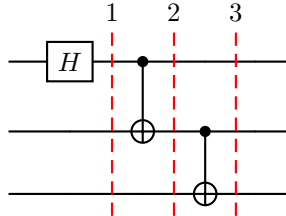# Assignment 1

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

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

The following 3 stage circuit will produce the desiried output state:

- Stage 1 - Hadamard Gate:

$$|0\rangle \otimes |0\rangle \otimes |0\rangle \xrightarrow{H \otimes I \otimes I} \frac{|0\rangle \otimes |1\rangle}{\sqrt{2}} \otimes |0\rangle \otimes |0\rangle$$
$$= \frac{1}{\sqrt{2}}(|000\rangle + |100\rangle)$$

- Stage 2 - 1st Control Not:
  Just looking at the first two qubits of the superposition. The first qubit is the control bit and second qubit is the bit we may modifiy.

$$\frac{1}{\sqrt{2}}(|000\rangle + |100\rangle) \xrightarrow{\text{CNOT}} \frac{1}{\sqrt{2}}(|000\rangle + |110\rangle)$$

- Stage 3 - 2nd Control Not:
  Just looking at the last two qubits of the superposition. The second qubit is the control bit and the third qubit is the bit we may modify

$$\frac{1}{\sqrt{2}}(|000\rangle + |110\rangle) \xrightarrow{\text{CNOT}} \frac{1}{\sqrt{2}}(|000\rangle + |111\rangle)$$