ECE374 SP23 HW3

Contributors

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Problem 4

An all-NFA M is a 5-tuple $(Q, \Sigma, \delta, q_0, F)$ that accepts $x \in \Sigma^*$ if **every** possible state that M could be in after reading input x is a state from F, in contrast to an ordinary NFA that accepts a string if **some** state among these possible states is an accept state.

Prove that all-NFAs recognize the class of regular languages.

Solution

Proof. Given a typical NFA $N = (Q, \Sigma, \delta, s, A)$, we can transform it into a DFA

$$D = (Q', \Sigma, \delta', s', A')$$

where

- $Q' = P(Q)$
- $\delta'(X, a) = \bigcup_{q \in X} \delta^*(q, a), \forall X \subseteq Q, a \in \Sigma$
- $s' = \epsilon\text{-reach}(s) = \delta^*(s, \epsilon)$
- $A' = \{X \subseteq Q | X \cap A \neq \emptyset\}$

The four definitions above also applies to the transformation of an all-NFA, *except* for A' which must be refined as

$$A' = \{X \subseteq Q | X \subseteq A \text{ and } X \neq \emptyset\}$$

since (1) X must be non-empty and (2) X must be a subset of A. This corresponds to the definition of an all-NFA that **every** possible ending state should be an accept state.