

Computational Quantum Physics Exercise 5

Using quantum objects to manipulate information provides a remarkably rich and highly unexplored resource that potentially allows to outperform classical calculations.

In this exercise you will emulate on a classical computer two simple protocols of quantum computation discussed in the lecture. To do this you will have to handle 2^N basis states of the N -qubit Hilbert space.

Assume the qubits to be ideal 2-level systems and the quantum gates to be ideal operations on the Hilbert space.

Problem 5.1 Quantum Teleportation

Implement the action of the Hadamard, Pauli-X, Pauli-Z, the two-qubit CNOT gates and single-qubit measurements.

Write the code that simulates the quantum teleportation protocol.

Problem 5.2 Deutsch-Jozsa algorithm

Simulate the circuit of the Deutsch-Jozsa algorithm described in the lecture notes for the number of qubits provided by the user in runtime.