflower lemma.

## WORKSHOPS

### ALGORITHMS FOR BIG DATA AND ML | ACM WINTER SCHOOL 2020-21

Institute of Mathematical Sciences, Chennai

- The workshop was organised by **Dr. Saket Saurabh** and **Dr. Venkatesh Raman** on **Streaming Algorithms**.
- The main topics covered were: Chernoff bounds, Morris counter, Lower Bounds, AMS estimator, Sparse recovery, Johnson–Lindenstrauss lemma, Graph streaming and PAC learning.

### ALGORITHMS AND LOWER BOUNDS | ACM WINTER SCHOOL 2021-22

IIT Madras and CMI, Chennai

- The workshop was organised by **Dr. Akanksha Agrawal** and **Dr. G. Philip** on **Algorithmic Lower Bounds**.
- The main topics covered were: Fast Fourier Transform, Linear Decision Trees, Polynomial Methods, Complexity Conjectures, and Reductions.

## AWARDS

- **Dean's Award for Academic Excellence** IIIT Delhi  
Awarded for excellent academic performance.
- **OnlyMyHealth HealthCare Heroes Award 2022** Dainik Jagran  
Awarded by Dainik Jagran to **Volunteers.Covihelp**, for exemplary social work during the Covid-19 Pandemic, using digital resources to help people.
- **SchoolTime Achievement Award** The Global Times  
Awarded for exemplary and lasting contribution to The Global Times, a student-run newspaper in the Amity Group of Schools and Universities.

## TEACHING EXPERIENCE

### TEACHING ASSISTANT | DISCRETE MATHEMATICS

INSTRUCTOR: DR. SAMRITH RAM

September 2021 - December 2021

Monsoon Semester, 2021

- Responsible for a group of **~90** students; my duties included taking weekly recitation/tutorial sessions, clearing doubts, and grading papers (assignments, quizzes, and exams).
- Took recitations, where I taught the students, clarified their doubts regarding course content, and did live problem-solving related to the course.
- Graded papers for all the 90 students, as well as made rubrics for the same.

### TEACHING ASSISTANT | ABSTRACT ALGEBRA I

INSTRUCTOR: DR. ANURADHA SHARMA

January 2022 - May 2022

Winter Semester, 2022

- Responsible for a group of **~20** students; my duties included taking weekly recitation/tutorial sessions, clearing doubts, and grading papers (assignments, quizzes, and exams).
- Took recitations, where I taught the students, clarified their doubts regarding course content, and did live problem-solving related to the course.
- Graded papers for all 80+ students in the course, as well as made rubrics for the same.

### TEACHING ASSISTANT | MULTIVARIABLE CALCULUS

INSTRUCTOR: DR. SATISH KUMAR PANDEY

August 2022 - December 2022

Monsoon Semester, 2022

- Responsible for a group of **30** students; my duties included taking weekly recitation/tutorial sessions, clearing doubts, and grading papers (assignments, quizzes, and exams).
- Took recitations, where I taught the students, clarified their doubts regarding course content, and did live problem-solving related to the course.
- Graded papers for all 30 students, as well as made rubrics for the same.

### TEACHING ASSISTANT | COMBINATORICS AND APPLICATIONS

INSTRUCTOR: DR. SAMRITH RAM

January 2022 - May 2022

Winter Semester, 2022

- My duties included clearing doubts and grading papers (assignments, quizzes, and exams).
- Took sessions where I clarified doubts regarding course content, grading, and exams.
- Graded the exams for the course.

## S-CUBE WORLD | STUDENT MENTOR AND CONTENT CREATOR

July 2020 - August 2020 | IIITD Incubation Center

- Designed quality study material and modules for school students, for a community of the students by the students.
- Created presentations for relevant paths and exams as a student mentor.

