Qiskit Lab Manual

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Qiskit

Need for Adding more Lab Manuals in Qiskit Textbook

Goal: Help new users to grasp concepts by visualizing.

To contribute content in Quantum Computing Labs, as part of Qiskit Textbook

- Visualize outputs in State Vector, QSphere, Bloch Sphere and Histogram Representations
- Execute using Simulators and Real Quantum devices

Our Contribution

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Lab 1: Working with Single Qubit Gates

- Effect of single qubit gates on Eigenvectors of Pauli matrices

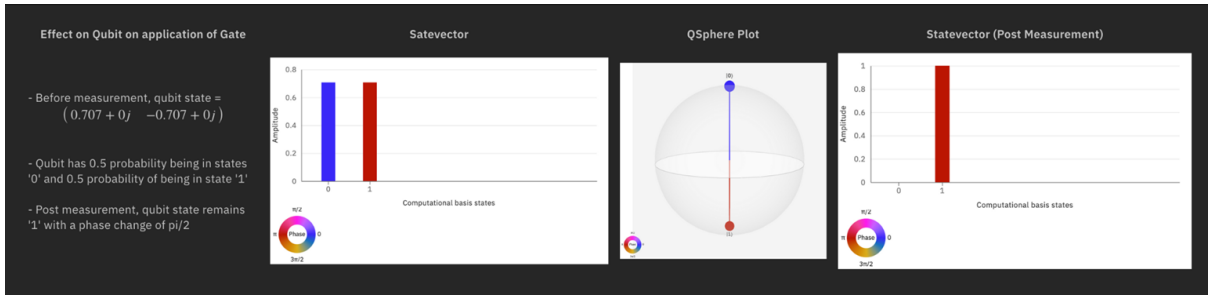

Fig 1.1: Example – Application of S-gate on |i> resulting into |->

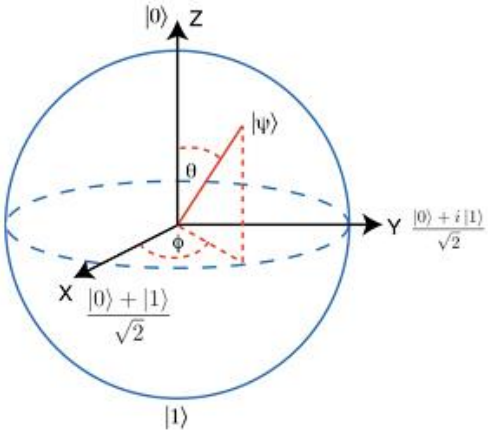

Fig 1.2: Eigenvectors

$$
\begin{aligned}
x|0\rangle &= |1\rangle \\
x|1\rangle &= |0\rangle \\
x|+\rangle &= |+\rangle \\
x|-\rangle &= -|-\rangle \\
x|i\rangle &= i|-i\rangle \\
x|-i\rangle &= -i|i\rangle
\end{aligned}
\qquad
\begin{aligned}
y|0\rangle &= i|1\rangle \\
y|1\rangle &= -i|0\rangle \\
y|+\rangle &= -i|-\rangle \\
y|-\rangle &= i|+\rangle \\
y|i\rangle &= |i\rangle \\
y|-i\rangle &= -|-i\rangle
\end{aligned}
\qquad
\begin{aligned}
z|0\rangle &= |0\rangle \\
z|1\rangle &= -|1\rangle \\
z|+\rangle &= |-\rangle \\
z|-\rangle &= |+\rangle \\
z|i\rangle &= |-i\rangle \\
z|-i\rangle &= |i\rangle
\end{aligned}
\qquad
\begin{aligned}
s|0\rangle &= |0\rangle \\
s|1\rangle &= i|1\rangle \\
s|+\rangle &= |i\rangle \\
s|-\rangle &= |-i\rangle \\
s|i\rangle &= |-\rangle \\
s|-i\rangle &= |+\rangle
\end{aligned}
$$

Fig 1.3: Gate applications on Eigenvectors in scope of Lab 1

Future Work

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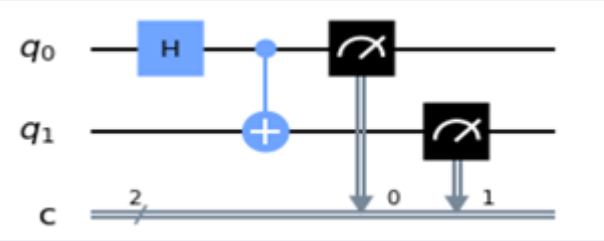
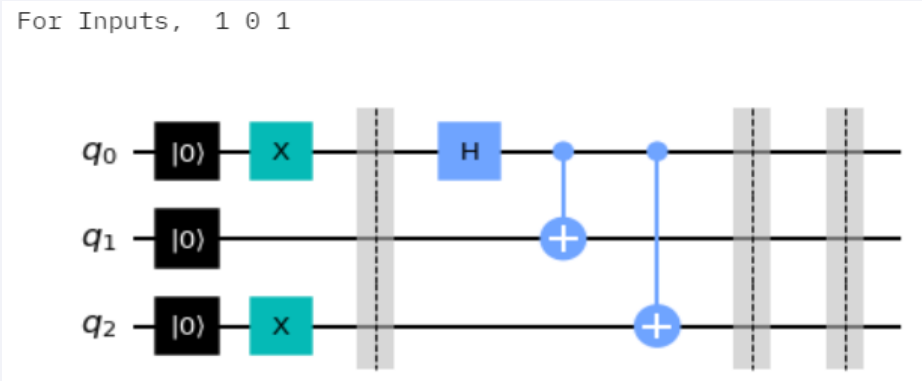
Lab 2: Bell States



- Explore and understand all the four maximally entangled Bell States

2

Lab 3: GHZ Circuit



- Explore and understand all the maximally entangled quantum states using 3-qubit GHZ circuit