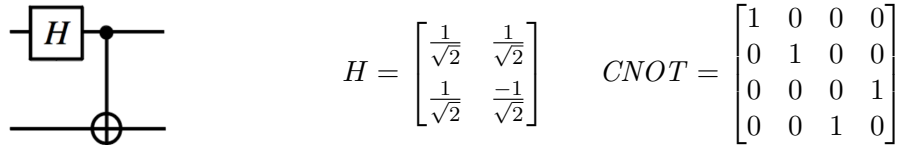


Assignment 15

Due by class time Thursday, November 10

1. Consider the circuit diagram shown below. This circuit takes two qubits as input and applies a Hadamard gate H to the top qubit, followed by a $CNOT$ gate to both qubits. The matrices for the H and $CNOT$ gates are also shown.



- (a) Show the matrix for this circuit.
- (b) Calculate the 2-qubit state vector produced as output when the circuit is applied to the input qubits $|0\rangle \otimes |0\rangle = |00\rangle$. Express the output state as a linear combination of the basis states $|00\rangle$, $|01\rangle$, $|10\rangle$, and $|11\rangle$:

$$\text{output} = \text{_____} |00\rangle + \text{_____} |01\rangle + \text{_____} |10\rangle + \text{_____} |11\rangle$$

- (c) Do the same for input $|01\rangle$:

$$\text{output} = \text{_____} |00\rangle + \text{_____} |01\rangle + \text{_____} |10\rangle + \text{_____} |11\rangle$$

- (d) Do the same for input $|10\rangle$:

$$\text{output} = \text{_____} |00\rangle + \text{_____} |01\rangle + \text{_____} |10\rangle + \text{_____} |11\rangle$$

- (e) Do the same for input $|11\rangle$:

$$\text{output} = \text{_____} |00\rangle + \text{_____} |01\rangle + \text{_____} |10\rangle + \text{_____} |11\rangle$$