Soham Chatterjee

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Education

- **Chennai Mathematical Institute** — **Chennai, Tamilnadu, India**
  B. Sc - Mathematics and Computer Science — *2021 – Ongoing*
- **Baranagar Narendranath Vidyamandir** — **Kolkata, West Bengal, India**
  Higher Secondary (12^{th} Standard) Education — *2018 – 2020*
- **Baranagar Ramakrishna Mission Ashrama High School** — **Kolkata, West Bengal, India**
  Secondary (10^{th} Standard) Education — *2008 – 2018*

Academic Achievements

- **GS Exam, I-PhD, Computer Science, 2024** — **TIFR, Mumbai, India**
  Nation wide entrance exam in Computer Science for Tata Insititute of Fundamental Research. Only 2 people got selected.
- **JEST, I-PhD, Theoretical Computer Science, 2024 - Rank 5** — **IMSC, India**
  Nation wide entrance exam in Computer Science for Insitute of Mathematical Sciences
- **NEST, B.Sc., 2021** — **NISER, India**
  Nation wide bachelors entrance exam for National Institute of Science Education and Research
- **WBJEE, B.Tech, 2020 - Rank 1893** — **WBJEEB, India**
  Joint Entrance exam for B.Tech for West Bengal state
- **12^{th} Statistics Olympiad, 2020 - Rank 28** — **AIMSCS, India**
  Organized by C R Rao Advanced Institute of Mathematics, Statistics and Computer Science

Internships

- **Polyhedral Combinatorics and Derandomization of Isolation Lemma**
  Supervisor: Rohit Gurjar, IIT Mumbai — *May - Jul, 2024*

  - I read the papers
    - 'Bipartite Perfect Matching is in QUASI-NC' by Fenner, Gurjar and Thierauf
    - 'Linear Matroid Intersection Is in QUASI-NC' by Gurjar and Thierauf
    - 'Fractional Linear Matroid Matching is in QUASI-NC' by Gurjar, Oki and Raj

    Learned how the idea of giving nonzero circulations to cycles and bounding number of integral vectors (corresponding those cycles) twice the size of smallest vector helps construct an isolating weights for bipartite perfect matching polytope to fractional matroid matching polytopes
  - Additionally I read about isolating a path connecting the source vertex and sink vertex in a black-box layered graph from the paper 'Derandomizing Isolation in Space-Bounded Settings' by Melkebeek and Prakriya.
- **Quantum Property Testing of Junta Functions and Partially Symmetric Functions.**
  Supervisor: Arijit Ghosh, Indian Statistical Institute, Kolkata — *Dec, 2024 – Going on*

  - I learned about Fourier Analysis of Quantum Boolean Functions and Quantum algorithms for Testing and Learning Stabilizer States from Quantum boolean functions' by Montanaro and Osborne
  - Also learned about Classical Junta Testing from Eric Blais' paper Testing Juntas Nearly Optimally and then read about Quantum Junta Testing Algorithm from 'Testing and Learning Quantum Juntas Nearly Optimally' by Chen, Nadimpalli and Yuen
  - And I learned about Partially Symmetric Boolean Functions and it's classical algorithm of testing partially symmetric functions from the paper 'Partially Symmetric Functions are Efficiently Isomorphism-Testable' by Blais, Weinstein and Yoshida and we were trying to come up with a Quantum Algorithm for Testing Partially Symmetric Boolean Functions.
- **Factorization of Arithmetic Circuits in Algebraic Complexity Theory**
  Supervisor: Nitin Saxena, IIT Kanpur — *May - Jul, 2022*

  - I read 'Discovering the roots: Uniform closure results for algebraic classes under factoring' by Dutta, Saxena and Sinhababu where I learned factorizing multivariate arithmetic circuits and VP closure under factorization.
  - Also read the Kaltofen's proof of VP closed under factorization.
  - Also learned how Polynomial Identity Testing and Multivariate Factorizations are equivalent from 'Equivalence of Polynomial Identity Testing and Deterministic Multivariate Polynomial Factorization' by Kopparty, Saraf and Shpilka
  - I also read how VBP is closed under factorization from Sinhababu and Tierauf's paper 'Factorization of Polynomials given by Arithmetic Branching Programs'

- Learned about the difficulties about proving factor closure for VF from the above mentioned two papers. I read about factorization of formulas with individual degree bounded form the paper 'Factors of low individual degree polynomials' by Rafael Oliveira and we were trying to remove the condition for formulas

- **Computational Number Theory and Algebra for Algebraic Comlexity Theory.**
  Supervisor: Nitin Saxena, IIT Kanpur *Dec - Jan, 2022*

  - I learned about Computational Number Theory and Algebra from Nitin Saxena's Course and read the book 'Modern Computer Algebra' by Von Zur Gathen and Jurgen Gerhard
  - Also I learned about Arithmetic Circuits from Amir Shpilka's Survey and Ramprasad Saptharishi's Survey on Arithmetic Circuits.

Course Projects

- **Presentation on Iterated Mod Problem** **Slides**
  Presented the paper "Hensel and Newton methods in valuation rings" by J von zur Gathen in Algebra and Computation course at CMI.
- **Presentation on Iterated Mod Problem** **Slides**
  Presented the paper "Iterated Mod Problem" by Karloff and Ruzzo in Parallel Algorithm and Complexity course at CMI.
- **Report on Algebraic Geometric Codes** **Link**
  Followed the Survey by Blake, Heegard, Høholdt, and Wei and Gil Cohen's Course in Algorithmic Coding Theory (II) course at CMI.
- **Qiskit Implementation of Quantum Circuit of Modular Exponentiation** **Link**
  Implemented the paper: "Quantum Networks for Elementary Arithmetic Operations" by Vedral, Barenco and Artur Ekert
- **Qiskit Implementation of Kushlevitz and Mansour Algorithm** **Link**
  Implemented the paper: "Learning Decision Trees Using The Fourier Spectrum" by Kushilevitz and Mansour
- **Qiskit Implementation of Some Quantum Algorithms** **Link**
  Implemented Grover Search for 2×2 sudoku and Iterative Phase Estimation

Workshop, Lecture Serires Attended

- **Quantum Semester Online** — **Chennai Mathematical Institute**
  Chennai, India *2024, Jan-May*
- **Sage Days 122** — **Chennai Mathematical Institute**
  Chennai, India *September, 2023*
- **p-adic Number Theory Lecture Series: Ram Murty** — **Math Dept, University of Mumbai**
  Mumbai, India *Online: August, 2023*

Relevent Courses

Math Courses:

Algebra

- Linear Algebra (Algebra 1)
- Group Theory (Algebra 2)
- Ring and Field Theory (Algebra 3)
- Commutative Algebra

Analysis

- Real Analysis (Analysis 1)
- Analysis in Euclidean Space (Analysis 2)
- Analysis in Metric Space (Analysis 3)

Other Math Courses

- Complex Analysis
- Calculus
- Probability Theory
- Topology

Computer Science Courses:

- Discrete Mathematics
- Design and Analysis of Algorithms
- Theory of Computation
- Complexity Theory
- Parallel Algorithms and Complexity
- Expander Graphs and Application
- Algorithmic Coding Theory (Two Parts)
- Quantum Algorithmic Thinking
- Quantum Information Theory

Computer Skills

- **Programming Languages:** C (Basic), Python (Intermediate), Qiskit (Intermediate), Haskell (Basic), Java (Basic), Unix/Linux Shell Scripting, HTML, CSS
- **Technical Skills:** LaTeX(Advanced), Markdown, Git, Basic works in terminal, VIM, Obsidian