Vipul Arora

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Research Interests

Theoretical Computer Science, with focus on Property Testing, Learning Theory, Complexity Theory, & Combinatorics.

Teaching Interests

Theoretical Computer Science, and Advanced Mathematics, especially Geometry, and Combinatorics.

Employment History

○ (Jan 2025 - Present) Postdoctoral Fellow at the Simons Institute, UC Berkeley.

Education

National University of Singapore (NUS) **Jan 2025**
Doctor of Philosophy (PhD), Computer Science *Thesis: Testing and Learning Polynomials Over Reals*

Indian Institute of Science (IISc), Bangalore **Dec 2018**
Doctor of Philosophy (PhD), Computer Science *(coursework only, moved to NUS in Jan 2019)*

Chennai Mathematical Institute (CMI) **July 2017**
Master of Science (M.Sc.), Computer Science *Thesis: Arithmetic Circuits: A Study*

Indian Institute of Technology (IIT), Kanpur **June 2014**
Bachelor of Technology (B.Tech.), Computer Science *Project: Entropy Estimation in Data Streams*

Publications and Preprints

1. *Low Degree Testing over the Reals.* Vipul Arora, Arnab Bhattacharyya, Noah Fleming, Esty Kelman, and Yuichi Yoshida. SODA 2023.
2. *Near-Optimal Degree Testing for Bayes Nets.* Vipul Arora, Arnab Bhattacharyya, Clément L. Canonne, and Joy Qiping Yang. ISIT 2023
3. *Outlier Robust Multivariate Polynomial Regression.* Vipul Arora, Arnab Bhattacharyya, Mathews Boban, Venkatesan Guruswami, and Esty Kelman. ESA 2024
4. *On Optimal Testing of Linearity.* Vipul Arora, Esty Kelman, and Uri Meir. SOSA 2025
5. *Testing Sparse Functions over the Reals.* Vipul Arora, Arnab Bhattacharyya, Philips George John, and Sayantan Sen. (Submitted to SODA 2026)

Research Programs Attended

○ Visiting Graduate Student as part of the Summer 2024 Program on Sublinear Algorithms at the Simons Institute, UC Berkeley.

Teaching Experience and Other Services

- Served as a tutor for Theoretical CS courses at NUS, viz. Discrete Structures, Design and Analysis of Algorithms, Randomized Algorithms, and Algorithms for Big Data.
- Served as reviewer for RANDOM 2023, and SODA 2026.

Awards Received

- Awarded the Research Achievement Award from NUS School of Computing, Jan 2023.
- Awarded a SIAM Student Travel Grant for attending SODA 2023, and SOSA 2025.
- Awarded a Registration Fee waiver for the ACM India IndiCS 2024 Seminar.

Seminars Given

- *Low Degree Testing over the Reals,* at the NUS AlgoTheory Seminar, CMI CS Seminar, IISc Bangalore Theory Seminar, Univ. of Sydney SACT Seminar, Univ. of Melbourne SCIS Seminar, NII Tokyo, Simons Institute (A Lightning Talk as part of the Extroverted Sublinear Algorithms Workshop), UIUC Theory TeaTime Seminar, LSE PhD Seminar on Combinatorics, Games, and Optimization, Univ. of Cambridge Algorithms and Complexity Seminar, ACM India IndiCS 2024 Seminar on Continuous Methods in Discrete Optimization and Complexity, CSE IIT Bombay Seminar, TIFR STCS Seminar, IMSc TCS Seminar, and the Simons Institute.
- *Outlier Robust Multivariate Polynomial Regression*, at the Tokyo Institute of Technology, the Simons Institute (Weekly Talk as part of the Sublinear Algorithms Program), TTIC (a lightning talk as part of the Workshop on Learning-Augmented Algorithms), CMI CS Seminar, IISc Bangalore Theory Seminar, and CSE IIT Bombay Seminar.
- *Tightly Relating L^1 and L^∞ Norms of Polynomials*, at the Simons Institute (A Hidden Gems Talk as part of the Sublinear Algorithms Program), and CMI Mathematics Seminar.
- *On Optimal Testing of Linearity* at the University of Warwick.
- *Testing Sparse Functions over Reals*, at the Simons Institute during the Sublinear Algorithms Reunion Workshop 2025.

