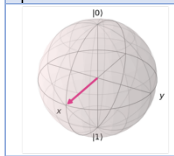
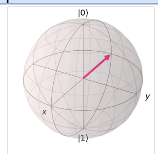
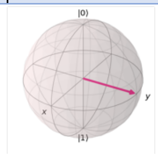
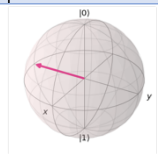
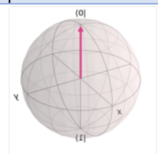
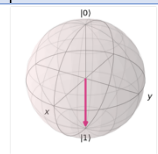
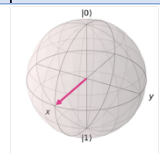
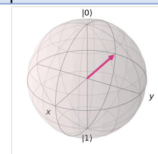
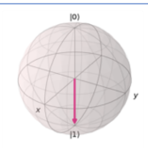
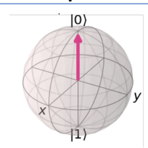
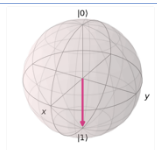
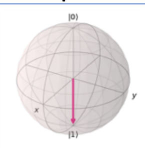
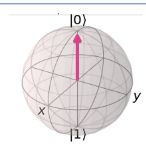
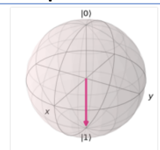
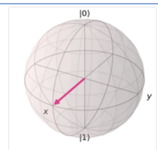
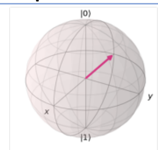
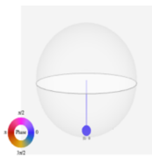
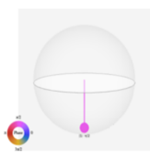
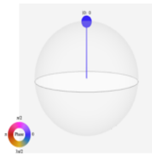
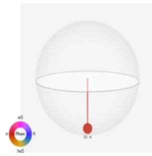
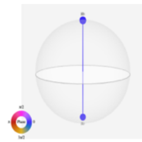
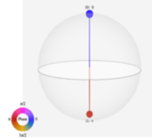
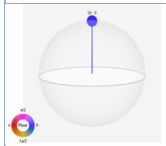
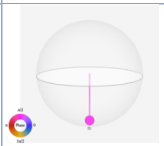
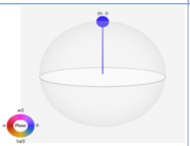
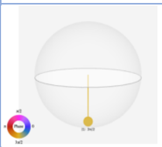
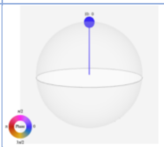
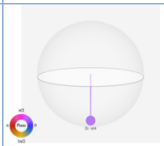
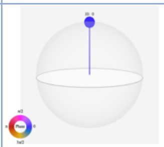
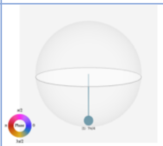
Pauli – X gate		**Pauli Y gate**		**Pauli Z gate**		**Hadamard Gate**	
NOT gate Bit-flip		Phase-flip and Bit flip gate		Phase-flip gate		Coin flip 50%-50 % distribution Qubit is in Superposition state in computational basis	
$X\lvert 0\rangle = \lvert 1\rangle$ $X\lvert 1\rangle = \lvert 0\rangle$		$Y\lvert 0\rangle = i\lvert 1\rangle$ $Y\lvert 1\rangle = -i\lvert 0\rangle$		$Z\lvert 0\rangle = \lvert 0\rangle$ $Z\lvert 1\rangle = -\lvert 1\rangle$		$H\lvert 0\rangle = 1/\sqrt{2}(\lvert 0\rangle+\lvert 1\rangle)$ $H\lvert 1\rangle = 1/\sqrt{2}(\lvert 0\rangle-\lvert 1\rangle)$	
$X=\lvert 1\rangle\langle 0\rvert + \lvert 0\rangle\langle 1\rvert$		$Y=i\lvert 1\rangle\langle 0\rangle - i\lvert 0\rangle\lvert 1\rangle$		$Z=\lvert 0\rangle\langle 0\rvert - \lvert 1\rangle\langle 1\rvert$		$H = \frac{\lvert 0\rangle+\lvert 1\rangle}{\sqrt{2}}\langle 0\rvert + \frac{\lvert 0\rangle-\lvert 1\rangle}{\sqrt{2}}\langle 1\rvert$	
$\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$		$\begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$		$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$		$\frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$	
Rotates by π about the X-axis of the bloch sphere		Rotates by π about the Y-axis of the bloch sphere		Rotates by π about the Z-axis of the bloch sphere		Rotation around the axis located at halfway between x and z axis or Half rotation of the Bloch Sphere	
				Computational Basis on the Bloch Sphere		**Computational Basis on the Bloch Sphere**	
				$\lvert 0\rangle$	**$\lvert 1\rangle$**		
Standard Basis on the Bloch Sphere		**Standard Basis on the Bloch Sphere**		**Standard Basis on the Bloch Sphere**		**$\lvert +\rangle$, $\lvert -\rangle$ are called Polar basis**	
$\lvert +X\rangle$	**$\lvert -X\rangle$**	**$\lvert +Y\rangle$**	**$\lvert -Y\rangle$**	**$\lvert +Z\rangle$**	**$\lvert -Z\rangle$**	$\lvert +\rangle$	$\lvert -\rangle$
							
