Measurement-based quantum computation

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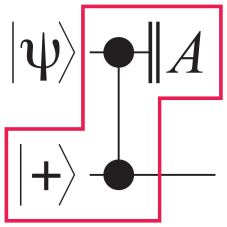
Tutorial 1

July 26, 2021

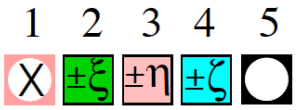
Question 1 [Half-teleporatation]. The picture below shows the half-teleportation circuit explaining the effect of one single measurement on the cluster state; you saw in class earlier today.

For which observables A is the resulting logical operation T_A acting on the input state $|\Psi\rangle$ (a) a unitary, and (b) a projection?



Question 2 [Temporal order]. The picture below shows a five-qubit cluster state for the implementation of a general logical 1-qubit rotation. Cluster qubit #5 is the output qubit.

Which measurement outcomes does the choice of measurement basis at cluster qubit #4 depend upon?



Question 3 [Cissors]. Think of a 1D cluster state as shown below. What happens if a qubit in the middle is measured in the Z-eigenbasis? What is the influence of the measurement outcome on the resulting state? Move on to 2D cluster states—what is the effect of Z-measurement now?

Hint: If you know the stabilizer formalism, it is helpful for this problem. If you don't, recall the creation procedure for cluster states using conditional phase gates, and note that such gates commute with Z-measurements (they are diagonal operations in the same basis).