# Homework 13

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December 12, 2019

Problem 1

Design the following 2-tape TM to accept the language of all strings of 0's and 1's with an equal number of each. The first tape contains the input, and is scanned from left to right. The second tape is used to store the excess of 0's over 1's, or vice-versa, in the part of input seen so far. Specify the states, transitions, and the intuitive purpose of each state.

Solution.
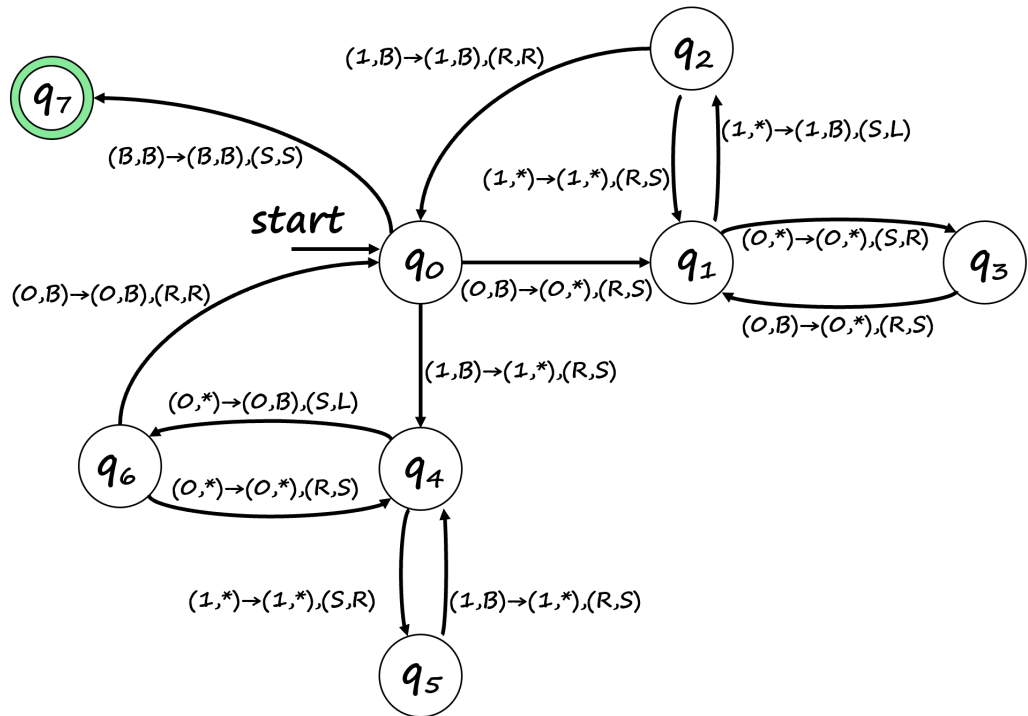
q_0: We have scanned 0's and 1's of equal size. If there's no symbol on first tape, we accept the input.

q_1: We have scanned more 0's than 1's, and the number of *'s on second tape indicate the number of 0's which exceeds the number of 1's.

q_2: When meet 1 from q_1, we need to erase one * on second tape. If there's no * on second tape, we transfer to q_0.

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q_3: When meet another 0 from q_1, we need to add another * on second tape.

q_4: We have scanned more 1's than 0's, and the number of *'s on second tape indicate the number of 1's which exceeds the number of 0's.

q_5: When meet another 1 from q_4, we need to add another * on second tape.

q_6: When meet 0 from q_4, we need to erase one * on second tape. If there's no * on second tape, we transfer to q_0.