Complexity Theory 2022/2023

Replacement Exam - 90 mins

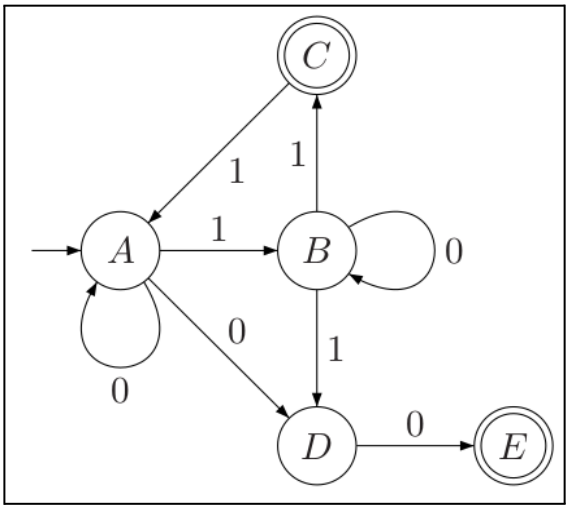
2ND YEAR - ENSIA

Exercise 1 (5 points) : (Answer without justification is not accepted)

1. A subset of a regular language, is a regular language, True or False? justify your answer. *(1 point)*
2. $L \subseteq \Sigma^*$ be an infinite language. Then the complement of L is finite. True or False? justify your answer *(1 point)*
3. Suppose all the words in language L are no more than 1024 characters long. Then L must be regular. True or False? justify your answer *(1 point)*
4. The language 0^n0^n is regular. True or False? justify your answer *(1 point)*
5. The language $L = \{wxw^R \mid x \in \Sigma^* \text{ and } |w|, |x| \geq 1\}$ such that w^R is the reversed form of w. L is non-regular. True or False? justify your answer *(1 point)*

Exercise 2 (5 points) :

1. Draw a DFA for the languages :
    1. L = {w | the length of w is even }. *(1 point)*
    2. L = {w ∈ {0, 1}* | between any two 0s of w, there is at least one 1} (2 points)
2. Convert the following NFA to DFA showing all the steps (2 points)



Exercise 3 (5 points) :

1. Given the $L = \{a^n b^m : n \textbf{ is not equal to } m\}$
    a. Provide a context free grammar that generates L (2 points)
    b. Draw the PushDown Automaton for L. *(1 points)*
2. Draw the PushDown Automaton for the following language : *(2 points)*
   $L = \{a^n\ b^m\ c^{n+m} : n \geq 0, m \geq 0\}$

Exercise 4 (5 points) :

Construct a Turing machine that doubles each character in its input string. For example, if the input is 0100, then the machine should change its tape so it contains 00110000. Show all the states and transitions. (From the Optional Exercises)