

## hw10

There's always some way to make a block encoding for any matrix  $B$ .

Therefore, as long as we can manipulate the quantum circuit to make it the same as the one in the problem, there will be some way to create the block encoding.

The idea is to split the original circuit into two parts, and let  $U_1$  acts on the  $|0\rangle$ , and let  $U_2$  act on the  $|1\rangle$ , and then we merge them together.

So hypothetically, we have a circuit that looks like this:

We firstly use an  $\mathcal{H}$  gate to the ancilla qubits, and then we apply the  $U_1$  gate with a projection that maps to  $|0\rangle^l$ , and then we apply the  $U_2$  gate with a projection that maps to  $|1\rangle^l$ , and then we apply the  $\mathcal{H}$  gate to the ancilla qubits again.

These two middle gates should be able to be implemented with  $V$ .