ICCS310: Assignment 3

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February 2021

1: NFA vs DFA Expressiveness

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(1)
Let construct an NFA, $M = (Q, \Sigma, \delta, q_0, F)$ where $Q = \{0, 1, ..., k\}$. Let $\delta(0, b) = 0, \delta(0, 1) = \{0, a\} = \{0, 1\}$ and $\delta(i - 1, a) = i$, for $2 \leq i \leq k$. Then set $q_0 = 0$ and $F = \{k\}$. We know that the machine will start at state 0 (starting state). When the machine locate an a it wil guess that it is a kth character to the right and will move to state 1. When it reaches state k, it will only accept if there are exactly $k - 1$ bits following the one that move from b to a.

(2)

Let the input have k character. We know that the characters can be either a or b. Let x and y be a string with k bit such that $x, y \in \Sigma^*$ and that $|x| = |y| = k$. Let i be a position such that $x_i \neq y_i$. Hence either x or y contain an a at the ith position. Let $z = b^{i-1}$, then z distinguish x and y as one of the xz and yz has an a at kth postion from the right. Since there are 2^k string of length k that are all distinguishable from the above prove, a DFA that accept this language need to have 2^k states.

4: HackerRank Challenge

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