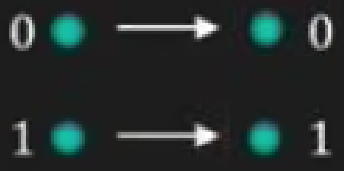
I Gate

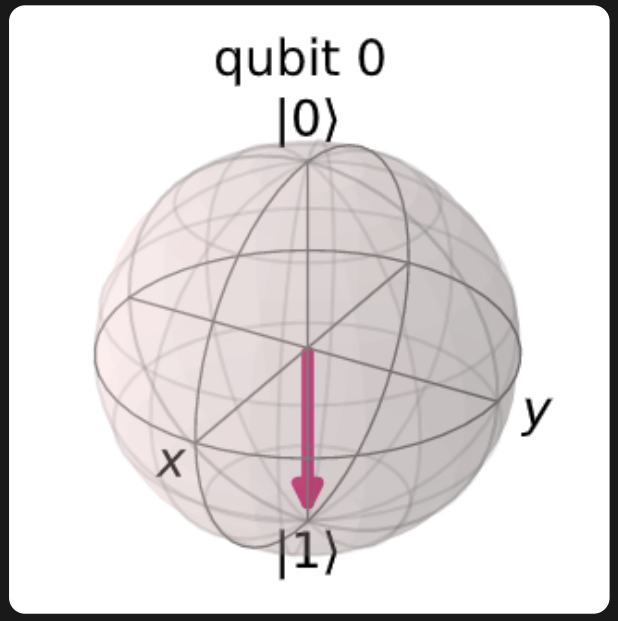
Identity

$$f(x) = x$$



$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

X Gate



Negation

$$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

Y Gate

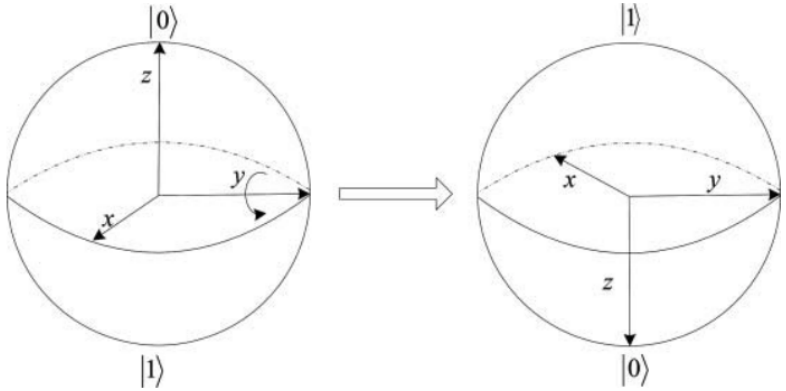
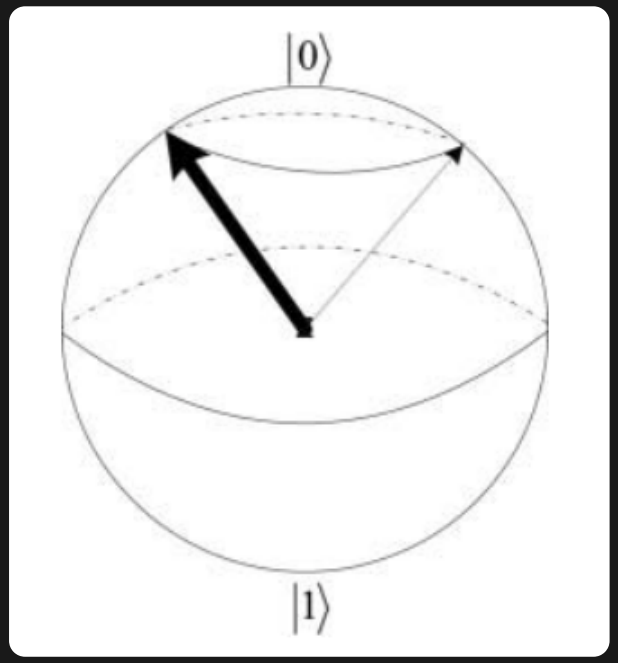


Figure 5.7. A rotation of the Bloch sphere at y.

