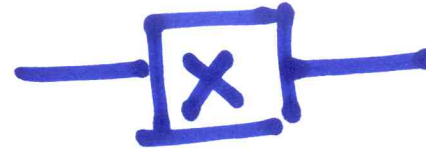


NOT : X - Gate

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



Phase Gate:

$$\begin{aligned} |0\rangle &\mapsto |0\rangle \\ |1\rangle &\mapsto -|1\rangle \end{aligned}$$

$$Z: \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$



$$\begin{pmatrix} 1 & 0 \\ 0 & e^{i\phi} \end{pmatrix}$$

$$\begin{aligned} |0\rangle &\mapsto |0\rangle \\ |1\rangle &\mapsto e^{i\phi} |1\rangle \end{aligned}$$

$$Z: \phi = \pi$$

T-Gate

$$\varphi = \frac{\pi}{4}$$

$$\begin{pmatrix} 1 & 0 \\ 0 & e^{i\pi/4} \end{pmatrix}$$

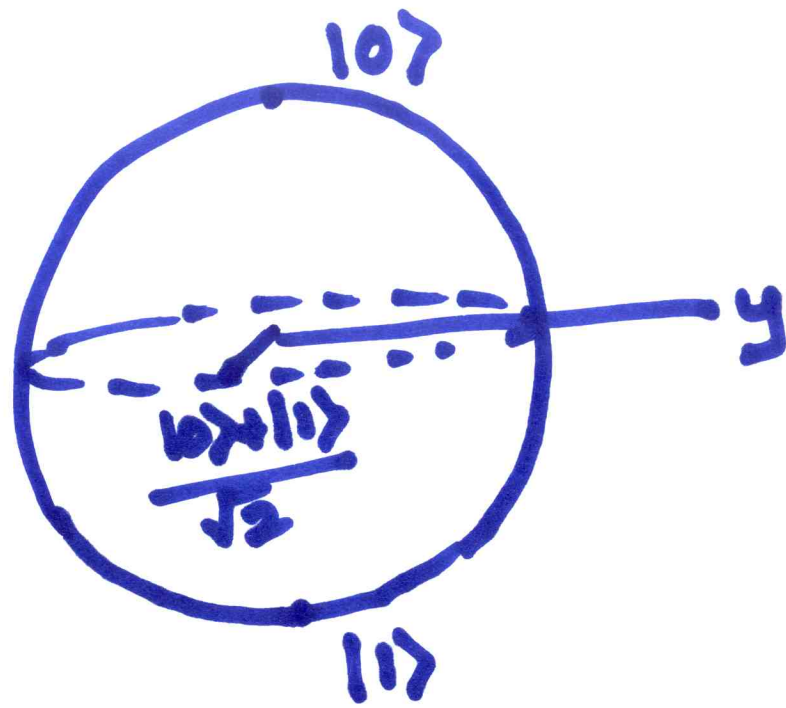
$\frac{\pi}{8}$ gate.

$$e^{i\pi/8} \begin{pmatrix} e^{-i\pi/8} & 0 \\ 0 & e^{i\pi/8} \end{pmatrix}$$

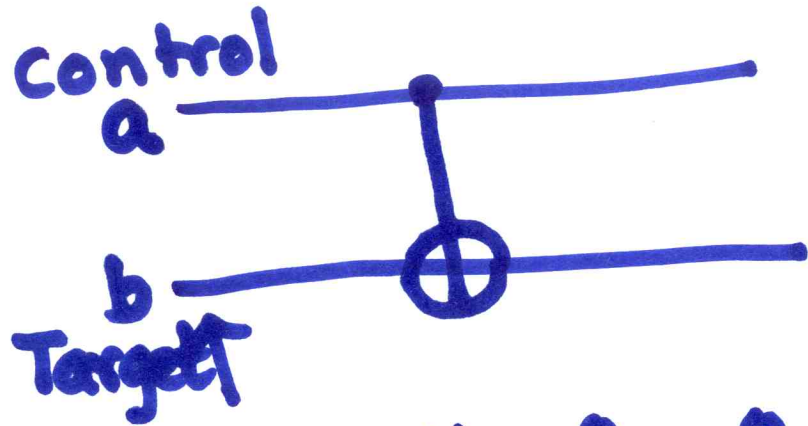
Hadamard Gate

$$|0\rangle \mapsto \frac{|0\rangle + |1\rangle}{\sqrt{2}}$$

$$|1\rangle \mapsto \frac{|0\rangle - |1\rangle}{\sqrt{2}}$$



CNOT (Controlled NOT)

