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【812】The power and limitations of learning quantum dynamics incoherently

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Quantum process learning is emerging as an important tool to study quantum systems, but little attention has been paid to whether dynamics of quantum systems can be learned without the system and target directly interacting. Here we provide bounds on the sample complexity of learning unitary processes incoherently and show that, if arbitrary measurements are allowed, then any efficiently representable unitary can be efficiently learned within the incoherent framework. However, when restricted to shallow-depth measurements only low-entangling unitaries can be learned. We demonstrate our incoherent learning algorithm by successfully learning a 16-qubit unitary on ibmq_kolkata, and further demonstrate the scalabilty of our proposed algorithm through extensive numerical experiments.

Theoretical Work

Theory

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