

## Sayan Mukherjee

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AFFILIATION/ PERSONAL INFORMATION	<b>Researcher</b> blueqat Research, blueqat Inc. Shibuya Scramble Square 39F, Shibuya 2-24-12, Tokyo, Japan 150-0002	Email: sayan@blueqat.com Ph: +1-312-383-9286 LinkedIn: sayanmukherjee1995 Github: Potla1995 Google Scholar: 1U95To0AAAAJ DOB: October 21, 1995
RESEARCH AREAS	Quantum Computing and Quantum Information, Machine Learning, Graph Theory and Optimization.	
EDUCATION	<b>Ph.D. in Mathematics</b> , University of Illinois at Chicago, USA August 2016 – May 2021 (GPA: 4.00/4.00) Department of Mathematics, Statistics and Computer Science Thesis Title: <i>Extremal Problems for Graphs and Hypergraphs</i> Advisor: Dr. Dhruv Mubayi 851 S. Morgan St., Chicago, IL 60607 Contact: dgs-mscs@uic.edu, +1-312-996-3041  <b>Bachelor of Mathematics</b> , Indian Statistical Institute, Bangalore, India June 2013 – May 2016 (Absolute score: 87.2%, first division with distinction) Statistics and Mathematics Unit 8th Mile, Mysore Road, Bangalore 560059 Contact: statmath@isibang.ac.in, +91-80-26985440	
WORK EXPERIENCE	June 2021– current	<b>Applied Researcher</b> <i>Company Name:</i> blueqat Co. Ltd. <i>Location:</i> Remote - Doing fundamental theoretical research on Quantum Computing and Machine Learning. - Publishing papers, giving presentations on the research at conferences and journals, and writing expository and advanced tutorials on quantum computing.  June–August 2020 <b>Quantum Computing Intern</b> <i>Company Name:</i> Elyah <i>Location:</i> Remote - Designed and implemented quantum algorithms solving problems with real life applications using Grover Search. - Coded in qiskit, pyquil and braket-sdk, and tested said algorithms on both simulators and quantum computers.
LANGUAGES	English, Bengali, Hindi, and Japanese.	
SKILLS	Independent and collaborative research, Programming (Python, C++), Computer Algorithms, Machine Learning, Graph Theory, Optimization.	
PROFESSIONAL SERVICE	Reviewer, <i>Discrete Mathematics</i> , Elsevier Endorser, <i>Combinatorics Publications</i> , arXiv	

