

EFFICIENT QUANTUM STATE PREPARATION USING DECISION DIAGRAMS

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Loading classical data into quantum registers is one of the most important primitives of quantum computing. While the complexity of preparing a generic quantum state is exponential in the number of qubits, in many practical tasks the state to prepare has a certain structure that allows for faster preparation. In this paper, we consider quantum states that can be efficiently represented by (reduced) decision diagrams, a versatile data structure for the representation and analysis of Boolean functions. We design an algorithm that utilises the structure of decision diagrams to prepare their associated quantum states. Our algorithm has a circuit complexity that is linear in the number of paths in the decision diagram. Numerical experiments show that our algorithm reduces the circuit complexity by up to 31.85% compared to the state-of-the-art algorithm, when preparing generic n -qubit states with different degrees of non-zero amplitudes. Additionally, for states with sparse decision diagrams, including the initial state of the quantum Byzantine agreement protocol, our algorithm reduces the number of CNOTs by 86.61% - 99.9%.