Posters Presented

- *Low Degree Testing over the Reals,* at the AMSI-AustMS Workshop on Bridging Maths and Computer Science 2022, NUS CS Research Area Open House 2023, and Workshop on Local Algorithms 2024.

Ph.D. Thesis

TESTING AND LEARNING POLYNOMIALS OVER REALS

Advisor: Prof. Arnab Bhattacharyya, (presently at) University of Warwick, UK

This thesis is about designing sublinear algorithms for some fundamental problems in property testing concerning multivariate polynomials over infinite domains, starting with *low degree testing*. All prior work on low degree testing was on finite domains, and in our work, we designed query-efficient algorithms for testing if a function is close to a low-degree polynomial. We also designed optimal algorithms for testing linear polynomials. Next, we solved *outlier robust multivariate polynomial regression*, giving optimal sample-efficient algorithms for the problem, in full generality. Finally, we solved the problem of testing for *sparse representations*.

M.Sc. Thesis

ARITHMETIC CIRCUITS: A STUDY
Advisor: Prof. Meena Mahajan, Institute of Mathematical Sciences (IMSc)
This thesis was a literature survey on arithmetic circuits, focused on the point of view of proving lower bounds on the size required for circuits to compute certain polynomials. Starting from Valiant's definitions of complexity classes VP, and VNP, and the notions of projections, and complete problems, the techniques studied included homogenization, design of universal circuits, formal partial derivative computation, and depth reduction, ending with a concrete lower bound for circuits computing the permanent polynomial.

B.Tech. Project

ENTROPY ESTIMATION IN DATA STREAMS USING STABLE DISTRIBUTIONS
Advisor: Prof. Sumit Ganguly, CSE Department, IIT Kanpur
The project focused on trying to relate the well-behaved characteristic functions of stable distributions and the hard-to-compute entropy function of a data stream. It involved developing approximation arguments to show that the function we were computing, a manipulated form of the characteristic function, was multiplicatively close to the desired entropy function.

Relevant Computer Science & Mathematics Courses Done

- At NUS (Doctoral):
  - Randomized Algorithms
  - Theory and Algorithms for Machine Learning
  - Property Testing
  - Algorithmic Mechanism Design
  - Bounded Space Computations
  - Probabilistic Proof Systems
  - Boolean Function Analysis
  - Mathematics of Data
- At IISc (Doctoral):
  - Topics in Algebra and Computation
  - Topics in Discrete Probability
  - Spectral Algorithms
  - Cryptography
  - Graph Theory
- At CMI, and IMSc, Chennai (Masters):
  - Computational Complexity
  - Infinite Discrete Structures
  - Graduate Algorithms
  - Algebra and Computation
  - Concrete Lower Bounds
  - Mathematical Logic
  - Mathematical Foundations of Computer Science
  - Mathematical Optimization
  - Dynamic Data Structures Lower Bounds
  - Dynamic Graph Algorithms
- At IIT Kanpur (Undergraduate):
  - Data Streaming: Algorithms & Systems
  - Theory of Computation
  - Design and Analysis of Algorithms
  - Discrete Mathematics
  - Data Structures & Algorithms
  - Applied Game Theory
  - Probability and Statistics
  - Complex Analysis & Linear Algebra
  - Real Analysis
  - Differential Equations

🖥 Skill-Set

- </> **Programming:** Java, C/C++, Python, x86 Assembly, GNU Octave, Matlab.
- **OS:** 🐧Linux, ⊞Windows, **Miscellaneous:** GApps, Microsoft Office , **Typesetting:** LaTeX

References

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Dr. Divesh Aggarwal
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