

If we apply the Hadamard gate on the most significant qubit, then we get

$$\begin{cases} \pm|0\rangle \otimes \frac{1}{\sqrt{2}}(|0\rangle - |1\rangle) & \text{if } f(0) \oplus f(1) = 0, \\ \pm|1\rangle \otimes \frac{1}{\sqrt{2}}(|0\rangle - |1\rangle) & \text{if } f(0) \oplus f(1) = 1. \end{cases}$$