RESEARCH  
EXPERIENCE

- April  
2022
- IDEAL Workshop on Clustering**  
*Organizer:* The Institute for Data, Econometrics, Algorithms, and Learning  
*Location:* Remote.  
 - Attended workshop on clustering algorithms in Theoretical Machine Learning. Lecturers from different academic institutes and companies discussed the recent progress on problems related to clustering.
- July  
2019
- Polynomial Methods in Combinatorics**  
*Workshop Lecturers:* Adam Sheffer, Joshua Zahl  
*Location:* University of California, Berkeley.  
 - Attended Summer Graduate School at the Mathematical Sciences Research Center via recommendation by the UIC Math department.  
 - Studied applications of the polynomial method in combinatorics and analysis, and attended daily collaborative problem solving sessions.
- June  
2018
- SIAM Conference on Discrete Mathematics**  
*Organizer:* Society for Industrial and Applied Mathematics  
*Location:* University of Colorado, Denver.  
 - Attended conference talks on the most recent advances in discrete mathematics, delivered by experts as well as graduate students working on the field.
- June  
2017
- Random Graphs and Probabilistic Methods**  
*Workshop Lecturers:* Dimitris Achlioptas, Louigi Addario-Berry, Andrzej Rucinski, Lutz Warnke  
*Location:* University of Toronto  
 - Attended Summer Graduate School at the Fields Institute for Research in Mathematical Sciences through a competitive selection procedure.  
 - Learned several recent techniques in random graphs and probabilistic methods via lectures and problem sessions organized at the summer school.
- May–July  
2016
- Stochastic Modeling of Biochemical Pathways**  
*Mentor:* Dr. Rajat K. De, Machine Intelligence Unit,  
*Location:* Indian Statistical Institute, Kolkata.  
 - Studied modeling of biochemical pathways as Markov Chains.  
 - Explored the problem of time required for a biochemical system to return to its original state. Solved the problem for linear cyclic reactions, leading to a journal publication.
- June–July  
2015
- Graph Theory as a Visiting Research Student**  
*Mentor:* Dr. Amitava Bhattacharya, Dept. of Mathematics,  
*Location:* Tata Institute of Fundamental Research, Mumbai.  
 - Studied Matching Theory, Flows and Networks, Vertex and Edge-Coloring, and Combinatorial Nullstellensatz.  
 - Solved problems in these topics as suggested by the guide.
- Jun–July  
2013
- Image Processing in Matlab using Morphological methods**  
*Mentors:* Dr. Abhijit Kar, Dept. of CS, Jadavpur University,  
 Dr. R.K. Chatterjee, Faculty of CS, Birla Inst. Tech.,  
 Dr. Somojit Saha, Neurologist.  
*Location:* Jadavpur University, Kolkata.  
 - Studied “Image Processing in Matlab” by Gonzalez-Woods-Eddins to learn the basics of Morphology.  
 - Designed an algorithm for segmentation of white matter from MRI images using modified Regiongrow techniques.

PRESENTATIONS  
AND TALKS

- 2021 **Turán Numbers of Hypergraph Suspensions of Even Cycles**  
University of Delaware  
Invited to give a talk at the Discrete Mathematics seminar at the University of Delaware on the preprint titled the same as above on April 21, 2021.
- 2020 **Learning Circuits using Value Injection Queries**  
Final Presentation, Introduction to Artificial Intelligence, UIC  
Presented a paper titled the same as above, authored by Dana Angluin, James Aspnes, Jiang Chen, Yinghua Wu, *Journal of Computer and System Sciences* 75 (2009): 60-77 as a final exam for the Fall 2019 course on Data Science lectured by Lev Reyzin.
- 2019 **Spectral Partitioning of Random Graphs**  
Final Presentation, Mathematical Foundations of Data Science, UIC  
Presented a paper titled the same as above, authored by Frank McSherry, *Foundations of Computer Science 2001: 529-537* as a final exam for the Fall 2019 course on Data Science lectured by Lev Reyzin.
- 2019 **An Invitation to Combinatorics**  
Graduate Student Colloquium, UIC  
Gave a talk to around 30 first year graduate students introducing some of the recent research in Combinatorics in the UIC Math department.
- 2018 **Analyzing Growth of an Extremal Function for Hypergraphs**  
Graduate Combinatorics/ Math and CS Seminar, UIC  
Presented research leading to the paper titled *On Maximum  $\mathcal{H}$ -free Subgraphs* to an audience of size roughly 10 consisting of graduate students and professors working on combinatorics and computer science in the department.
- 2018 **An introduction to the Turán problem on graphs**  
Graduate Theoretical CS Seminar, UIC  
Gave a survey of Turán problems on graphs to graduate students and professors working on combinatorics and computer science in the department.
- 2017 **The emergence of linearly sized paths in the “supercritical regime” for the random graph  $G(n, p)$**   
Graduate Theoretical CS Seminar, UIC  
Presented recent research on emergence of linear paths in random graphs aimed at graduate students and professors working on combinatorics and computer science in the department.

