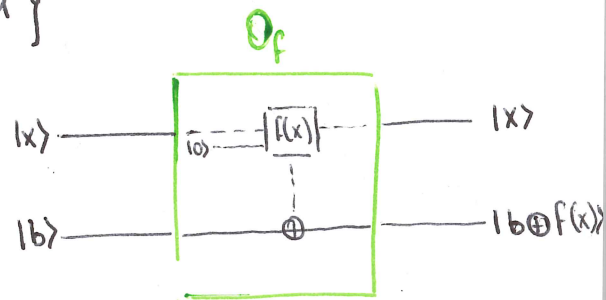


Phase kick-back

f is a boolean function $f: \{0,1\}^n \rightarrow \{0,1\}$

$$O_f: |x\rangle|b\rangle \longrightarrow |x\rangle|b \oplus f(x)\rangle$$

$$U_f: |x\rangle \longrightarrow (-1)^{f(x)} |x\rangle$$



$$(a) \quad |x\rangle|1\rangle \xrightarrow{I \otimes H} |x\rangle \frac{1}{\sqrt{2}} [|0\rangle - |1\rangle] \xrightarrow{O_f} \frac{1}{\sqrt{2}} [|x\rangle|f(x)\rangle + |x\rangle|1 \oplus f(x)\rangle] \quad (c)$$

$$(d) \quad (-1)^{f(x)} |x\rangle|1\rangle \xleftarrow{I \otimes H} (-1)^{f(x)} |x\rangle \otimes \frac{1}{\sqrt{2}} [|0\rangle - |1\rangle]$$

