CS3231 : Tutorial - 3

Rahul Jain

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1. Give state diagrams for NFA as required for recognizing the following languages. In all parts the alphabet is $\{0, 1\}$.

   (a) NFA for $\{w|\ w$ contains an even number of 0s, or contains exactly two 1s$\}$ with six states; NFA for $0^*1^*00^*$ with three states; NFA for $\{0\}$ with two states (also give a formal description of this last NFA).

   (b) NFA for A^* where $A = \{01\} \cup \{001\}$. Convert this NFA to equivalent DFA .

   (c) For each $k \geq 1$, let $C_k = \{\Sigma^* 0 \Sigma^{k-1}\}$. Give an NFA with $k+1$ states recognizing C_k. Also give a formal description of this NFA .

2. Prove the following languages are not regular :

   (a) $\{0^n 1^m 0^n |\ m, n \geq 0\}$.

   (b) $\{0^m 1^n |\ m \neq n\}$.

   (c) $\{w|\ w \in \{0, 1\}^*$ is not a palindrome$\}$. Palindrome is a string that reads the same forward and backward.

3. Covert the following regular expressions into NFA.

   (a) $(0 \cup 1)^* 000 (0 \cup 1)^*$.

   (b) $(((00)^*(11)) \cup 01)^*$.

   (c) ϕ^*.

4. For languages A and B, let the shuffle of A and B be the language :

   $\{w \mid w = a_1 b_1 \cdots a_k b_k,$ where $a_1 \cdots a_k \in A$ and $b_1 \cdots b_k \in B,$ each $a_i, b_i \in \Sigma^*\}$.

   Show that the class of regular languages is closed under shuffle.

5. For language A, let

   $$DROP - OUT(A) = \{xz \mid xyz \in A \text{ where } x, z \in \Sigma^*, y \in \Sigma\} .$$

   Show that if A is regular then $DROP - OUT(A)$ is regular.

Continued in the next page.

6. Convert the following finite automaton into regular expressions :

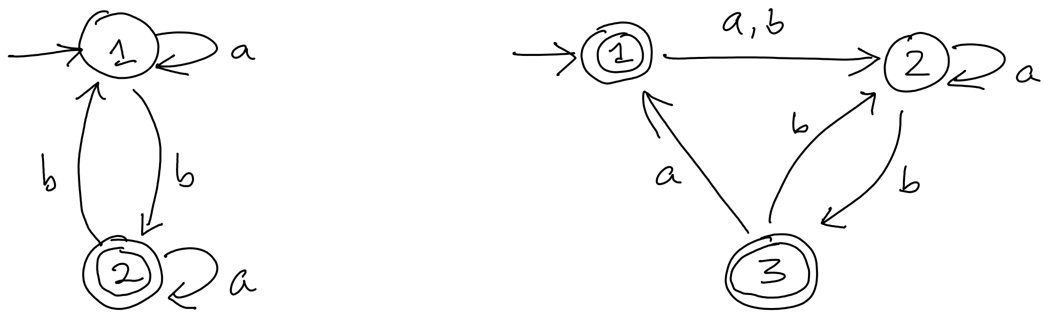

Figure 1: Figure for Question 6