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#Toffoli Gate Demo

# Install Qiskit if not already installed
!pip install qiskit matplotlib

from qiskit import QuantumCircuit
from qiskit.quantum_info import Statevector
from qiskit.visualization import plot_bloch_multivector
import matplotlib.pyplot as plt

# 1. Create a 3-qubit Quantum Circuit
qc = QuantumCircuit(3)

# 2. Setup initial state: Toffoli only flips the target if both controls are 1
# Qubit 0 and Qubit 1 are controls, Qubit 2 is the target
#Comment out one of the lines to see no change
#qc.x(0) # Flip control 0 to state |1>
qc.x(1) # Flip control 1 to state |1>

fig_0 = plot_bloch_multivector(qc, title="Initial States", reverse_bits=False)
display(fig_0)

# 3. Apply the Toffoli (CCX) gate
# Parameters: control_qubit_1, control_qubit_2, target_qubit
qc.ccx(0, 1, 2)

# 4. Get the final statevector of the system
state = Statevector.from_instruction(qc)

# 5. Visualize the state of each qubit on its own Bloch sphere
# In this case: Q0 and Q1 will be at |1> (South Pole), Q2 will flip to |1>
fig_1 = plot_bloch_multivector(state, title="Final States after Toffoli Gate", reverse_bits=False)
display(fig_1)

# Optional: Draw the circuit to verify the gate sequence
print(qc.draw())

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Requirement already satisfied: matplotlib in /usr/local/lib/python3.12/dist-packages (3.10.0)
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Initial States