$X\lvert 0\rangle = \lvert 1\rangle$	$X\lvert 1\rangle = \lvert 0\rangle$	$Y\lvert 0\rangle = i\lvert 1\rangle$	$Y\lvert 1\rangle = -i\lvert 0\rangle$	$Z\lvert 0\rangle = \lvert 0\rangle$	$Z\lvert 1\rangle = -\lvert 1\rangle$	$H\lvert 0\rangle = 1/\sqrt{2}(\lvert 0\rangle+\lvert 1\rangle)$	$H\lvert 1\rangle = 1/\sqrt{2}(\lvert 0\rangle-\lvert 1\rangle)$
States of the qubit on Bloch sphere		**States of the qubit on Bloch sphere**		**States of the qubit on Bloch sphere**		**States of the qubit on Bloch sphere**	
							
Qphere: No phase change		**Phase: pi/2**	**Phase: -pi/2**	**No phase change**	**Phase change**	**Equiprobability**	**Equiprobability**
							
XXX= X XYX= Y XZX= Z		YXY=-X YYY= Y YZY=-Z		ZXZ=-X ZYZ=-Y ZZZ= Z		HXH = Z HYH = −Y HZH = X	

<table>
<tr><th>S gate gate</th><th>Sdg/ S dagger/ S†</th><th>T gate</th><th>Tdg gate/ T dagger/ T†</th><th>P gate</th></tr>
<tr>
<td>• Induces π /2 phase
• Square root of Z gate
• 2√Z-gate
• Also called as π /4
• S-gate is not its own inverse</td>
<td>• Induces - π 2 phase
• S dagger is the conjugate transpose(or Hermitian transpose) of the S gate
• Inverse of the S gate</td>
<td>• Induces π /4 phase
• forth root of the Z gate
• 4√Z-gate
• Also called as π /8 $e^{i\frac{\pi}{8}}\begin{bmatrix}e^{-i\frac{\pi}{8}} & 0\\ 0 & e^{i\frac{\pi}{8}}\end{bmatrix}$</td>
<td>• Induces - π /4 phase
• T dagger is the conjugate transpose(or Hermitian transpose) of the T gate
• Inverse of the T gate</td>
<td>• Phase gate
• Parametrised gate
• Requires a parameters (φ)</td>
</tr>
<tr>
<td>SS=Z
P-gate with ϕ=π/2</td>
<td>S† S† = Z
P-gate with ϕ= -π/2</td>
<td>TTTT=Z
P-gate with ϕ=π/4</td>
<td>T† T† T†T† = Z
P-gate with ϕ= -π/4</td>
<td>P(ϕ)
ϕ is a real number</td>
</tr>
<tr>
<td>quarter -turn around the Bloch sphere rotates the qubit by π /2 radians along the z-axis</td>
<td></td>
<td>rotates the qubit by π /4 radians along the z-axis</td>
<td></td>
<td>Rotates the qubit with the parameters ϕ around the Z-axis direction.</td>
</tr>
<tr>
<td>S|0>= |0>
S|1> = i|1></td>
<td>S† |0>= |0>
S† |1> = - i|1></td>
<td>T|0>= |0>
T|1> = i|1></td>
<td>T† |0>= |0>
T† |1> = - i|1></td>
<td>Φ=0, we get identity</td>
</tr>
<tr>