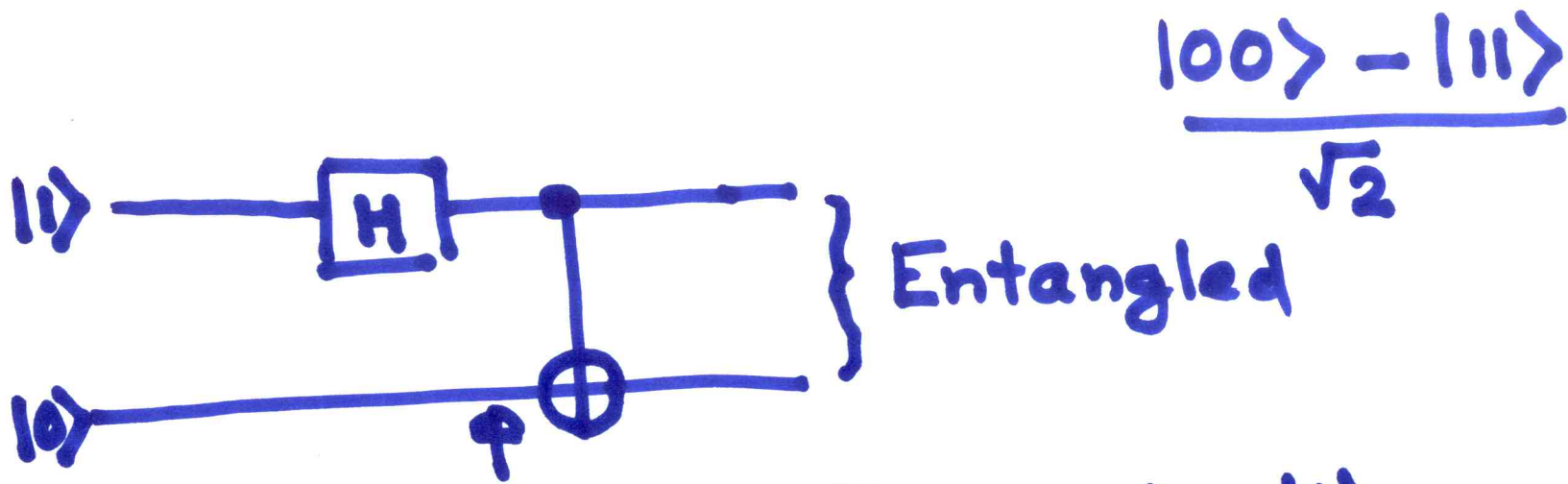


$$\begin{array}{ll}
 \text{if } a=0 & b \rightarrow b \\
 a=1 & b \rightarrow \bar{b}
 \end{array}$$

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

$|10\rangle$
 \uparrow

$|11\rangle$
 \uparrow

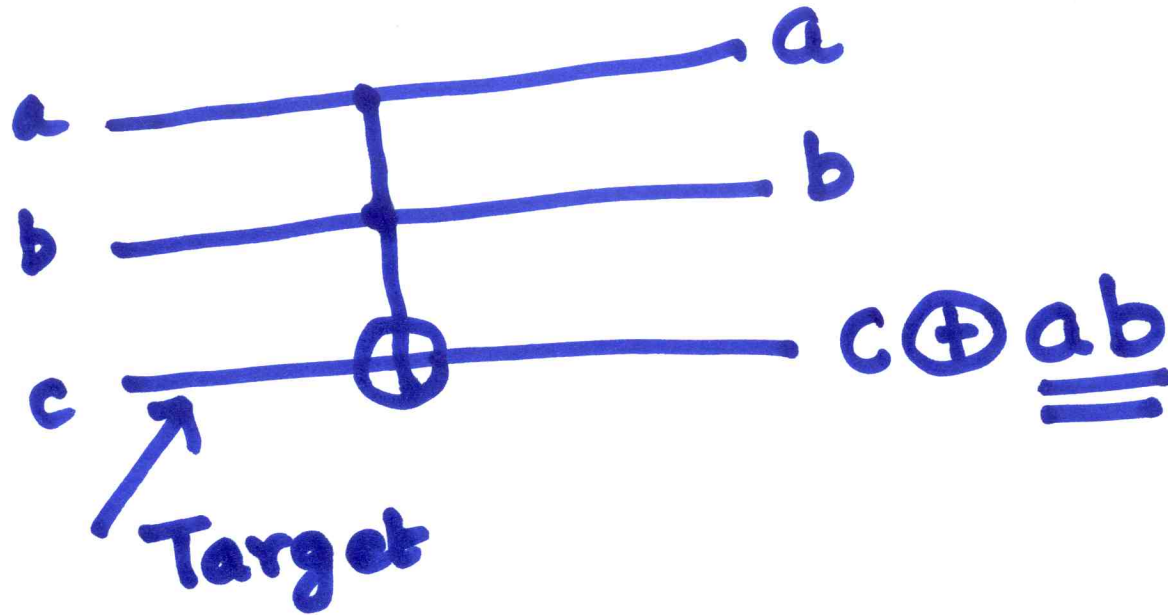


Control $|1\rangle \xrightarrow{H} \frac{|0\rangle - |1\rangle}{\sqrt{2}}$

$$\frac{|0\rangle - |1\rangle}{\sqrt{2}} \otimes |0\rangle = \frac{|00\rangle - |10\rangle}{\sqrt{2}}$$

$\xrightarrow{\text{CNOT}} \frac{|00\rangle - |11\rangle}{\sqrt{2}}$

CCNOT (Toffoli Gate)



CNOT

