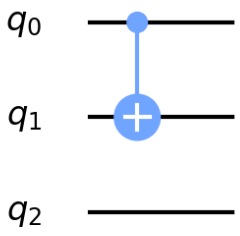
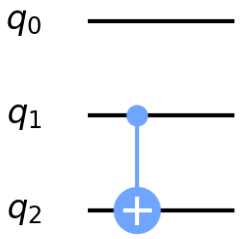
Quantum Computation 101 for Physicists

Home exercise 2

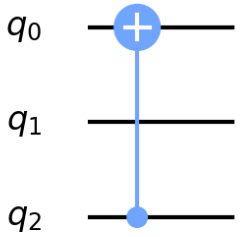
1. Prove that $e^{i\frac{\varphi}{2}\hat{n}\cdot\vec{\sigma}} = \cos(\frac{\varphi}{2}) + i\sin(\frac{\varphi}{2})\hat{n}\cdot\vec{\sigma}$.
2. Find $\hat{n}$ and φ for the operator: $U = \begin{pmatrix} \frac{1}{2} + i\frac{\sqrt{3}}{2\sqrt{2}} & \frac{\sqrt{3}}{4}(1+i) \\ \frac{\sqrt{3}}{4}(-1+i) & \frac{1}{2} - i\frac{\sqrt{3}}{2\sqrt{2}} \end{pmatrix}$
3. For three qubits, find the matrix of the following circuits:



(a)



(b)



(c)