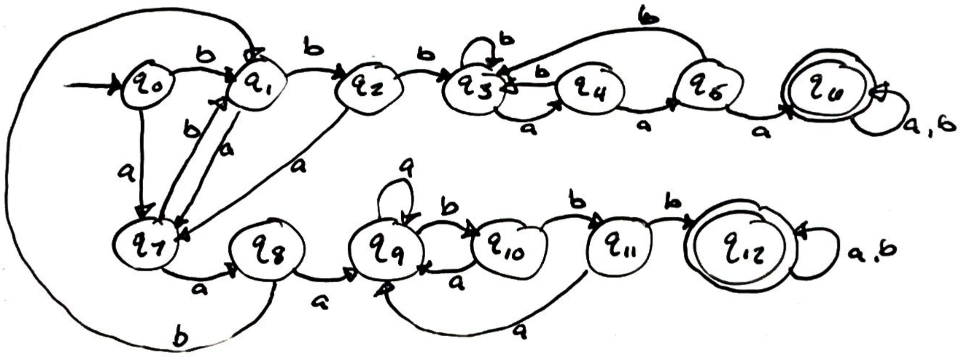
Eric Altenburg

Problem set 1

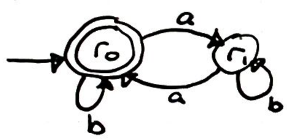
9/4/19

1. 1) $L_1 = \{w : w$ contains the string aaa and the string bbb$\}$.

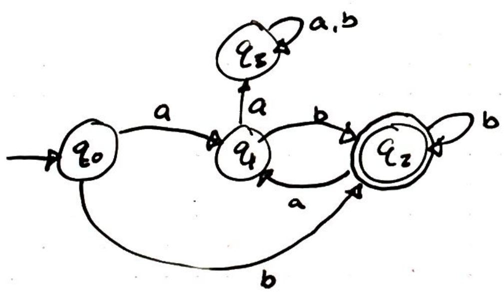


2) $L_2 = \{w : w$ contains an even # of a's and each a is followed immediately by at least one b.$\}$

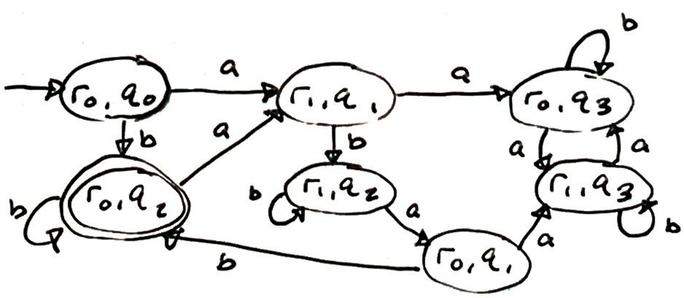
M_1 : even # of a's where 0 is considered even



M_2 : every a must be followed by at least one b.

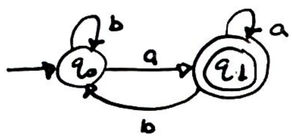


M_3 : combination

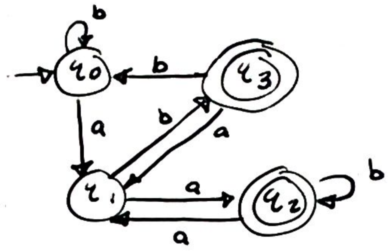


3) $L_3 = \{w : \text{the third last symbol in } w \text{ is } a\}$

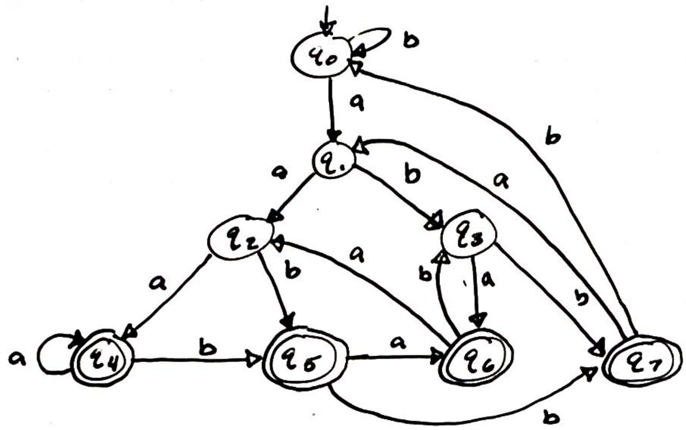
M_1 where ends in a:



M_2 where a is second to last:



M:



2. Let M_1 recognize A_1 where $M_1 = (Q_1, \Sigma_1, \delta_1, q_1, F_1)$ and

M_2 recognize A_2 where $M_2 = (Q_2, \Sigma_2, \delta_2, q_2, F_2)$.

Machine $M = (Q, \Sigma, \delta, q, F)$ recognize the union of the two regular languages which are different. $(\Sigma = \Sigma_1 \cup \Sigma_2)$

1) $Q = \{(r_1, r_2) \mid r_1 \in Q_1 \text{ and } r_2 \in Q_2\}$

Q is all pairs of states $Q_1 \times Q_2$

2) Σ_1 is for alphabet of M_1 and Σ_2 is for M_2. Since they are different,

$\Sigma = \Sigma_1 \cup \Sigma_2$

3) For each $(r_1, r_2) \in Q$ and each $a \in \Sigma$, let

$$\delta((r_1, r_2), a) = \begin{cases} (\delta_1(r_1, a), r_2) & \text{when } a \in \Sigma_1 \text{ and } a \notin \Sigma_2 \\ (r_1, (\delta_2(r_2, a))) & \text{when } a \in \Sigma_2 \text{ and } a \notin \Sigma_1 \\ (\delta_1(r_1, a), \delta_2(r_2, a)) & \text{when } a \in \Sigma_1 \text{ and } a \in \Sigma_2 \end{cases}$$

δ gets state of M (which is pair of states from M_1 and M_2) and input symbol then returns M's next state. Has 3 possible next states as input can either be in Σ_1 but not Σ_2; in Σ_2 and not Σ_1, or in both.

4) $q = (q_1, q_2)$

5) F is set of pairs in which either member is an accept state

$F = \{ (r_1, r_2) \mid r_1 \in F_1 \text{ or } r_2 \in F_2 \}$

Pledge: I pledge my honor that I have abided by the Stevens Honor System.

- [signature]