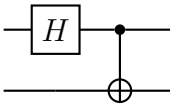
CS469/569 Quantum Information and Computation (Spring 2024)

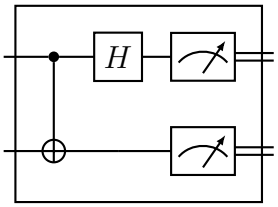
Homework 1. Out: 1/27/24

1. Show that the Hadamard gate *almost* commutes with the Pauli gates: that is, if A is a Pauli matrix, then there is another Pauli matrix B so that $AH = HB$.

2. Show that the Bell states form a basis of all two-qubit states.



3. Explain what does it mean to perform a Bell basis measurement of a two-qubit state.



4. Describe a quantum circuit that starting with $|000\rangle$ prepares the output state

$$|\Psi\rangle = \frac{1}{\sqrt{2}}(|000\rangle + |111\rangle).$$

5. (CS569: Entanglement Swapping) Suppose that Alice and Bob share a Bell state, and that Bob and Charlie share another a different Bell state. Confirm (or deny) that the protocol below where we perform a Bell measurement on Bob's particles will create an entangled pair between Alice and Charlie.