## VOLUNTEERING EXPERIENCE

### VOLUNTEERS.COVIHELP | CO-FOUNDER

<https://www.volunteerscovihelp.org/>

- Co-Founded and actively worked for the Volunteers.Covihelp organisation during the second wave of the deadly covid-19 pandemic in India.
- The organisation had **24x7 manned helplines** on Facebook, Instagram, Whatsapp, and Twitter. The helplines provided seekers with self-verified information on leads for oxygen cylinders, blood and plasma donors, RT-PCR tests, hospital beds, medicines, etc.
- The organisation had **300+ volunteers**, and successfully resolved **1700+ cases**.
- Also **raised Rs. 25000+** through multiple fundraiser events to donate to patients and for setting up of OPDs.
- Personally worked on **100+ cases**, trained the volunteers, and helped set up the organisation systems on Discord, Google Forms, Airtable, etc.
- Awarded the HealthCare Heroes Award 2022 in the Digital Healthcare category (Details for the same can be found [here](#))

### STUDENT MENTOR

STUDENT MENTORSHIP PROGRAM, IIIT DELHI

September 2022 - Present

- Selected as a student mentor for the Student Mentorship Program at IIIT Delhi.
- Acting as a mentor for 4 mentees, helping them adjust to college life, and tackling the paradigm shift it accompanies.
- Serving as their first point of contact for any scenario.
- Holding weekly to biweekly meetings discussing their mental health, how they cope with the changes, etc.

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### PROJECT ROSHNI: BOOK DONATION

IIIT Delhi | Member

- Collected, organised, curated, and purchased books for donation to underprivileged kids in government schools during Diwali 2019.
- Donated and distributed over 500 books in government schools across New Delhi.

## RELEVANT COURSEWORK

### READING COURSES

- **COMBINATORICS AND REPRESENTATION THEORY** A  
Advisor: Dr. Samrith Ram Monsoon Semester, 2022
  - Studied an assortment of topics from **Combinatorics** and **Representation Theory**, using multiple texts.
  - Main topics covered were Snake Oil, WZ Pairs, Gosper's Algorithm, Pólya-Redfield Theorem, Cycle Index, Symmetric Functions, Partitions, Weighted Objects, and Tableaux.
  - Some texts used were *Generatingfunctionology* by Wilf, *A = B* by Zeilberger, Wilf, Petkovšek, *A Course in Enumeration* by Aigner, and *Bijjective Combinatorics* by Loehr.
- **DIFFERENTIAL GEOMETRY WITH TOPOLOGY** A  
Advisor: Dr. Shilpak Banerjee Summer Semester, 2021
  - Studied **Point-Set Topology** from *Topology* by Munkres.
  - Covered sections on **Differential Geometry** from *Elementary Differential Geometry* by Pressley.
  - Also covered the required multivariable calculus and multivariable analysis prerequisites.
  - Main topics included: Topology, Basis for topology, Metric Spaces, Connectedness, Compactness, Homeomorphisms, Curves and Surfaces, Manifolds, Orientability of Surfaces, Isometries.
- **ADVANCED LINEAR ALGEBRA** <sup>1</sup>

Advisor: Dr. Samrith Ram

Winter Semester, 2022

- Studied **Linear Algebra** from *Linear Algebra* by Hoffman & Kunze, and *Linear Algebra Done Right* by Axler.
- Main topics included: Vector Spaces, Basis, Fields, Maxtrix Systems, Dual Spaces, Functionals, Cyclic Decompositions, Jordan Form, Canonical Forms, Inner Product Spaces.

