CENG213 THEORY OF COMPUTATION

ASSIGNMENT #1

Due date: 22.11.2021.

1. **(15 points)** For L = { $w \in$ {a, b}* : $\#_{ab}(w) \neq \#_{ba}(w)$ for any w } where $\#_s(w)$ is the number of occurrences of substring s in w.

   a. Construct a DFA that recognizes L.
   b. Write the equivalent regular expression for the DFA in (a).

2. **(15 points)** For L = { $xyz \in$ {a, b}* : $|x|=|z|=2$ and xz is a palindrome }.

   a. Construct a DFA that recognizes L.
   b. Write a code in Python to detect whether a given string is in L by using "regex" (You can use the "re" library of Python). The code should be written on paper. You can assume that a variable named "w" holds the string.

3. **(15 points)** For L = { $w \in \Sigma_2$: Top row is lexicographically larger than the bottom row }

   where $\Sigma_2 = \begin{bmatrix} a|b|c \\ a|b|c \end{bmatrix}^*$

   which means that Σ_2 contains all columns of a's, b's, and c's of height two. A string of symbols in Σ_2 gives two rows of a's, b's, and c's.

   For example,

   $$\begin{bmatrix} a \\ a \end{bmatrix} \begin{bmatrix} b \\ b \end{bmatrix} \begin{bmatrix} c \\ b \end{bmatrix} \begin{bmatrix} a \\ c \end{bmatrix} \in L \quad \text{(since } abca > abbc\text{)}$$

   a. Construct a DFA that recognizes L.
   b. Write the equivalent regular expression for the DFA in (a).

4. **(15 points)** Please find a regular expression for the following language:

   a. $L = \{w \in \{a, b, c\}^* : "aaa", "bbb" \text{ and } "cc" \text{ strings cannot occur in } w\}$.

   b. Write a code in Python to detect whether the given string is in L or not. Implement your code in the Python programming language in a well commented way. Your comments will also be evaluated.

5. **(15 points)** Let $\Sigma = \{a, b, c\}$.

   a) Find a regular expression for the language L that does not include "ab", "ac", "bc" strings.
   b) Construct a DFA for the regular expression that you found in part A.

6) **(25 points)**

   a) Let $R = \{(a, b), (b, c), (c, d), (b, a)\}$ be a relation on $\{a, b, c, d\}$. Find R^+.
   b) Let $R = \{(1, 2), (2, 3), (3, 4)\}$ be a relation on $\{1, 2, 3, 4\}$. Find R^+ by using the graphical representation of R.