

Tutorial 4

23.4.2021

Task 1. Find a matrix corresponding to the Toffoli gate.

Task 2. Let U be a two-level operator, nontrivial only on $|k\rangle$ and $|l\rangle$. How do $U|k\rangle$ and $U|l\rangle$ look like? How does U look like as a matrix?

Task 3. What two-level operators can be written as a controlled matrix?

Task 4. Find a decomposition of CCZ (doubly controlled Z) gate, into one qubit gates and CNOTs.

Task 5. Find a circuit of the operator U , such that implements modular addition: $U(|a\rangle|b\rangle) = |a\rangle|(a+b)\%2^k\rangle$

a) $a, b \in \mathbb{Z}_2$

b) $a \in \mathbb{Z}_2, b \in \mathbb{Z}_4$

c) $a, b \in \mathbb{Z}_4$