## GRADUATE COURSES

• <b>INTRODUCTION TO FUNCTIONAL ANALYSIS</b> Instructor: Dr. Satish Kumar Pandey	<b>A [CLASS RANK 1]</b> Winter Semester, 2022
• <b>ABSTRACT ALGEBRA II</b> Instructor: Dr. Sneha Chaubey	<b>A</b> Winter Semester, 2022
• <b>CALCULUS ON <math>\mathbb{R}^n</math></b> Instructor: Dr. Kaushik Kalyanaraman	<b>A</b> Winter Semester, 2022
• <b>APPROXIMATION ALGORITHMS</b> Instructor: Dr. Syamantak Das	<b>A</b> Monsoon Semester, 2022
• <b>THEORY OF MODERN CRYPTOGRAPHY</b> Instructor: Dr. Donghoon Chang	<b>A</b> Winter Semester, 2022
• <b>TOPICS IN NUMBER THEORY</b> Instructor: Dr. Anuradha Sharma	<b>B</b> Monsoon Semester, 2022
• <b>APPLIED CRYPTOGRAPHY</b> Instructor: Dr. Subhabrata Samajder	<b>B-</b> Monsoon Semester, 2021
• <b>MEASURE AND PROBABILITY THEORY</b> <sup>2</sup> Instructor: Dr. Subhajit Ghosechowdhury	Winter Semester, 2023
• <b>INFORMATION THEORY</b> <sup>2</sup> Instructor: Dr. Manuj Mukherjee	Winter Semester, 2023
• <b>LATTICES IN COMPUTER SCIENCE</b> <sup>2</sup> Instructor: Dr. Subhabrata Samajder	Winter Semester, 2023
• <b>INTRODUCTION TO QUANTUM COMPUTING</b> <sup>2</sup> Instructor: Dr. Debajyoti Bera	Winter Semester, 2023
• <b>COMMUNICATION COMPLEXITY</b> <sup>1</sup> Instructor: Dr. Sajin Koroth	Summer Semester, 2022

## UNDERGRADUATE COURSES

• <b>DISCRETE MATHEMATICS</b> Instructor: Dr. Samrith Ram	<b>A+ [CLASS RANK 1]</b> Monsoon Semester, 2020
• <b>REAL ANALYSIS II</b> Instructor: Dr. Satish Kumar Pandey	<b>A [CLASS RANK 1]</b> Monsoon Semester, 2021
• <b>ABSTRACT ALGEBRA I</b> Instructor: Dr. Sneha Chaubey	<b>A</b> Winter Semester, 2021
• <b>PROBABILITY AND STATISTICS</b> Instructor: Dr. Sanjit K. Kaul	<b>A</b> Winter Semester, 2020
• <b>DIFFERENTIAL EQUATIONS</b> Instructor: Dr. Ashish Kumar Pandey	<b>A</b> Winter Semester, 2021
• <b>THEORY OF COMPUTATION</b> Instructor: Dr. Debajyoti Bera	<b>A</b> Winter Semester, 2021
• <b>DATA STRUCTURES AND ALGORITHMS</b> Instructor: Dr. Subhabrata Samajder	<b>A</b> Winter Semester, 2020
• <b>DIGITAL CIRCUITS</b> Instructor: Dr. Sneh Saurabh	<b>A</b> Monsoon Semester, 2019
• <b>LINEAR ALGEBRA</b> Instructor: Dr. Acushla Saraswat	<b>A-</b> Monsoon Semester, 2019
• <b>REAL ANALYSIS I</b> Instructor: Dr. Debika Banerjee	<b>A-</b> Monsoon Semester, 2020
• <b>ANALYSIS AND DESIGN OF ALGORITHMS</b> Instructor: Dr. Syamantak Das	<b>A-</b> Winter Semester, 2021
• <b>BASIC ELECTRONICS</b> Instructor: Dr. Vivek Bohara	<b>A-</b> Winter Semester, 2020
• <b>MODERN ALGORITHM DESIGN</b> Instructor: Dr. Syamantak Das	<b>B</b> Monsoon Semester, 2021

- **SIGNALS AND SYSTEMS** B  
Instructor: Dr. Pravesh Biyani Monsoon Semester, 2020
- **COMBINATORICS AND ITS APPLICATIONS** <sup>1</sup>  
Instructor: Dr. Samrith Ram Winter Semester, 2021
- **MULTIVARIATE CALCULUS** <sup>1</sup>  
Instructor: Dr. Shilpak Banerjee Monsoon Semester, 2021
- **NUMBER THEORY** <sup>1</sup>  
Instructor: Dr. Sneha Chaubey Monsoon Semester, 2020

