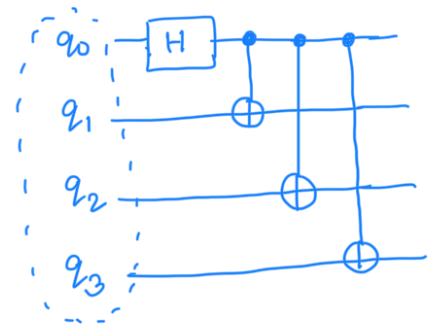
QUBIT SELECTION

Refer to Measurement error mitigation demo where we pre-selected some qubits.

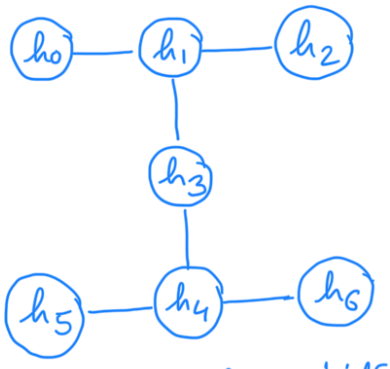
Q> were those the best qubits to select?

Circuit



virtual/circuit qubit

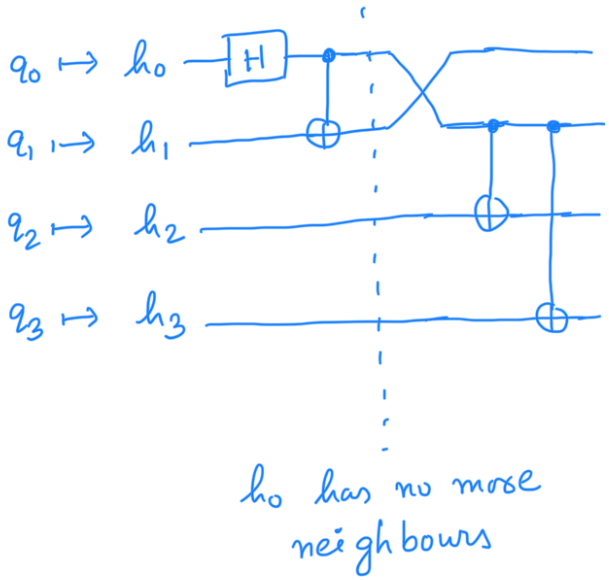
Hardware



physical qubits

Q) which virtual qubit should be placed on which physical qubit?

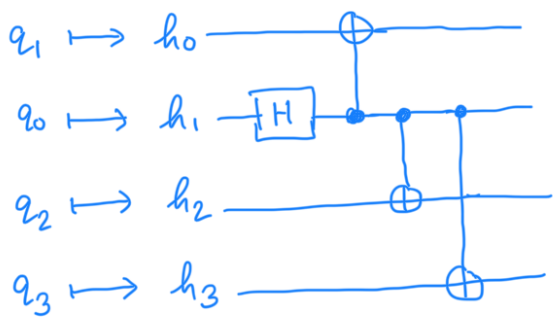
attempt 1: $q_0 \to h_0$, $q_1 \to h_1$, ..., $q_3 \to h_3$



$\Rightarrow$ 1 swap gate

h_0 has no more neighbours

attempt 2 : $q_0 \to h_1$, $q_1 \to h_0$, $q_2 \to h_2$, $q_3 \to h_3$



$\Rightarrow$ 0 swap gate

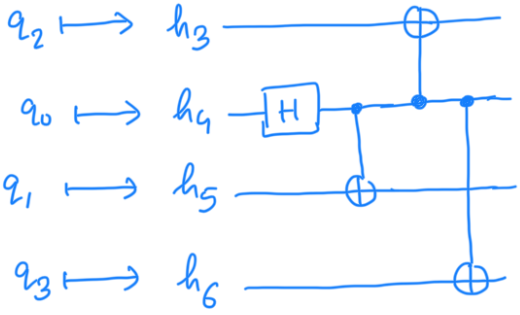
this transpilation is better

attempt 3 : $q_0 \to h_4$, $q_1 \to h_5$, $q_2 \to h_3$, $q_3 \to h_6$

h_0

h_1

h_2



$\Rightarrow$ 0 swap gate

which one of the last two should we select ?

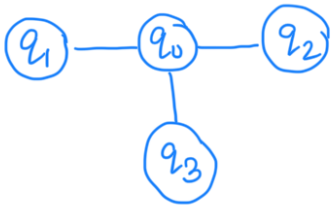
$\Rightarrow$ NOT ALL QUBITS & INTERACTIONS HAVE THE SAME ERROR PROBABILITY

- Joint optimization is hard

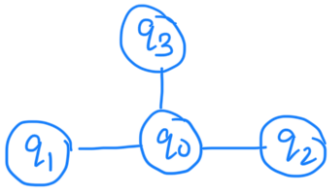
Idea of mapomatic

1) Find an optimal placement without considering the error probability of the qubits / interaction.
   - any one of the last 2 placements is good.

2) Create a graph from the transpiled circuit.



3) Find subgraph isomorphisms of the transpiled graph on the hardware graph.
   - how many different ways can we place the transpiled graph on the hardware graph without losing the orientation?



⇒ correspond to the 3rd transpilation

4) Calculate the error probability of each isomorphism.
   - one method is to check the error probability of all qubits (correspond to 1 qubit gates), readout error, and interactions (correspond to 2 qubit gates)

5) Select the isomorphism with the lowest error probability