ICCS310: Assignment 2

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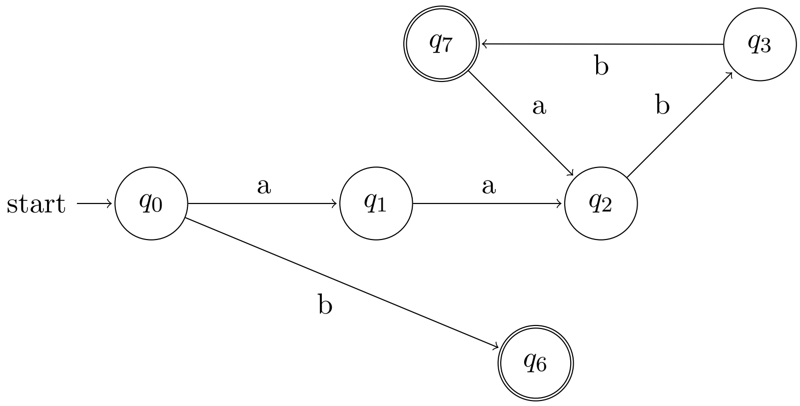
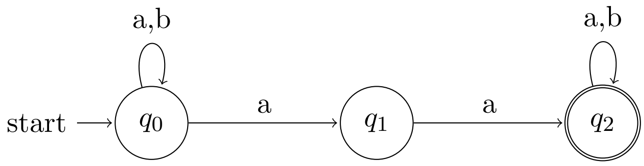
1: Regex to NFA/DFA

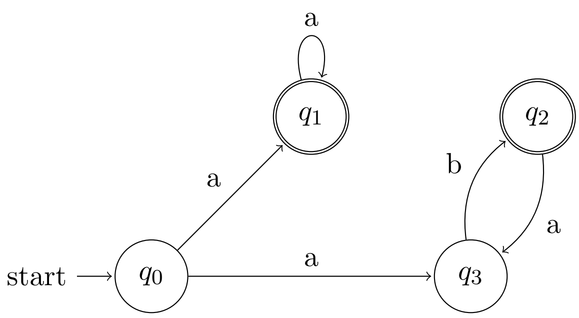
(1) $a(abb)^* + b$



(2) $(a+b)^*aa(a+b)^*$



(3) $a^+ + (ab)^+$



2: Finite-State Machines to Regex

(1) $\varnothing^*$ (Rejecting any input)

(2) $a^* + a^*b^+a^+b$ (Contains only as or any pattern of as to bs to as to bs.)

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3: Binary Addition

$$A = \{w \in \Sigma^* \mid \text{ the bottom row of w is the sum of the top two rows } xy \in L_1\}$$

Prove that A is regular.

Proof:

4: Division Operation?

$$\frac{L_1}{L_2} = \{x \mid \exists \in L_2 \text{ s.t. } xy \in L_1\}$$

Prove that if L_1 and L_2 are regular, then $\frac{L_1}{L_2}$ is also regular.

Proof: From a lemma, for every regular expression R, there is a DFA that recognizes the language $L(R)$. Suppose L_1 and L_2 are regular, then there exist DFA $M_1 = (Q, \Sigma, \delta, q_0, F_1)$ which accepts L_1 and DFA $M_2 = (Q, \Sigma, \delta, q_0, F_2)$ which accepts L_2. We want to show that $L_3 = \frac{L_1}{L_2}$ where $L_1, L_2, L_3 \in \mathbb{I}$.

We have that $Q, \Sigma, \delta,$ and q_0 in M_1 and M_2 can be shared, just that the accepting states are different. L_3 then can be recognized by some DFA $M_3 = (Q, \Sigma, \delta, q_0, F_3)$. We know that Σ is a number digit alphabet (0-9). Then, each state is just an integer. So, $\forall x \in F_1, \exists y \in F_2,$ and $\exists z \in F_3, zy = x$.

From the observation, L_1, which is regular, contains accepting states that made of zy from F_2 and F_3. Also, L_2, which is regular, recognized by M_2 and we can choose any number to be an accepting state in F_2 (As long as we accept at least a number). Since F_3 can be any state (number) also, there always exist z that will satisfied $zy = x$. Thus, M_3 exists since we can design F_3.

Therefore, if L_1 and L_2 are regular, then $\frac{L_1}{L_2}$ is also regular. $\square$

5: Does It Accept Everything?

Let $M = (Q, \Sigma, \delta, q_0, F)$.

(1) DFS could be a solution

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6: All The Same?

(1)

(2)

(3)