

Examples of Quantum Circuit Diagrams

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Below some examples of quantum circuit diagrams are given. They are typeset using a modified version of the \LaTeX package *QCircuit*. The source for the present document, the modified *QCircuit* package, and the project *An Introduction to Quantum Computing* from which the diagrams are taken are available online at <http://go.warwick.ac.uk/mtcharemza/pastprojects> .

$$|0\rangle \text{ --- } \boxed{H} \text{ --- } \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle)$$

Figure 1: Example of Hadamard gate acting on one qubit.

$$|0\rangle \text{ --- } \oplus \text{ --- } |1\rangle$$

Figure 2: Example of a *not* gate acting on one qubit.

$$\begin{array}{ccc} |1\rangle & \text{---} \bullet & |1\rangle \\ & | & \\ |0\rangle & \text{---} \oplus & |1\rangle \end{array}$$

Figure 3: Example of a controlled-*not* gate.

$$\frac{1}{\sqrt{2}} (|0\rangle + |1\rangle) \longrightarrow \boxed{M} \text{ } \text{=} ?$$

Figure 4: Example of a measurement. Note that for the input mixed state $\frac{1}{\sqrt{2}} (|0\rangle + |1\rangle)$, it is unknown what the result of the measurement will be. All that is known is that the result has equal probability of being $|0\rangle$ or $|1\rangle$.

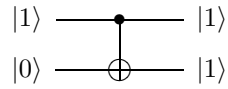


Figure 5: Example of a controlled-*not* gate.

$$\frac{1}{\sqrt{2}} (|0\rangle + |1\rangle) \longrightarrow \boxed{M} \text{ } \text{=} ?$$

Figure 6: Example of a measurement. Note that for the input mixed state $\frac{1}{\sqrt{2}} (|0\rangle + |1\rangle)$, it is unknown what the result of the measurement will be. All that is known is that the result has equal probability of being $|0\rangle$ or $|1\rangle$.

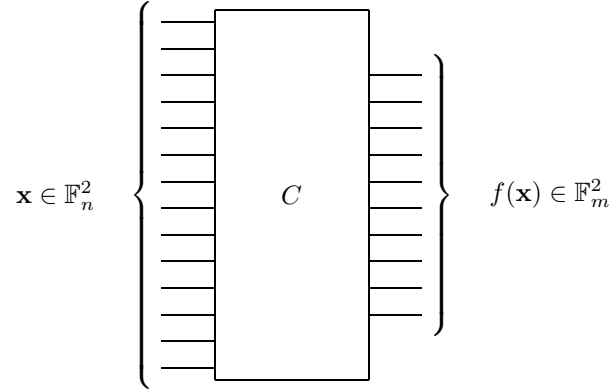


Figure 7: Boolean circuit performing function $f : \mathbb{F}_n^2 \rightarrow \mathbb{F}_m^2$.

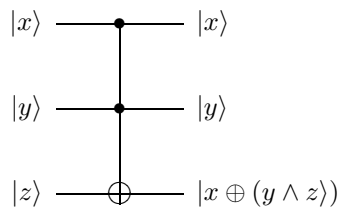


Figure 8: Toffoli gate.

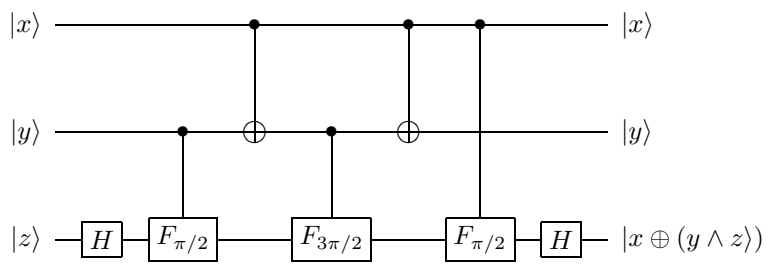


Figure 9: Decomposition of a Toffoli gate.

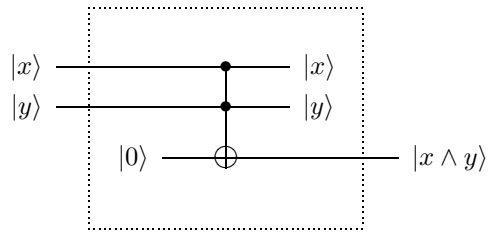


Figure 10: Toffoli gate as an *and* gate.

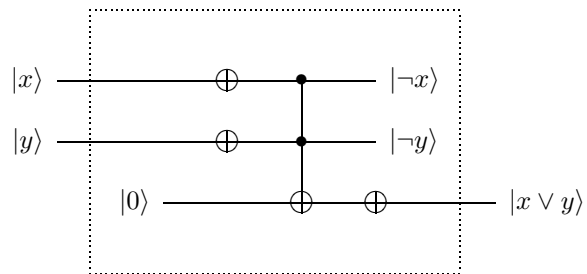


Figure 11: A Toffoli gate as an *or* gate.

