University of Jyväskylä - Course TIEJ6003
intro2QC Summer2024: ex4

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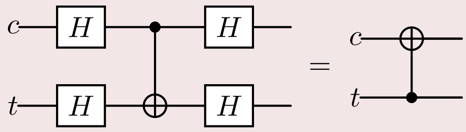
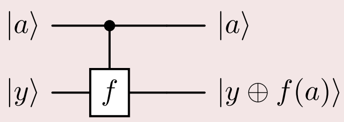
Exercise 4.1: circuits equivalence

Show this equivalence:

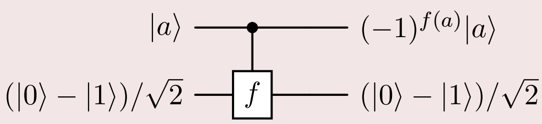


Exercise 4.2: controlled-f gate

Verify that given the following controlled-f gate,



the following "trick" is valid:



Exercise 4.3: identity

Let $H^{\otimes n}$ denote Hadamard gates applied individually to n qubits.
Let $P := 2\,|0^{\otimes n}\rangle\,\langle 0^{\otimes n}| - I^{\otimes n}$, where $|0^{\otimes n}\rangle\langle 0^{\otimes n}|$ is the projector onto the n-qubit zero state.

Prove that

$$H^{\otimes n} P H^{\otimes n} = 2\,|\psi_u\rangle\,\langle\psi_u| - I$$

where $|\psi_u\rangle$ is the uniform superposition over the computational basis states,

$$|\psi_u\rangle := \frac{1}{2^{n/2}} \sum_{j}^{2^n-1} |j\rangle$$