Footnotes: <sup>1</sup> Course audited with instructor's permission <sup>2</sup> Course ongoing as of writing

## PROGRAMMING PROJECTS

### QUADROTOR DRONE SIMULATOR

CYBORG: ROBOTICS CLUB AT IIITD

April 2020 - June 2020



- Worked with Devansh Gupta to create a quadrotor simulator using **Numpy** and **Matplotlib** in Python.
- It takes quadrotor parameters (size and dynamics) and the way-points for its path from editable text files.
- Uses **Euler-Newtonian** rigid body dynamics, and a multi-loop **PID** controller to simulate the motion of the given quadrotor and give plots for the motion of the same along with the errors.

### LINE FOLLOWER

ELECTROHOLICS: ELECTRONICS CLUB AT IIITD

January 2020 - February 2020

- Worked with Madhur Kumar to create a PID-based Line Following Robot.
- The Robot is built using an Arduino, takes values of the PID constants as inputs, and follows a black line.
- The robot was featured as an entry in the Robotics Competition at Breeze 2020 (at Shiv Nadar University).

### COLOUR SWITCH

ADVANCED PROGRAMMING: COURSE PROJECT

November 2020 - December 2020

Monsoon Semester, 2020



- Worked with Agamdeep Bains to create a **JavaFX** based PC rendition of the popular mobile game **Colour Switch** completely from scratch. Instructor: **Dr. Vivek Kumar**.
- Created the infinite version of the game, with additional functionalities including multiple saves and in-game boosts.

### CACHE SIMULATOR

COMPUTER ORGANISATION: COURSE PROJECT

April 2020 - May 2020

Winter Semester, 2020

- Simulated L1 and L2 caches in python, with options for Direct as well as n-Associative mappings, implemented using bit-string operations. Instructor: **Dr. Prabhaker Mateti**.
- The simulator allows for reading and writing to the cache, with hits and misses also reported to the user.

### SMART ROOM PROTOTYPE

PROTOTYPING INTERACTIVE SYSTEMS: COURSE PROJECT

October 2019 - December 2019

Monsoon Semester, 2019



- Worked with Agamdeep Bains and Aryan Behal to create a prototype of a low cost smart room, as an alternative to the current expensive solutions available in the market. Instructor: **Dr. Aman Parnami**.
- Created a **gesture controlled** scalable prototype, using **Computer Vision** based devices that could be kept in the room. The Computer Vision processes ran on **Raspberry Pi** modules embedded in the devices themselves.

**PROFICIENT IN:** SageMath ● Julia ● LaTeX ● Beamer ● Python ● C++ ● C ● Java

## CO-CURRICULARS

### CLUB INVOLVEMENT

AS PRESIDENT

- **Évariste:**  
Mathematics and Theoretical CS Club of IIIT Delhi.
- **Electroholics:**  
Electronics Club of IIIT Delhi.
- **The 65th Square:**  
Chess Club of IIIT Delhi.

AS CORE MEMBER

- **Cyborg:**  
Robotics Club of IIIT Delhi.
- **LitSoc:**  
Literary/Debating/Pop-Culture Society of IIIT Delhi.
- **PhiloSoc:**  
Philosophy Society of IIIT Delhi.

### SPORTS

- Lawn Tennis

Played **nationals** in 2016, and also represented the institute in multiple tournaments.

- **Chess**

Played **zonals** multiple times, and also represented the institute in multiple tournaments.

## **WRITING**

- **The Global Times**

Wrote for The Global Times, a student-run newspaper, for over 8 years in school. Won multiple awards for contribution including awards like **SchoolTime Achievement**, Best Article, etc.

- **IIIT Delhi**

Contributed articles to **Kaleidoscope**, IIIT Delhi's college magazine. Also organised **Haiku** and **Content Writing** events at Odyssey 2020.