

Präsenzübungen zur Vorlesung
Quantenalgorithmen
WS 2013/2014
Blatt 4 / 5 December, 2013

Exercise 1:

Prove the following lemma:

$$\sum_{x \in \{0,1\}^n} (-1)^{xy} = \begin{cases} 2^n, & y = 0^n \\ 0, & \text{otherwise.} \end{cases}$$

Exercise 2:

In class, you saw two types of quantum queries. Given a boolean function $f : \{0, 1\}^n \rightarrow \{0, 1\}$,

- *phase* query maps $|x\rangle \mapsto (-1)^{f(x)}|x\rangle$,
- U_f query (*XOR*) maps $|x\rangle \otimes |y\rangle \mapsto |x\rangle \otimes |y \oplus f(x)\rangle$.

1. Show how to simulate an XOR query using a single phase query.
2. Show how to simulate a phase query to f using a single XOR query.

Exercise 3:

Let $|xy\rangle$ with $x \in \mathbb{F}_2^n, y \in \mathbb{F}_2$ be any state. Let $f : \mathbb{F}_2^n \rightarrow \mathbb{F}_2$ with U_f - reversible embedding of f . Show that the QC below maps the state $|xy\rangle$ to the state $(-1)^{f(x)y}|xy\rangle$:

