TOC Assignment → 5

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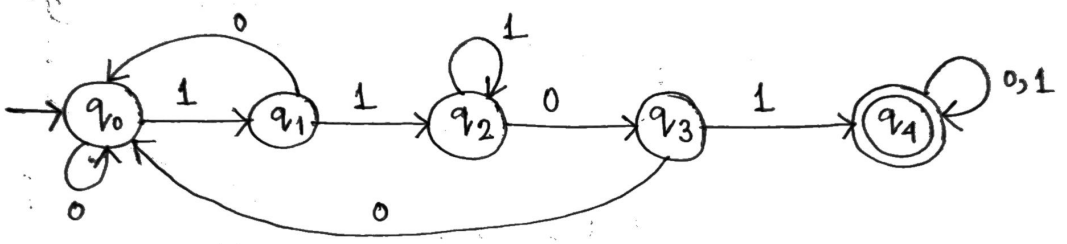
1. The language

$L_1 = \{ x \in \{0,1\}^* \mid x \text{ contains } 1101 \text{ as a substring} \}$

L_1 is a regular language since, we can draw DFA M_1 for the language such that $L(M_1) = L_1$.

Now, the DFA M_1 is:



$M_1 = \{ Q, \Sigma, \delta, q_0, F \}$

where, $Q = \{ q_0, q_1, q_2, q_3, q_4 \}$ $\quad F = \{ q_4 \}$

$\Sigma = \{0, 1\}$ $\quad q_0 \rightarrow$ initial state.

$\delta \rightarrow$ transition function, & $\delta : Q \times \Sigma \rightarrow Q$

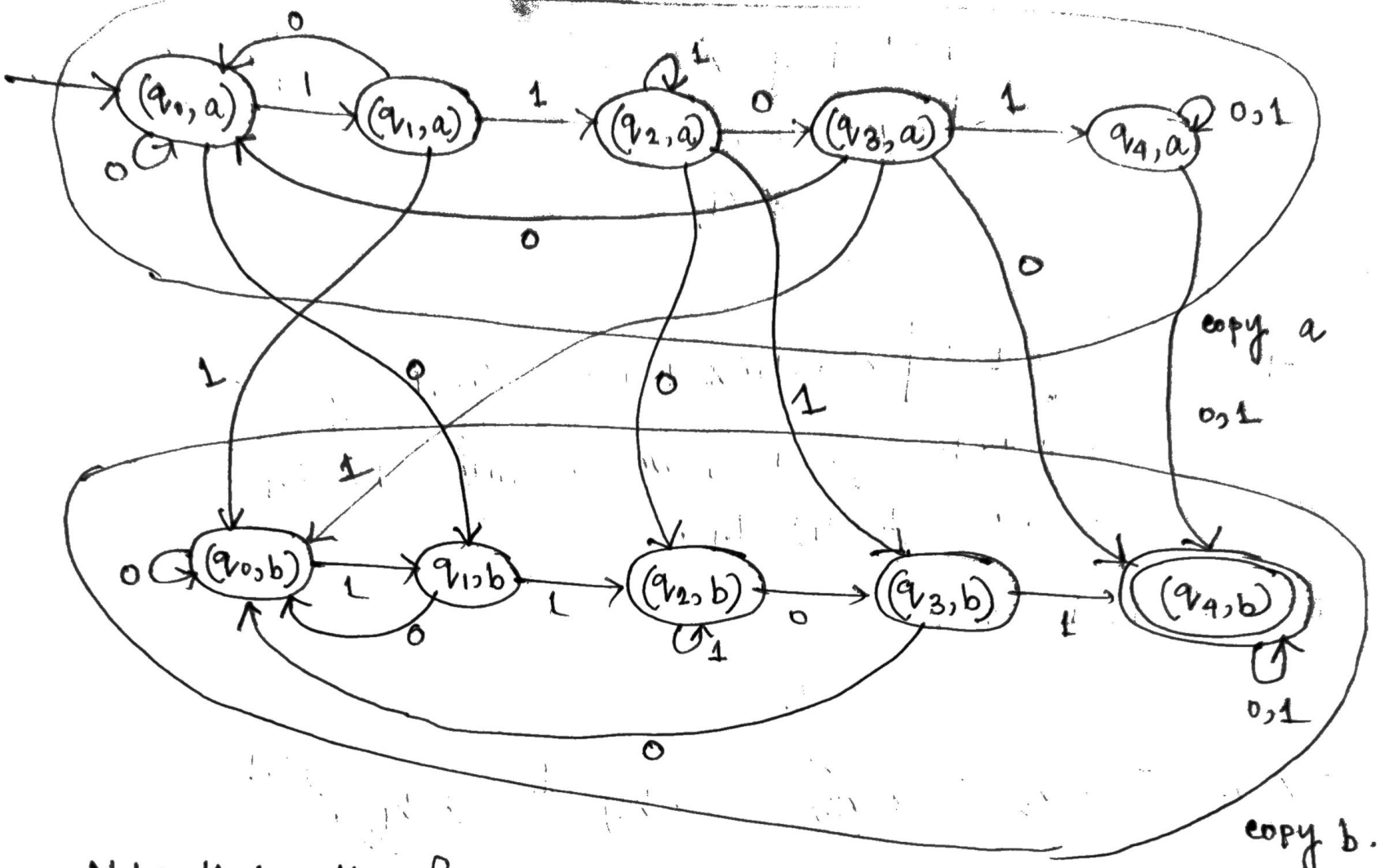
$\delta(q_0,0) = q_0$, $\delta(q_1,0) = q_0$, $\delta(q_2,0) = q_3$, $\delta(q_3,0) = q_1$, $\delta(q_4,0) = q_4$

$\delta(q_0,1) = q_1$, $\delta(q_1,1) = q_2$, $\delta(q_2,1) = q_2$, $\delta(q_3,1) = q_4$, $\delta(q_4,1) = q_4$

Now, $L_2 = \{ y \in \{0,1\}^* \mid$ there exist a $x \in L_1$, exactly one-bit of which is flipped to obtain $y \}$

we have to design an NFA M_2, such that $L(M_2) = L_2$.

for that, we need two copies of the DFA M_1.



Note that, though copy a and b are copies of DFA M_1, copy a doesn't contain the final state. and copy b doesn't contain the initial state.

$$M_2 = \{ (Q_2, \Sigma, \delta_2, (q_0,a), F_2 \}$$

where, $Q_2 = \{ (q_i,a), (q_j,b) \mid 0 \leq i,j \leq 4, i,j \in \mathbb{I}^+ \}$

$$\Sigma = \{0,1\}$$

$$F_2 = \{ (q_4,b) \}$$