Sayan Mukherjee

Project Research Associate, The University of Tokyo

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EDUCATION

University of Illinois at Chicago
Ph.D., Mathematics, *Aug 2016 - Aug 2021*
Thesis title: *Extremal Problems for Graphs and Hypergraphs* (Advisor: Dr. Dhruv Mubayi)

Indian Statistical Institute, Bangalore
B.S., Mathematics, *Jul 2013 - Jun 2016*

WORK EXPERIENCE

Project Assistant Professor (特任助教), Department of Physics, The University of Tokyo
Feb 2024 - current

- Principal Investigator, Extremal problems in graphs, their generalizations and applications to tensor networks and computer science (JSPS Grant Number 24K22830)
- Research supported by the Center for Innovations in Sustainable Quantum AI (JST Grant Number JPMJPF2221) and Quantum Software Project Endowed Chair.
- Conducting research on tensor networks, theoretical computer science and computer graphics.

Applied Researcher, Blueqat Inc.
Jun 2021 - Jan 2024

- Conducted independent and collaborative research on quantum algorithms, machine learning and graph theory at the Blueqat Research Lab.
- Collaborated on joint research projects worldwide with researchers from The University of Tokyo, Tsukuba University, Aoyama Gakuin University, University of Warwick, Quantescence, Balyasny Asset Management.

Visiting Researcher, Department of Physics, The University of Tokyo
Aug 2022 - Jan 2024

- Visited the Todo research group at the Department of Physics, Graduate School of Science as a collaborative joint researcher.
- Conducted research on tensor networks for quantum simulation and theoretical computer science.

Graduate Teaching Assistant, UIC
Aug 2016 - May 2021

- Led and instructed over twenty different discussion sessions of 20-25 students each, including the following subjects: Linear Algebra, Graph Theory, Introduction to Python, Introduction to Data Structures, Computer Algorithms, Codes and Cryptography.
- Duties included grading homework assignments and exams, preparing course materials and holding mentoring hours with undergraduate students.

RESEARCH AREAS OF INTEREST

Tensor networks, quantum algorithms, theoretical computer science, computer graphics, extremal combinatorics

LANGUAGES

- Bengali and Hindi (native), English (fluent) and Japanese (JLPT N1)

SKILLS

- Experienced in C++, sage, python
- Proficient in Algorithms, Graph Theory and Combinatorial Optimization
- Experienced in Quantum Algorithms and Theoretical Machine Learning

INTERNSHIP EXPERIENCE

Quantum Computing Software Intern, Elyah
May 2020 - Aug 2020

- Designed and implemented quantum algorithms solving problems with real life applications using Grover Search. Work led to a journal publication.

Research Intern, Stochastic Modeling of Biochemical Pathways, Indian Statistical Institute
Apr 2016 - Jul 2016
Mentor: Dr. Rajat K. De

- Explored the problem of the time required for a closed biochemical system to return to its original state. Solved the problem for linear cyclic reactions, leading to a journal publication.

Visiting Research Student on Graph Theory, Tata Institute of Fundamental Research
Jun 2013 - Jul 2013
Mentor: Dr. Amitava Bhattacharya

- Studied Matching Theory, Flows and Networks, Vertex and Edge-Coloring, and the Combinatorial Nullstellensatz. Solved problems on the topics as suggested by the mentor.

INVITED TALKS

- *Tight query complexity bounds for learning graph partitions,* Presented at Conference of Learning Theory, (July 2022)
- *Extremal number of hypergraph suspensions of even cycles,* Discrete Mathematics Seminar, University of Delaware (April 2021)

HONORS AND AWARDS

- University of Illinois at Chicago Merit Award for incoming students, Fall 2016
- KVPY Fellow, Govt. of India, 2013-2016
- Merit Certificate, Indian National Mathematical Olympiad, 2012, 2013

TEACHING EXPERIENCE

Duties at University of Illinois, Chicago (2016-2021)

- Led and instructed discussion sessions at various levels with 20-25 students each
- Duties include grading homework assignments and exams, preparing course materials and holding weekly mentoring hours with undergraduate students

Courses Taught and Graded

- Fall 2016: Calculus I
- Spring 2017: Calculus I
- Fall 2017: Calculus II
- Spring 2018: Calculus II
- Fall 2018: Applied Linear Algebra, Graph Theory

- Spring 2019: Python Programming, Data Structures
- Fall 2019: Data Structures, Precalculus, Graph Theory
- Spring 2020: Combinatorics, Codes and Cryptography
- Summer 2020: Computer Algorithms I
- Fall 2020: Data Structures, Graph Theory, Computer Algorithms I
- Spring 2021: Calculus for Life Sciences

SERVICE

- Reviewer, *Discrete Mathematics*, Elsevier
- Reviewer, *Nature*, Springer
- Reviewer, *AISTATS 2024*
- Endorser, *Combinatorics publications*, arXiv

PUBLICATIONS (by area)

(Google Scholar: 1U95To0AAAAJ)

Extremal Combinatorics

1. Extremal numbers of hypergraph suspensions of even cycles, *European Journal of Combinatorics 118, 2024*
2. Exact generalized Turan number for K_3 versus suspension of P_4, *Discrete Mathematics 347(4), 2024*
3. Triangles in graphs without bipartite suspensions (with D. Mubayi), *Discrete Mathematics 346(6), 2023*
4. Stability theorems for some Kruskal-Katona type results (with X. Liu), *European Journal of Combinatorics 110, 2023*
5. Maximum H-free subgraphs (with D. Mubayi), *Journal of Combinatorics 12 (2), 2021*

Theoretical Computer Science

6. Robustness of spectral clustering under local differential privacy (with V. Suppakitpaisarn), *submitted, 2024*
7. Tight query complexity bounds for learning graph partitions (with X. Liu), *Conference of Learning Theory (COLT) 2022, in Proceedings of Machine Learning Research*

Quantum Computing

8. A Grover search based algorithm for the list coloring problem, *IEEE Transactions on Quantum Engineering (TQE), 2022*

Computer Graphics

9. Stylized Rendering as a Function of Expectation (with R. West), *ACM Transactions on Graphics 43 (4) (SIGGRAPH), 2024*
10. Neural sequence transformation (with S. Mukherjee, B.S. Hua, N. Umetani, D. Meister), *Pacific Graphics Conference (PG) 2021, in Computer Graphics Forum 40 (7)*

Others

11. Expected return time to the initial state for biochemical systems with linear cyclic chains: unidirectional and bidirectional reactions (with R.K. De, D. Ghosh), *Sādhanā 44, 2019*
12. Neuberg locus and its properties (with D. Banerjee), *Journal of Classical Geometry 2, 2013*