TEACHING  
EXPERIENCE AT  
UIC

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|--------|------|---|
| Fall   | 2016 | Teaching Assistant, Calculus I  |
| Spring | 2017 | Teaching Assistant, Calculus I  |
| Fall   | 2017 | Teaching Assistant, Calculus II   |
| Spring | 2018 | Teaching Assistant, Calculus II   |
| Fall   | 2018 | Grader, Applied Linear Algebra, Graph Theory  |
| Spring | 2019 | Teaching Assistant, Python Programming, Data Structures                             |
| Fall   | 2019 | Teaching Assistant, Data Structures, Precalculus, Graph Theory                      |
| Spring | 2020 | Grader, Combinatorics, Codes and Cryptography                                       |
| Summer | 2020 | Grader, Computer Algorithms I   |
| Fall   | 2020 | Teaching Assistant, Data Structures, Graph Theory,<br>Grader, Computer Algorithms I |
| Spring | 2021 | Teaching Assistant, Calculus for Life Sciences                                      |
- Duties**
- Lead and instruct over twenty different discussion sessions of 20-25 students each, including subjects in mathematics and computer science.
  - Grading homework assignments and exams, preparing course materials and holding mentoring hours with undergraduate students.

## OTHER PROJECTS

- **Estimating beatmap difficulty in osu! rhythm game**

Designing and testing an unofficial algorithm to compute the difficulty of beatmaps in a rhythm game called “osu!”. Also writing a discord bot in python to recommend beatmaps to players based on the type of maps they usually like to play.

Github: [https://github.com/Potla1995/POT\\_Bot](https://github.com/Potla1995/POT_Bot)

- **Translating Light Novel from Japanese to English**

Translated Volume 3 of a light novel (as a fan) named “Real na Kanojo nante Irimasen!” (English: “I don’t need a real girlfriend!”) from Japanese to English. Also built the webpage hosting the translations from scratch using Bootstrap, CSS, mdbook, and Travis CI.

Web: <https://potla1995.github.io/>

## HONORS AND AWARDS

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|-----------|---|
| 2016      | <b>Merit Award, Fall 2016, UIC</b><br>(Based on academic performance and MS exam)                                   |
| 2013–2016 | <b>KVPY Fellowship from Govt. of India</b><br>(Rank: 100 (India), Qualified for BS at Indian Institute of Sciences) |
| 2011      | <b>Sharygin Geometry Olympiad, online correspondence round</b><br>(Rank: 4 (intl.), score: 53/63)                   |
| 2011–2013 | <b>Indian National Mathematical Olympiad</b><br>(Merit Certificate Holder for 2012 and 2013)                        |

## PUBLICATIONS

- D. Banerjee, S. Mukherjee, *Neuberg Locus and its Properties*, J. Classical Geometry, Volume **2** (2013), 26–38. (pdf)
- S. Mukherjee, D. Ghosh, R.K. De, *Expected Return Time to the Initial State for Biochemical Systems with Linear Cyclic Reactions: Unidirectional and Bidirectional*, Sadhana, Volume **44** (2019), 03. (pdf)
- D. Mubayi, S. Mukherjee, *Triangles in graphs without bipartite suspensions*, submitted (2020). (pdf)
- X. Liu, S. Mukherjee, *A new stability theorem for the expansion of cliques*, submitted (2020). (pdf)
- D. Mubayi, S. Mukherjee, *Maximum  $\mathcal{H}$ -free Subgraphs*, Journal of Combinatorics, Volume **12 (2)** (2021). (pdf)
- S. Mukherjee, *Turán Numbers of Hypergraph Suspensions of Even Cycles*, submitted (2021). (pdf)
- S. Mukherjee, S. Mukherjee, B.S. Hua, N. Umetani, D. Meister, *Neural Sequence Transform*, Computer Graphics Forum, Volume **40 (7)** (2021). (pdf)
- S. Mukherjee, *Extremal Problems for Graphs and Hypergraphs*, University of Illinois at Chicago, Thesis (2021). (pdf)
- S. Mukherjee, *A Grover search-based algorithm for the list coloring problem*, IEEE Transactions on Quantum Engineering, Volume **3** (2022). (pdf)
- X. Liu, S. Mukherjee, *Tight query complexity bounds for learning graph partitions*, accepted, Conference on Learning Theory (2022). (pdf)