Yupan Liu

Curriculum Vitae

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Education

2022.10– 2025.03 (Expected)	**Ph.D. in Mathematics**, *Nagoya University*, Nagoya, Japan. Advisor: François Le Gall Ph.D. Thesis: *Complexity-theoretic perspectives on quantum state testing*
2020.07– 2020.12	**Ph.D. in Computer Science (Discontinued)**, *Hebrew University*, Jerusalem, Israel. Advisor: Dorit Aharonov
2017.10– 2020.03	**M.Sc. in Computer Science**, *Hebrew University*, Jerusalem, Israel. Advisors: Dorit Aharonov and Itai Arad (Technion) Overall GPA: 93.22 M.Sc. Thesis: *Towards a quantum-inspired proof for* IP = PSPACE
2013.09– 2017.07	**B.Eng. in Computer Science and Technology**, *Zhejiang University*, Hangzhou, China. Overall GPA: 85.28, Major (last-two-year) GPA: 88.22 Senior Project Advisor: Xin Wan

Research Interests

My research interests lie in theoretical computer science, with a focus on quantum complexity theory and quantum algorithms. My work centers on two main themes:

- **The interplay between quantum property testing and complexity theory**, including various settings of quantum state testing (both computational hardness and algorithmic aspects), the computational power of the classes QSZK and BQL, and the design of new quantum algorithms that are efficient in terms of time or space.
- **Quantum computation with limited resources, especially the role of randomness**. Specifically, the impact of intermediate measurements in different contexts related to quantum logspace (e.g., space-bounded quantum interactive proofs), and the computational power of the class StoqMA, with connections to derandomization and PCP.

Research Experience

2022.10-	**Research Student**, *Graduate School of Mathematics*, Nagoya University, Nagoya, Japan. Advisor: François Le Gall
2022.04- 2022.08	**(Remote) Visiting Student**, *Graduate School of Mathematics*, Nagoya University, Nagoya, Japan. Advisor: François Le Gall
2021.03- 2021.08	**(Remote) Visiting Student**, *Centre for Quantum Software and Information*, University of Technology Sydney, Sydney, Australia. Advisor: Zhengfeng Ji
2017-2020	**Research Student**, *School of Computer Science and Engineering*, Hebrew University, Jerusalem, Israel. Advisors: Dorit Aharonov and Itai Arad (Technion)

2018-2019	**Research Student**, *School of Computer Science and Engineering*, Hebrew University, Jerusalem, Israel. Advisor: Guy Kindler
Summer 2019	**Research Internship**, *Centre for Quantum Technologies*, National University of Singapore. Advisors: Itai Arad (Technion) and Miklos Santha
Summer 2016	**Research Internship**, *Centre for Quantum Technologies*, National University of Singapore. Advisors: Itai Arad and Miklos Santha
2016–2017	**Research Student**, *Department of Physics*, Zhejiang University, Hangzhou, China. Advisor: Xin Wan

Publications

(The authors of papers in theoretical computer science are listed *alphabetically*.)

◇ François Le Gall, **Yupan Liu**, Harumichi Nishimura, and Qisheng Wang. Space-bounded quantum interactive proof systems. To appear at *the 28th Annual Quantum Information Processing Conference (QIP 2025)*. Also available at arXiv:2410.23958, 2024.

◇ **Yupan Liu** and Qisheng Wang. On estimating the trace of quantum state powers. To appear in *Proceedings of the 2025 ACM-SIAM Symposium on Discrete Algorithms (SODA 2025)*. To appear at *the 28th Annual Quantum Information Processing Conference (QIP 2025)*. Also available at arXiv:2410.13559, 2024.

◇ François Le Gall, **Yupan Liu**, and Qisheng Wang. Space-bounded quantum state testing via space-efficient quantum singular value transformation. *In submission*. Also available at arXiv:2308.05079, 2023.

◇ **Yupan Liu**. Quantum state testing beyond the polarizing regime and quantum triangular discrimination. *In submission*. Also available at arXiv:2303.01952, 2023.

◇ Hugo Delavenne, François Le Gall, **Yupan Liu**, and Masayuki Miyamoto. Quantum Merlin-Arthur proof systems for synthesizing quantum states. To appear in *Quantum*. Also available at arXiv:2303.01877, 2023.

◇ **Yupan Liu**. StoqMA meets distribution testing. In *Proceedings of 16th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2021)*, LIPIcs volume 197, pp.4:1-4:22, 2021. Also available at arXiv:2011.05733, 2020.