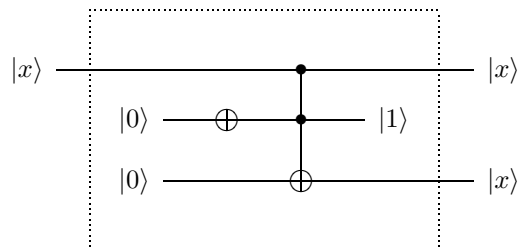


Figure 12: Toffoli gate as *fanout*.

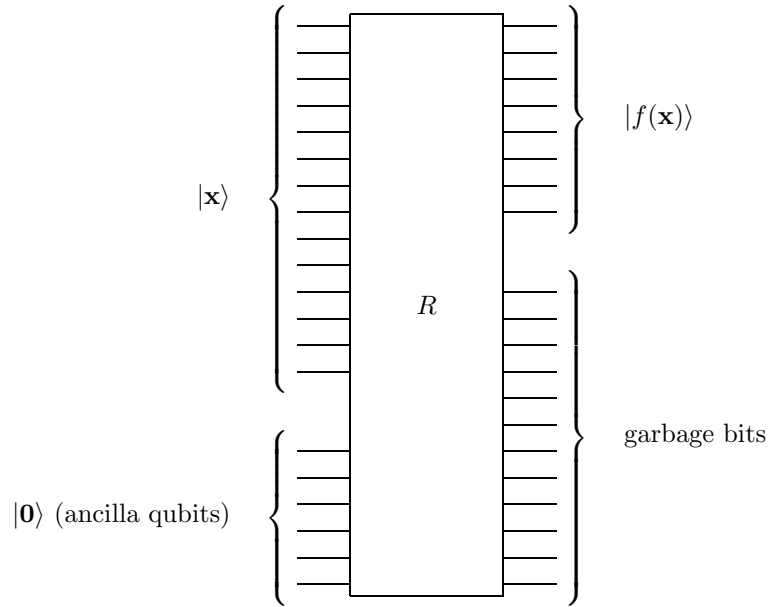


Figure 13: Quantum circuit emulating boolean circuit that performs function $f : \mathbb{F}_n^2 \rightarrow \mathbb{F}_m^2$.

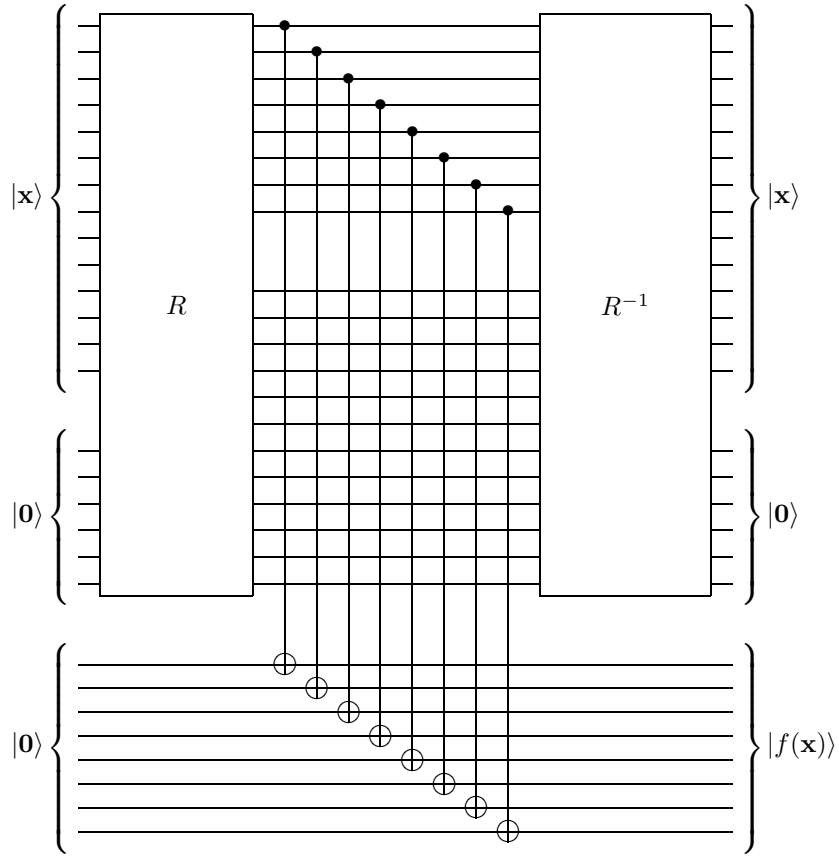


Figure 14: Quantum circuit emulating boolean circuit that performs function $f : \mathbb{F}_n^2 \rightarrow \mathbb{F}_m^2$. Note that this circuit preserves input and ancilla qubits.

