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Symbolic Quantum Computation Simulation in SymPy[1] ADDISON CUGINI, MATT CURRY, BRIAN GRANGER, Cal Poly San Luis Obispo — Quantum computing is an emerging field which aims to use quantum mechanics to solve difficult computational problems with greater efficiency than on a classical computer. There is a need to create software that i) helps newcomers to learn the field, ii) enables practitioners to design and simulate quantum circuits and iii) provides an open foundation for further research in the field. Towards these ends we have created a package, in the open-source symbolic computation library SymPy, that simulates the quantum circuit model of quantum computation using Dirac notation. This framework builds on the extant powerful symbolic capabilities of SymPy to preform its simulations in a fully symbolic manner. We use object oriented design to abstract circuits as ordered collections of quantum gate and qbit objects. The gate objects can either be applied directly to the qbit objects or be represented as matrices in different bases. The package is also capable of performing the quantum Fourier transform and Shor's algorithm. A notion of measurement is made possible through the use of a non-commutative gate object. In this talk, we describe the software and show examples of quantum circuits on single and multi qbit states that involve common algorithms, gates and measurements.

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