Negation

$$\begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$$

Z Gate



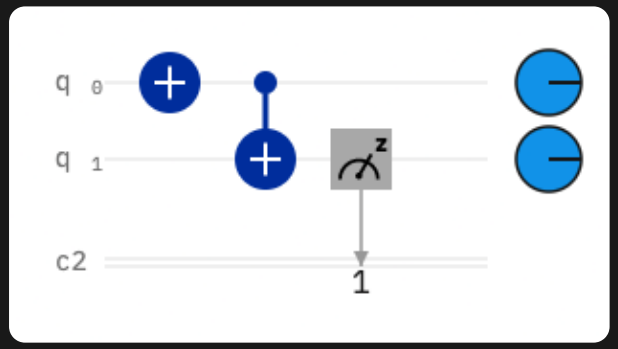
Phase Flip

$$\begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$$

Qiskit Demo: Hands-On With Pauli Gates

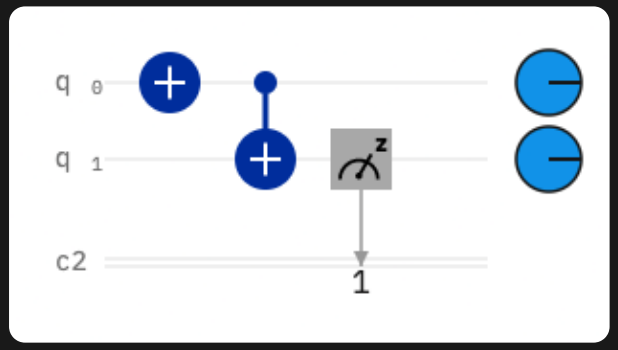
Multi-Qubit Gates

CNOT Gate



XOR

CNOT Gate



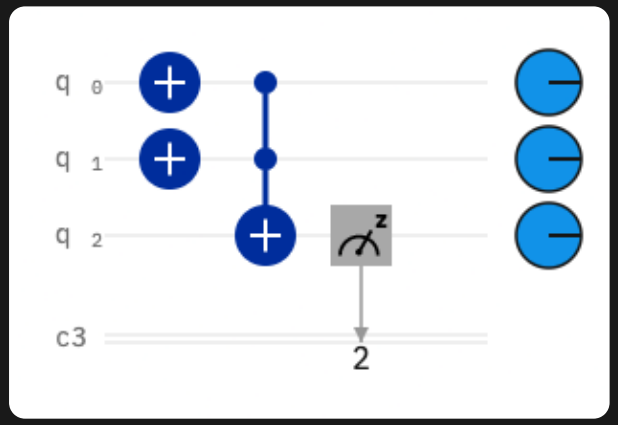
XOR

Flips target if control is 1

Controlled-U Gate

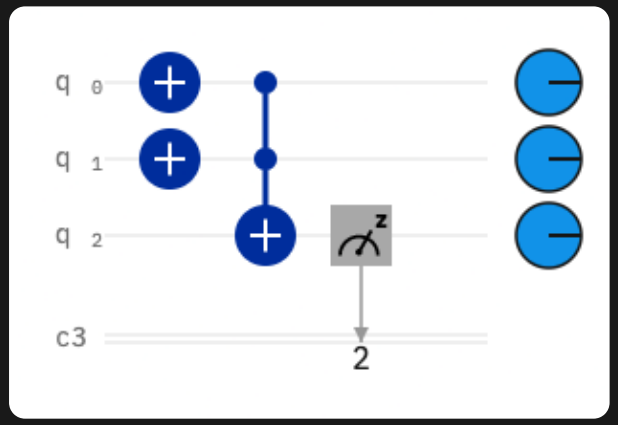
$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & a & b \\ 0 & 0 & c & d \end{pmatrix}$$

Toffoli Gate (CCNOT)



Matrix similar to CNOT

Toffoli Gate (CCNOT)



Matrix similar to CNOT

Flips target if both control qubits are 1

Project: Quantum Adding Machine

References

- *Yanofsky, Mannucci. Quantum Computing for Computer Scientists*
- YouTube. Quantum Computing for Computer Scientists
- YouTube. Quantum Gates
- Qiskit Textbook. Single Qubit Gates
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