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Quantum Computing
Assignment 5
(Working with single qubit in Qiskit)

Instructions: The assignment is self-explanatory. Try yourself, as these concepts will be used for later assignments. **For Section 1 to Section 6, repeat these questions for quantum state $|0\rangle, |1\rangle$, $1/\sqrt{2}(|0\rangle + |1\rangle)$**

Section 1

X-Gate on Bloch Sphere and State Vector Create a quantum circuit with single qubit.

1. Apply X-Gate to the qubit.
2. Draw the Circuit.
3. Show the qubit on Bloch Sphere.
4. Display the state vector of the quantum state.

You can refer https://qiskit.org/textbook/ch-states/single-qubit-gates.html for details.

Section 2

Y-Gate on Bloch Sphere and State Vector Create a quantum circuit with single qubit.

1. Apply Y-Gate to the qubit.
2. Draw the Circuit.
3. Show the qubit on Bloch Sphere.
4. Display the state vector of the quantum state.

You can refer https://qiskit.org/textbook/ch-states/single-qubit-gates.html for details.

Section 3

Z-Gate on Bloch Sphere and State Vector Create a quantum circuit with single qubit.

1. Apply Z-Gate to the qubit.
2. Draw the Circuit.
3. Show the qubit on Bloch Sphere.
4. Display the state vector of the quantum state.

You can refer https://qiskit.org/textbook/ch-states/single-qubit-gates.html for details.

Section 4

Phase-Gate on Bloch Sphere and State Vector Create a quantum circuit with single qubit.

1. Apply S-Gate to the qubit.
2. Draw the Circuit.
3. Show the qubit on Bloch Sphere.
4. Display the state vector of the quantum state.

You can refer https://qiskit.org/textbook/ch-states/single-qubit-gates.html for details.

Section 5

T-Gate on Bloch Sphere and State Vector Create a quantum circuit with single qubit.

1. Apply T-Gate to the qubit.
2. Draw the Circuit.
3. Show the qubit on Bloch Sphere.
4. Display the state vector of the quantum state.

You can refer https://qiskit.org/textbook/ch-states/single-qubit-gates.html for details.

Section 6

$S^\dagger$-Gate on Bloch Sphere and State Vector Create a quantum circuit with single qubit.

1. Apply $S^\dagger$-Gate to the qubit.
2. Draw the Circuit.
3. Show the qubit on Bloch Sphere.
4. Display the state vector of the quantum state.

You can refer https://qiskit.org/textbook/ch-states/single-qubit-gates.html for details.

Section 6

$T^\dagger$-Gate on Bloch Sphere and State Vector Create a quantum circuit with single qubit.

1. Apply $T^\dagger$-Gate to the qubit.
2. Draw the Circuit.
3. Show the qubit on Bloch Sphere.
4. Display the state vector of the quantum state.

You can refer https://qiskit.org/textbook/ch-states/single-qubit-gates.html for details.

Section 7

U-Gate on Bloch Sphere and State Vector Universal single qubit gate is defined using $U(\theta, \phi, \lambda) = \begin{bmatrix} cos(\theta/2) & -e^{i\lambda}sin(\theta/2) \\ e^{i\phi}sin(\theta/2) & e^{i(\lambda+\phi)}cos(\theta/2) \end{bmatrix}$ Create a quantum circuit with a single qubit. Find the value of (θ, ϕ, λ) for $X, Y, Z, H, S, T, S^\dagger, T^\dagger$ and verify it using state vector and Bloch sphere.

You can refer https://qiskit.org/textbook/ch-states/single-qubit-gates.html for details.