Shuyang Gong

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RESEARCH INTERESTS

Probability theory and its intersection with statistical physics, combinatorics, statistics and computer science.

EDUCATION

Peking University, Beijing, China — September, 2021 — June, 2026(expected)
PhD in Mathematics

Shandong University, Jinan, China — September, 2017 — June, 2021
Bachelor of Mathematics: GPA ranked 1st/132

PUBLICATIONS/PREPRINTS

- **A polynomial-time approximation scheme for the maximal overlap of two independent Erdős-Rényi graphs.**
  Preprint: https://arxiv.org/abs/2210.07823, submitted
  Coauthors: Jian Ding(PKU) and Hang Du(MIT)
  Abstract: We presented a polynomial-time algorithm that finds a vertex correspondence which maximizes the overlap of two independent Erdős-Rényi graphs with a constant arbitrarily close to 1 compared with the asymptotic of the maximal overlap. This result gives a new example to the few problems that efficient algorithms exist for random instances while worst-cases are known to be NP-hard.
- **The Algorithmic Phase Transition of Random Graph Alignment Problem.**
  Preprint: https://arxiv.org/abs/2307.06590, submitted
  Coauthor: Hang Du(MIT) and Rundong Huang(PKU)
  Abstract: We study the graph alignment problem over two independent Erdős-Rényi graphs on n vertices, with edge density p falling into two regimes separated by the critical window around $p_c = \sqrt{\log n/n}$. Our result reveals an algorithmic phase transition for this random optimization problem: polynomial-time approximation schemes exist in the sparse regime, while statistical-computational gap emerges in the dense regime. Additionally, we establish a sharp transition on the performance of online algorithms for this problem when p lies in the dense regime, resulting in a $\sqrt{8/9}$ multiplicative constant factor gap between achievable and optimal solutions.

TALKS

- An Introduction to First Passage Percolation. — Shandong University/October 12, 2020
- A polynomial-time approximation scheme for the maximal overlap of two independent Erdős-Rényi graphs. — Shandong University/November 7, 2022
- Algorithms and Phase Transitions in Random Graph Alignment Problem. — Peking University/September 11, 2023

CONFERENCES

- The 42nd Conference on Stochastic Processes and their Applications. — Wuhan, China/June 27—July 1, 2022
- Probability, Stochastic Analysis and Related Topics. — Sanya, China/Janurary 3—7, 2023
- The 8th National Probability and Statistics Annual Conference of China. — Fuzhou, China/August 20—24, 2023

SELECTED AWARDS

- National Scholarship — October, 2019/Shandong University
- National Scholarship — October, 2020/Shandong University
- Principal Scholarship**(Top Award for Undergraduates)** — October, 2020/Shandong University
- Schlumberger Scholarship — October, 2023/Peking University

LANGUAGE

Chinese(native), English(fluent)

TEACHING EXPERIENCES

- Calculus (C) Fall, 2021
  Lecturer: Prof. Wenyuan Yang/Course webpage
  Content: properties of single/multi-variable functions, geometry objects in Euclidean space, series expansion, differentiation and integration, etc.
- **Applied Stochastic Processes** Spring, 2022
  Lecturer: Prof. Dayue Chen
  Content: Discrete time Markov chains: invariant measure, hitting time, recurrent/transient Markov chains, Ergodic theorem, convergence rate, simple random walk. Continuous time Markov chains: Poisson process, contact process, queueing systems. Brownian Motion: Gaussian processes, Brownian Motion, invariance principle, Brownian Bridge, OU process, stochastic integral.
- **Applied Stochastic Processes** Fall, 2022
  Lecturer: Prof. Jian Ding
  Content: Discrete time Markov chains: invariant measure, hitting time, recurrent/transient Markov chains, Ergodic theorem, convergence rate, simple random walk. Continuous time Markov chains: Poisson process, contact process, queueing systems. Brownian Motion: Gaussian processes, Brownian Motion, invariance principle, Brownian Bridge, OU process, stochastic integral.
- **Measure Theory** Spring, 2023
  Lecturer: Prof. Fuxi Zhang
  Content: Measurable space, measurable functions, measure space, integration, signed measure, product spaces, monotone theorems, decomposition theorems, convergence theorems.
- **Advanced Probability Theory** Fall, 2023
  Lecturer: Prof. Xinyi Li
  Content: Law of Large Numbers: independence, weak law of large numbers, Borel-Cantelli Lemmas, strong law of large numbers, random series, large deviations. Central limit theorems: weak convergence, characteristic functions, central limit theorems, Poisson convergence, Poisson processes, stable laws, infinitely divisible distributions. Martingales: conditional expectation, Martingales, Doob's inequality, convergence in L^p, square integrable martingales, optional stopping theorems.