◇ Dorit Aharonov, Alex B. Grilo, and **Yupan Liu**. StoqMA vs. MA: the power of error reduction. To appear in *Quantum*. Also available at arXiv:2010.02835, 2020.

◇ Ayal Green, Guy Kindler, and **Yupan Liu**. Towards a quantum-inspired proof for IP = PSPACE. *Quantum Information & Computation*, 21(5-6):0377-0386, 2021. Also available at arXiv:1912.11611, 2019.

Seminar Talks

◇ *Space-bounded quantum interactive proof systems*. CS Theory Seminar, Penn State University, Jan. 22nd, 2025.

◇ *Space-bounded quantum interactive proof systems*. CS Theory Student Seminar, Columbia University, Oct. 16th, 2024.

◇ *On estimating the trace of quantum state powers*. School of Engineering and Applied Sciences, Harvard University, Oct. 10th, 2024.

◇ *On estimating the trace of quantum state powers*. Department of Mathematics, Ohio State University (Online), Oct. 8th, 2024.

- ◇ *Space-bounded quantum state testing via space-efficient quantum singular value transformation*. Quantum Information Theory Seminar, University of Bristol, Mar. 6th, 2024.
- ◇ *Space-bounded quantum state testing via space-efficient quantum singular value transformation*. Algorithm and Complexity Seminar, University of Cambridge, Feb. 26th, 2024.
- ◇ *Space-bounded quantum state testing via space-efficient quantum singular value transformation*. CS Seminar, Centre for Quantum Technologies, National University of Singapore (Online), Nov. 20th, 2023.
- ◇ *Space-bounded quantum state testing via space-efficient quantum singular value transformation*. QuSoft (Online), Sept. 22nd, 2023.
- ◇ *Space-bounded quantum state testing via space-efficient quantum singular value transformation*. Research Center for Quantum Software, Tsinghua University, Aug. 9th, 2023.
- ◇ StoqMA *meets distribution testing*. Department of Computer Science and Technology, Nanjing University, Dec. 9th, 2020.
- ◇ *The untold story of* StoqMA. University College London (Online), Dec. 3rd, 2020.
- ◇ *The untold story of* StoqMA. Yukawa Institute for Theoretical Physics, Kyoto University (Online), Nov. 30th, 2020.
- ◇ *Towards a quantum-inspired proof for* IP = PSPACE. NTT Basic Research Laboratories, Oct. 18th, 2019.
- ◇ *Towards a quantum-inspired proof for* IP = PSPACE. Yukawa Institute for Theoretical Physics, Kyoto University, Oct. 15th, 2019.
- ◇ *An Invitation to Stoquastic Hamiltonian Complexity*. University of Science and Technology of China, Oct. 8th, 2019.

Conference Talks

- ◇ *On estimating the trace of quantum state powers*. Contributed talk, 2025 Annual ACM-SIAM Symposium on Discrete Algorithms (SODA 2025), Jan 12th, 2025.
- ◇ *Space-bounded quantum state testing via space-efficient quantum singular value transformation*. Shenzhen-Nagoya Workshop on Quantum Science 2024, Sept. 19th, 2024.
- ◇ *Quantum state testing beyond the polarizing regime and quantum triangular discrimination*. Regular talk, LA Symposium 2023 in Summer, July 4th, 2023.
- ◇ StoqMA *meets distribution testing*. Contributed talk, 16th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2021), July 7th, 2021.
- ◇ StoqMA *meets distribution testing*. AMSS-UTS Joint Workshop on Quantum Computing (Online), Dec. 16th, 2020.

Professional Services

Reviewer FOCS (2024, 2023, 2020), STOC (2025, 2024, 2023), CCC (2024), SODA (2025, 2024, 2022), ITCS (2024), ICALP (2024×2), ESA (2024); QIP (2025×4, 2024×3, 2023, 2022×2, 2021), TQC (2024, 2022, 2020×2), AQIS (2023); SIAM Journal on Computing, Nature Physics, Theory of Computing Systems, Quantum Journal.

Academic Honors & Awards

Nagoya University Interdisciplinary Frontier Fellowship, *Nagoya University*.
2023.04 - 2025.03

Teaching Experience

Fall 2019 **Kazhdan's Lecture: Computation, quantumness, symplectic geometry, information**,
Hebrew University, Jerusalem, Israel.
Instructors: Gil Kalai, Leonid Polterovich, Dorit Aharonov, Guy Kindler
Scribed notes for all computer science oriented lectures (half of the course).