

# 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.