Middle East Technical University Department of Computer Engineering

CENG 280

Formal Languages and Abstract Machines

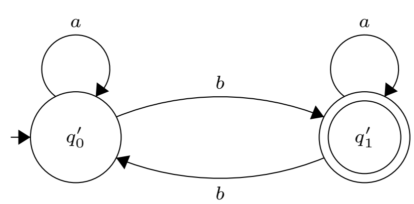
Spring 2022-2023

Homework 3

Sample Solutions

Answer for Q1

1. Where $q_0' = \{q_0, q_1, q_3, q_4\}$, $q_1' = \{q_2, q_5\}$,



2. $[\epsilon] = a^* \cup Lba^*$
   $[b] = L$

3. Consider the strings that are in the language. $u = (m + n - k)/2$ given.
   There are infinitely many different u values since the $(m + n - k)/2$ can be equal to any natural number when different values are given to m, n and k under defined restrictions (i.e. $m, n, k, u \in \mathbb{N}$). That is, if we divide each the strings in the language as $w_1 \circ w_2$ while $w_1 = a^n b^m c^k$ and $w_2 = d^u$, there are infinitely many w_1 prefices each are required to be appended a different w_2 suffix so as to create a string that is in the language. In other words, there are infinitely many equivalence classes, by the dfinition of the equivalence class.
   According to MyHill-Nerode Theorem, a regular language has finitely many equivalence classes. So, the given language is not regular.

Answer for Q2

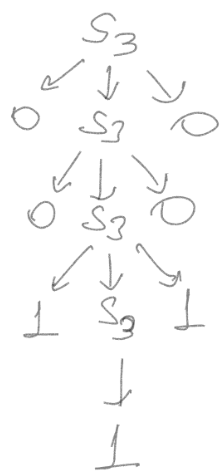
1. $G_1 = (V_1, \Sigma, R_1, S_1)$ where $V_1 = \{S_1, B\} \cup \Sigma$, $\Sigma = \{a, b\}$ and
   $R_1 = \{S_1 \text{ –> }$ `BbB`
   `B` –> `BB | aBb | bBa | b | e` }

2. $G_2 = (V_2, \Sigma, R_2, S_2)$ where $V_2 = \{S_2, A, B\} \cup \Sigma$, $\Sigma = \{0, 1, 2\}$ and

R_2 = $\{S_2$ -> AB
A -> 0A1 | e
B -> 1B2 | e$\}$

3. $G_3 = (V_3, \Sigma, R_3, S_3)$ where $V_3 = \{S_3\} \cup \Sigma$, $\Sigma = \{0, 1\}$ and
R_3 = $\{S_3$ -> 0 | 1 | 0S0 | 0S1 | 1S0 | 1S1$\}$

$S_3 \rightarrow 0S_30 \rightarrow 00S_300 \rightarrow 001S_3100 \rightarrow 0011100$



Answer for Q3

- Set of strings that start and end with the same symbol.
- Set of strings that contains at least 2 1's.