<td>$\begin{bmatrix}1 & 0\\ 0 & e^{\frac{i\pi}{2}}\end{bmatrix}$ or $\begin{bmatrix}1 & 0\\ 0 & i\end{bmatrix}$</td>
<td>$\begin{bmatrix}1 & 0\\ 0 & e^{-\frac{i\pi}{2}}\end{bmatrix}$ or $\begin{bmatrix}1 & 0\\ 0 & -i\end{bmatrix}$</td>
<td>$\begin{bmatrix}1 & 0\\ 0 & e^{\frac{i\pi}{4}}\end{bmatrix}$ or $\begin{bmatrix}1 & 0\\ 0 & \frac{1}{\sqrt{2}}(1+i)\end{bmatrix}$</td>
<td>$\begin{bmatrix}1 & 0\\ 0 & e^{-\frac{i\pi}{4}}\end{bmatrix}$ or $\begin{bmatrix}1 & 0\\ 0 & \frac{1}{\sqrt{2}}(1-i)\end{bmatrix}$</td>
<td>$\begin{bmatrix}1 & 0\\ 0 & e^{i\phi}\end{bmatrix}$</td>
</tr>
<tr>
<td>S|0>=|0>
S|1> = i|1></td>
<td>S† |0>=|0>
S† |1> = - i|1></td>
<td>T|0>=|0>
T|1> = i|1></td>
<td>T† |0>=|0>
T† |1> = - i|1></td>
<td>P|0>=|0>
ϕ = π , P|1>= -1>
ϕ = π /2, P|1>= i|1>
ϕ = π /4, P|1>=. -i|1></td>
</tr>
<tr>
<td> </td>
<td> </td>
<td> </td>
<td> </td>
<td>ϕ = π , Z
ϕ = π /2, S
ϕ = π /4, T</td>
</tr>
</table>

<table>
<tr><th>Identity gate</th><th>Rotation Gates: Non-Clifford gates</th><th>Phase Gates</th><th>U</th></tr>
<tr>
<td>No operation, basis remain unchanged

I|0>=|0>
I|1>=|1>
Matrix representation:

$\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$</td>
<td>Rotation through angle θ(radians) around the x-axis
$R_x(\theta) = \begin{pmatrix}\cos\left(\frac{\theta}{2}\right) & -i\sin\left(\frac{\theta}{2}\right)\\ -i\sin\left(\frac{\theta}{2}\right) & \cos\left(\frac{\theta}{2}\right)\end{pmatrix}$

Rotation through angle θ(radians) around the y-axis
$R_y(\theta) = \begin{pmatrix}\cos\left(\frac{\theta}{2}\right) & -\sin\left(\frac{\theta}{2}\right)\\ \sin\left(\frac{\theta}{2}\right) & \cos\left(\frac{\theta}{2}\right)\end{pmatrix}$

Rotation through angle θ(radians) around the z-axis
$R_z(\theta) = \begin{pmatrix}e^{-i\frac{\theta}{2}} & 0\\ 0 & e^{i\frac{\theta}{2}}\end{pmatrix}$</td>
<td>Z
S
Sdg
T
Tdg
P</td>
<td>$\begin{bmatrix}\cos(\frac{\theta}{2}) & -e^{i\lambda}\sin(\frac{\theta}{2})\\ e^{i\phi}\sin(\frac{\theta}{2}) & e^{i(\phi+\lambda)}\cos(\frac{\theta}{2})\end{bmatrix}$
• General form of a single unitary
• Single qubit rotation with U(θ,ϕ,λ)
• parametrised gate
• most general of all single-qubit quantum gates
• Superposition : u(pi/2,0,pi)
• P gate using u(0,0,λ)</td>
</tr>
</table>