Web based Quantum Computer Simulator and sympolic extensions

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The objective of this paper is to present a quantum computer simulator with a web interface based on the circuit model of quantum computation [3]. This is the standard model for which most quantum algorithms have been developed. Quantum algorithms are expressed as circuits of quantum registers (series of qubits) and quantum gates operating on them. Each quantum gate is a unitary transformation on the Hilbert space determined by the quantum register.

The quantum computer simulator is developed in Python, using some extra libraries for our purposes. The fundamental library that is used is Numpy: the package for scientific computing with Python.

Because of the limitations of GUI for a large number of qubits, we propose an another version of quantum computer simulator without a user interface, which could simulate quantum computations for larger inputs. The inputs of the simulator are the number of qubits, the number of computation steps, the initial state of quantum register and the gates that applied at each step. The outputs of the simulator are the quantum register state at each step (the probability of measuring each one of the possible states and the phases of each state).

The quantum computer simulator is a useful tool for studying and understanding quantum circuits, quantum computations and well known quantum algorithms such as Grover's algorithm [1, 2] and Quantum Fourier Transform. It may also be very useful for the development of new quantum algorithms and the construction of new quantum gates.

Another approach of developing a quantum simulator in Python, is to use instead of Numpy, Sympy python library (Symbolic Python). The advantage of this change is that you can represent very large numbers, as a result of using arbitrary precision arithmetic. On the other hand, Numpy uses machine arithmetic, which imports limitations.

References

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