香港浸會大學 HONG KONG BAPTIST UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE 計算機科學系

DEPARTMENT OF COMPUTER SCIENCE

SEMINAR

2025 SERIES

Efficient Learning for Linear Properties of Bounded-gate Quantum Circuits

DATE & TIME

5 AUG 2025 (TUE) 10:30 - 11:30 AM

VENUE

JC3 UG05, JOCKEY CLUB CAMPUS OF CREATIVITY

DR. MIN-HSUI HSIEH

Director
Hon Hai Quantum Computing Research Center

ABSTRACT

The vast and complicated many-qubit state space forbids us to comprehensively capture the dynamics of modern quantum computers via classical simulations or quantum tomography. Recent progress in quantum learning theory prompts a crucial question: can linear properties of a many-qubit circuit with d tunable RZ gates and G − d Clifford gates be efficiently learned from measurement data generated by varying classical inputs? In this work, we prove that the sample complexity scaling linearly in d is required to achieve a small prediction error, while the corresponding computational complexity may scale exponentially in d. To address this challenge, we propose a kernel-based method leveraging classical shadows and truncated trigonometric expansions, enabling a controllable trade-off between prediction accuracy and computational overhead. Our results advance two crucial realms in quantum computation: the exploration of quantum algorithms with practical utilities and learning-based quantum system certification. We conduct numerical simulations to validate our proposals across diverse scenarios, encompassing quantum information processing protocols, Hamiltonian simulation, and variational quantum algorithms up to 60 qubits.

SPEAKER'S BIOGRAPHY

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