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Title: An Algebraic Specification for Quantum Computation in Maude

Abstract: With the rapid advancement of quantum computing, the formal specification and verification of quantum systems have become increasingly important research topics. Maude is a high-performance algebraic specification and programming language widely used to formalize and verify concurrent and distributed systems. This talk presents an algebraic specification for quantum computation in Maude, providing a formal framework for modeling quantum systems, reasoning about them symbolically and exactly, and verifying their desired properties. We will present how to represent complex numbers in quantum computation exactly using the ring $\mathbb{D}[\omega]$, how to represent quantum states and quantum operations using Dirac notation, and how to leverage a collection of laws from quantum mechanics and matrices to enable automated reasoning about quantum computation. Finally, we will demonstrate the applicability of the framework by verifying several non-trivial quantum programs in Maude as case studies.