Somnath Bhattacharjee

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Education

2024 – current **PhD Computer Science, University of Toronto**
Advisor: Dr. Swastik Kopparty and Dr. Shubhangi Saraf

2022 – 2024 **M.Sc. Computer Science, Chennai Mathematical Institute**
Thesis on *Rank Computation problem for Linear Matrices*
Thesis advisor: Dr. Partha Mukhopadhyay
Report: [PDF]

2019 – 2022 **B.Sc. Mathematics and Computer Science, Chennai Mathematical Institute**

2017 – 2019 **Higher Secondary Education, Ramakrishna Mission Vidyalaya, Narendrapur**

2011 – 2017 **Secondary Education, Ramakrishna Mission Vidyalaya, Narendrapur**

Research Interest

Algebraic Algorithms, Algebraic and Boolean Complexity Theory, Fine-grained Complexity, Pseudorandomness, Computational Algebra, Error-correcting codes, Algebraic Proof Complexity

Research Publications

Conference Proceedings

[C1] **S. Bhattacharjee**, M. Bläser, P. Dutta and S. Mukherjee. *Exponential Lower Bounds via Exponential Sums*. In proceeding ICALP 2024, https://drops.dagstuhl.de/entities/document/10.4230/LIPIcs.ICALP.2024.24

[C2] **S. Bhattacharjee**, M. Kumar, V. Ramanathan, R. Saptharishi and S. Saraf. *Deterministic factorization of constant-depth algebraic circuits in subexponential time*. In proceeding FOCS 2025.

Submitted/Pre-prints

[P1] **S. Bhattacharjee**, M. Kumar, S. Rai, V. Ramanathan, R. Saptharishi and S. Saraf. *Closure under factorization from a result of Furstenberg*. ECCC: https://eccc.weizmann.ac.il/report/2025/084.

[P2] **S. Bhattacharjee**, M. Kumar, S. Rai, V. Ramanathan, R. Saptharishi and S. Saraf. *Constant-depth circuits for polynomial GCD over any characteristic*. ECCC: https://eccc.weizmann.ac.il/report/2025/085.

Research Internships and Projects

2023 – 2024 Project on *Witness for ABP-PIT via non-commutativity*
Guide Dr. Partha Mukhopadhyay (CMI) and Dr. Iddo Tzameret (Imperial college, London)
In this project, I'm studying upper bounds and lower bounds for the proof-size of non commutative ABPs (which are commutatively zero) using commutators as axioms.

Research Internships and Projects (continued)

2023 (summer)
- Project on *Black-box approximate algorithm for Edmond problem*
  Guide Dr. Abhranil Chatterjee (ISI Cal) and Dr. Partha Mukhopadhyay (CMI)
  In this project I tried to find black box subexponential approximate algorithm for edmonds' problem using Bläser-Jindal-Pandey idea. I also read about algorithms for matroids using edmonds' problem (commutative and non-commutative both) algorithms.

2022 – 2023
- Worked on *The conditional optimality of Ryser formula: Algebraic version of Strong ETH*
  with Dr. Markus Bläser (University of Saarland), Dr. Pranjal Dutta (NUS) and Saswata Mukherjee (CMI)
  In this project I learned about parameterized complexity and fine grained complexity and their relation with algebraic complexity. We finally achieve exponential lower bound in parameterized valiant classes from tau-conjecture.
  This project leads to the submitted work *Lower bounds in parameterized algebraic complexity via exponential sums*, [PDF]

2022 (summer)
- Project on *Uniform Determinantal Complexity*
  Guide: Dr. Markus Bläser (University of Saarland).
  That internship was funded by MPI software system, Saarbrucken.
  Here we have improved the upper bounds for specific Generic polynomials with/without approximation

2022 (6th semester)
- Reading project on *Lower bounds and Border Complexity*
  Guide: Dr. Partha Mukhopadhyay (CMI)
  In this project I studied the determinant complexity and ABP-size lower bounds for power sum. Further more I studied the power of small width ABPs, separation between width-2 weak and general ABP, universality of approximated width-3 weak ABP and width-2 ABP.

