Module 4: Post_Homework

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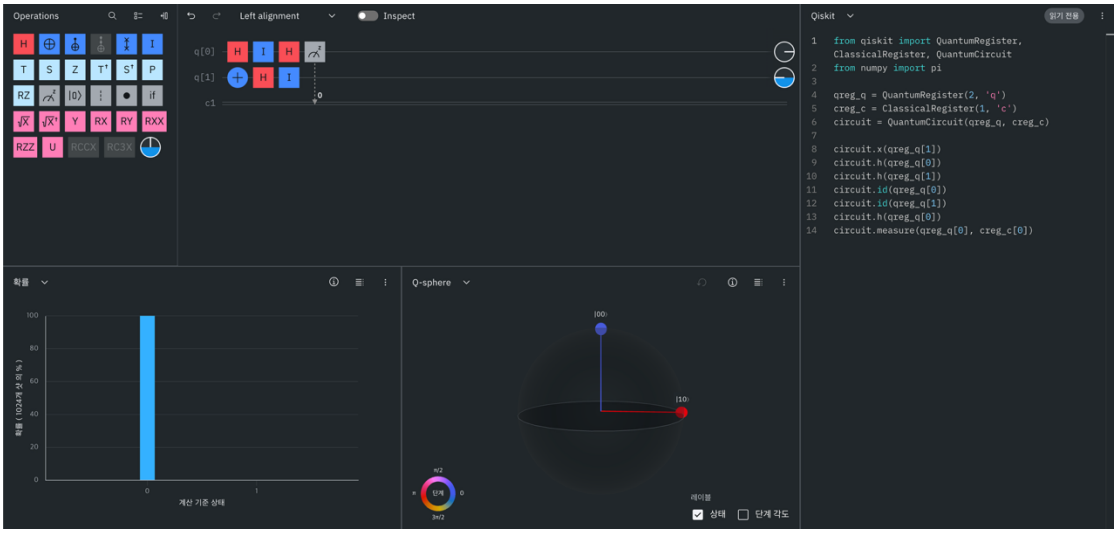
1. My IBM instance: d4taqv4gk3fc73asmfe0
2. Quantum Circuit Implementation
   Out of 4 functions, I implemented the f(x) = 0 function, which is a Constant function. The Quantum Oracle for this function is the Identity operation $(U_f\,|x\rangle|y\rangle = |x\rangle|y \oplus 0\rangle = |x\rangle|y\rangle)$, meaning no gates change the state of the qubits during the oracle step.

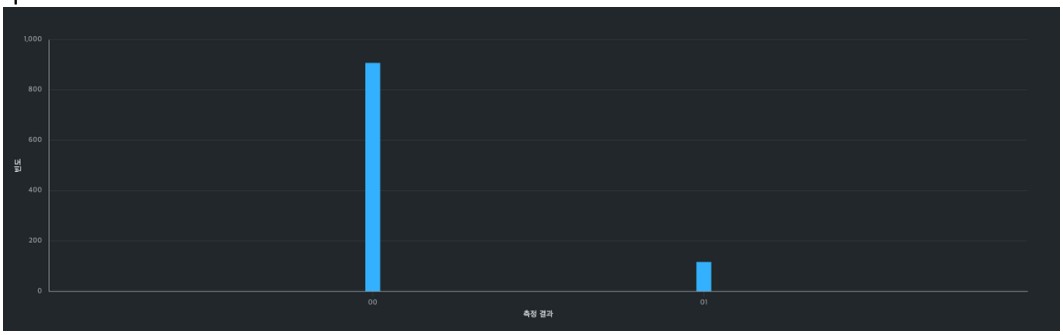


[Hypothesis]

1) The qubits start at $|0\rangle|1\rangle$ (after applying X to q1).
2) Hadamard gates transform the state to $|+\rangle|-\rangle$.
3) Since $f(x) = 0$, the Oracle acts as an Identity matrix (I), leaving the state as $|+\rangle|-\rangle$.
4) The final Hadamard gate on q0 transforms $|+\rangle$ back to $|0\rangle$.
5) Therefore, we expect the measurement outcome of 0 with 100% probability, which correctly identifies the function as Constant.

The simulation also confirms the hypothesis(outcome 0 with 100%)

3. Result on Real Device
   - Device name: ibm_torino
   - The result on the real device shows that the outcome '0' is dominant, which matches the simulation. This experimentally verifies that the implemented function is indeed Constant. The small presence of outcome '1' is due to the inherent noise and gate errors of the real quantum hardware.



Job results

작업 결과

측정 결과	빈도
00	907
01	117

상태 타임라인

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