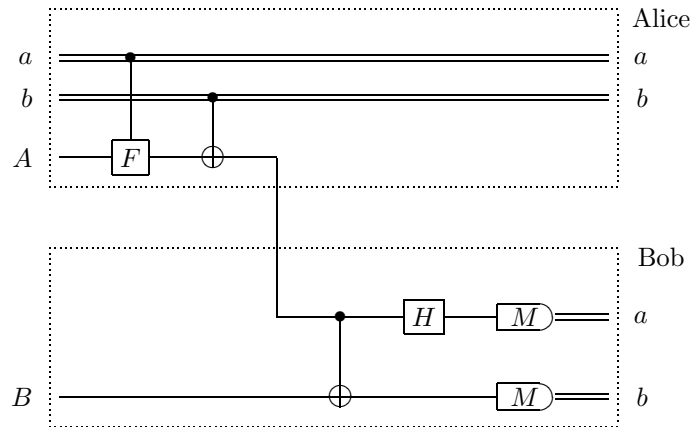


Figure 15: Superdense coding.

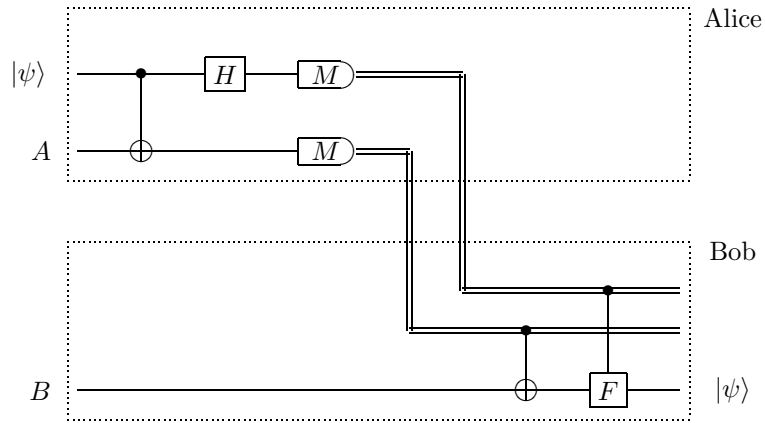


Figure 16: Quantum teleportation.

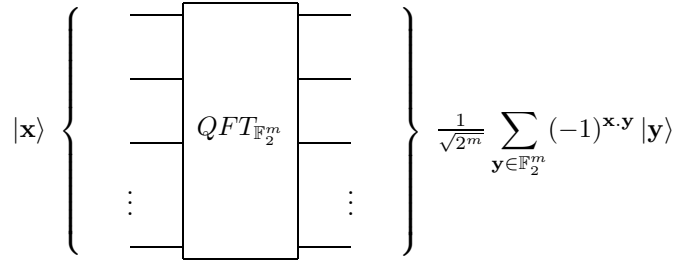


Figure 17: Quantum Fourier transform in \mathbb{F}_2^m .

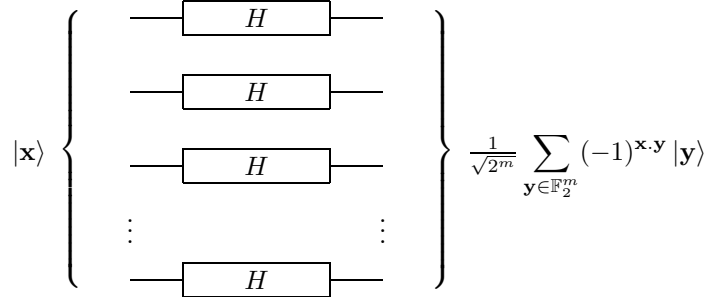


Figure 18: Decomposition of QFT in \mathbb{F}_2^m .

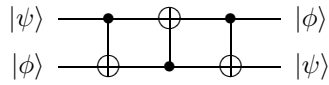


Figure 19: Swap of two qubits.

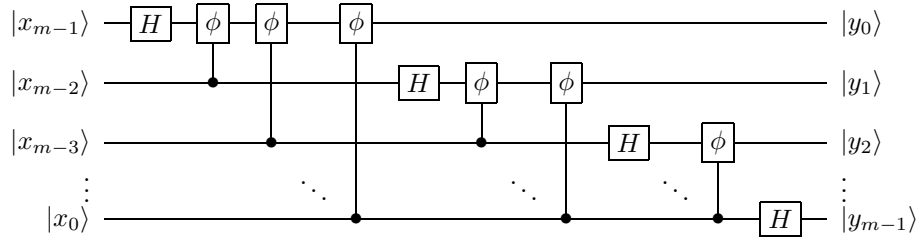


Figure 20: Decomposition of QFT in \mathbb{Z}_{2^m} .

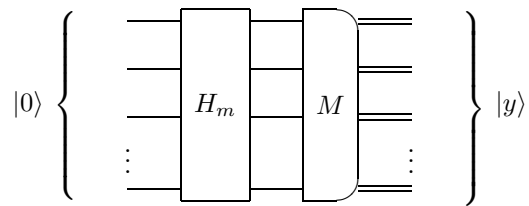


Figure 21: Circuit that generates random numbers.