2021 (summer)
- Reading project on *PIT using ROABP and Diagonal Circuits*
  Guide: prof. Nitin Saxena (IITK)
  In this project I studied about progress in PIT in various models, mainly focusing on diagonal circuits.
  Report of the internship: [PDF]

Talks and Presentations

2025
- **Seminar talk** (UofT, CMI):
  "Complexity of Factors"
  Slides: [PPT]
- **Seminar talk** (CMI):
  "Deterministic factorization of constant-depth algebraic circuits in subexponential time"
  Slides: [PDF]

2024
- **Seminar talk** (ISI Kolkata, TIFR Mumbai):
  "Explonential lower bounds via exponential sums"
  Slides: [PDF]
- **MSc Thesis Presentation** (CMI):
  "A study on Rank Computation problem for Linear Matrices"
  Slides: [PDF]

2023
- **Course-work Presentation** (Timed Automata):
  "Decidability of Timed Communication Automata" by Lorenzo Clemente
  Slides: [PDF]

Talks and Presentations (continued)

- **Course-work Presentation** (Parallel Algorithm and Complexity):
  "Linear Matroid Intersection is in Quasi-NC" by Rohit Gurjar and Thomas Thierauf
  Slides: [PDF]

2022

- **Course-work Presentation** (Complexity Theory II):
  "$BPSPACE(S) \subseteq DSPACE(S^{3/2})$ " by Michael Saks and Shiyu Zhou
  Report: [PDF]
- **Course-work Presentation** (Matching and Flow Algorithms):
  "An $O(n \log^2 n)$ Algorithm for Maximum Flow in Undirected Planar Networks" by Refael Hassin and Donald B. Johnson
  Report: [PDF], Slides: [PDF]

2021

- **Course-work Presentation**(Structure vs Hardness in Cryptography):
  "Lattice Basis Delegation in Fixed Dimension and Shorter-Ciphertext Hierarchical IBE" by Shweta Agrawal, Dan Boneh and Xavier Boyen.
  Report:[PDF], Slides: [PDF]
- **CMI Student Seminar**: "Progress in PIT"
  Slides: [PDF]

Attended Workshops

May 2025 — ICTS Workshop on HDXs and Codes

March 2025 — Workshop on Algebraic Complexity Theory (WACT'25)

Jan-Apr 2024 — Quantum Computing Semester, CMI

March 2023 — Workshop on Algebraic Complexity Theory (WACT'23)

2021-2022 — School and Conference on Geometric Complexity Theory (online)

Academic Achievements

2025 — In a joint work with Kumar, Rai, Ramanathan, Saptharishi and Saraf, we solved a long standing open problem by showing formulas and constant depth circuits are closed under taking factors.

2022 — Selected for Sriram and Infosys scholarship for Masters Degree

Research Intern in Max Planck Institute for Software Systems.

2019 — Selected for INSPIRE scholarship (sponsored by central Government for research purpose, given to the top 1% student of India)

Selected for Sriram scholarship (Based on the result of CMI admission test)

2018 — Attended JBNSTS junior science camp held at IISER Kolkata

JBNSTS junior scholar (Government sponsored science scholarship test)

2017 — Swami Vivekananda Scholarship (State-Government scholarship based on Board-marks)

2015 — 3rd in Mathemazic (Intra-city mathematical quiz competition)

Teaching Assistant

Sep-Nov 2025

- Introduction to Theory of Computation (UofT course)
  60 hrs TA-ship
- Computational Complexity and Computability (UofT course)
  60 hrs TA-ship

Teaching Assistant (continued)

Jan-Mar 2025	Algorithm Design, Analysis and Complexity (UofT course) 60 hrs TA-ship
Sep-Nov 2024	Introduction to Theory of Computation (UofT course) 90 hrs TA-ship
Jan-Apr 2024	Discrete Math (CMI course) Instructor: Dr. Samir Datta
Jan-Mar 2024	Design and Analysis of Algorithms (NPTEL course) Instructor: Dr. Madhavan Mukund
Aug-Nov 2023	Design and Analysis of Algorithms (CMI course) Instructor: Dr. G. Philip
	Linear Algebra (Sai University course) Instructor: Dr. Neha Prabhu
Aug-Sep 2023	Design and Analysis of Algorithms (NPTEL course) Instructor: Dr. Madhavan Mukund
Jan-Apr 2023	Discrete Maths (CMI course) Instructor: Dr. V. Arvind and Dr. Amit Sinhababu
Jan-Apr 2022	Computational Complexity Theory (CMI course) Instructor: Dr. Prajakta Nimbhorkar
Aug-Nov 2021	Mathematical Methods of Analysis (CMI course) Instructor: Dr. Kavita Sutar
Apr-Jul 2021	Discrete Maths (CMI course) Instructor: Dr. K. V. Subrahmanyam

Extra Curricular Activities

Programming Languages	Python, C, C++, JAVA, Haskell, Latex and HTML
Magazine	I was one of the co-editors of the science magazine Tiyas. It is an online science magazine mainly contains lots of science articles, puzzles, quizzes and many more
STEMS	I was part of question setting committee for computer science in STEMS 2021, 2022, 2023 I was part of core organising committee of our college fest Tessellate 2020
Games	I mainly play and watch football. Other than that I used to play Table Tennis, Cricket, Basketball, Volleyball and Chess etc.
Others	In my spare time I used to perform drama, recitation and music. Also I love to read story books and watch movies.