Simulation of Quantum Computation with Wolfram Mathematica Package "QuantumCircuit"

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Quantum computation and quantum information is a rapidly developing research area of modern science and technology. Quantum computers are to be able to perform certain computational tasks much more efficiently than classical computers. At the same time a realistic quantum computer is still not available and the majority of studies in this field are theoretical ones. This stimulates development of classical simulators of quantum computation which help to understand better existing quantum algorithms and can be used for searching and testing new effective algorithms.

The purpose of this talk is to present the Wolfram Mathematica package "QuantumCircuit" for simulation of quantum computation based on the circuit model (see [1, 2, 3, 4]). The package provides a user-friendly interface to specify a quantum circuit, to draw it, and to construct the corresponding unitary matrix for quantum computation defined by the circuit. Using this matrix, one can find the final state of the quantum memory register by its given initial state and to check the operation of the algorithm determined by the quantum circuit.

As an application of the package "QuantumCircuit" we demonstrate simulation of quantum circuits implementing several the best known quantum algorithms [5]. Among them we consider the Grover search algorithm and the Shor algorithm for integer factorization. In addition, we analyze some examples of the circuits used for quantum error correction.

References

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