Quantum Calculator: Investigating How a Quantum Computer Works through Simulation

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Quantum computers enable to obtain high speeds and great computational powers. They are based on the application of operators on a quantum system. The project investigates how to reproduce the operating principle of these devices. The aim is enhancing the possibility to easily study quantum algorithms on a classical computer. This project consists in a simulator, written in Python language, which reproduces on a deterministic computer the behaviour of a quantum computer. Once chosen, Pauli operators, Hadamard and Controlled-NOT gate are implemented on the code. These quantum operators are analysed through data obtained from their execution on a real device and through theoretical expected values. The calibration of the simulator follows quantum operators' analysis. Quantum phenomena of superposition and entanglement are implemented on both real quantum and classical devices. Simulators reliability has been tested by comparing results with experimental data obtained from a real quantum computer. The simulator allows the user to try different operators and reproduces the most common errors present in a real quantum device, by taking into account their class and frequency. Some of the quantum phenomena simulated are superposition and entanglement of two or more qubits. Quantum algorithms can be executed on the simulator using a simple syntax. The study showed how to increase reliability of a quantum computer simulator implementing its performance according to real devices functioning and experimental data. Further analysis about error distributions on other quantum computers will enable to improve the simulators code.

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