

# SABANCI UNIVERSITY

## Faculty of Engineering and Natural Sciences CS 302 Automata Theory Fall 2020

### Remote Midterm

**Duration: 60 +10 minutes**

#### Question 1 (50 points)

(a) (15 pts) Consider the language  $L_1 \subseteq \{a,b,c\}$  with the *sort-check property* ; i.e. all its strings are sorted from left to right according to the order  $a < b < c$  (for example  $aabcc$  and  $bcc$  are in the language and  $acbb$  or  $bcaac$  are not !). State whether  $L_1$  is a regular language or not by either finding a *NFA* that accepts it or a *RE* that expresses it , if it is *regular* ; or by using the pumping lemma to show that it is *not regular*.

(b) (15 pts) Repeat part (a) for  $L_2$  where  $L_2$  , like  $L_1$  above, has the *sort-check* property and in addition, in each string the number of  $a$ 's is twice the number of  $c$ 's .

(c) (20 pts) Construct a *CFG* for the language  $L_2$  given in part (b).

#### Question 2 (50 points)

(a) (25 pts) Write down a regular expression  $E$  over the alphabet  $\{0,1\}$  where each string corresponding to the language expressed by  $E$  has at least one substring  $11$  in it. Give a leftmost derivation for the regular expression  $E$  using the *CFG of regular expressions* over the alphabet  $\{0,1\}$ .

(b) (25 pts) Find a *minimum state DFA*  $W$  that accepts the **complement** of the language described by  $E$  in part (a).