

Theory of Computing

Revision : DFA - CFG - Midterm

TD - R

2ND YEAR - ENSIA

EXERCISES

Exercise C1 (DFA) :

Give state diagrams of DFAs recognizing the following languages. In all parts, the alphabet is $\{0,1\}$. (3 points)

1. $\{w \mid w \text{ doesn't contain the substring } 110\}$
2. $\{w \mid \text{the length of } w \text{ is at most } 5\}$
3. $\{w \mid w \text{ is any string except } 11 \text{ and } 111\}$

Exercise C2 (CFG) :

An elevator is controlled by two commands: “ \uparrow ” to raise the elevator one floor and “ \downarrow ” to lower the elevator one floor. Suppose the number of floors in the building is infinite and the elevator starts at the ground floor. Find the CFG that generates valid command sequences verifying the following conditions:

- a. The elevator never descends below the ground floor.
- b. The elevator must always return to the ground floor at the end of the control sequence.
- c. The empty control sequence is valid.

Exercise C3 (Selected Midterm Questions):

1. For the alphabet $\{0..9\}$, construct the DFA for the language where the sum of the digits is a multiple of 3. (Accepted word 3012, $3+0+1+2=6$ which is divisible by 3)
2. Words must start and end with 1. Any 0 in the word must be immediately preceded and followed by 1. The length of the word must be at least 4.
3. The language of all strings not containing the substring 000.
4. Prove that the following language is not regular :
 $L = \{0^k \mid k \text{ is a prime number} \}$. Provided that the set of prime numbers is infinite.(no need to prove this).
5. Generate the Context Free grammar for the following languages:
 - a. The number of ‘a’ is not the same as the number of ‘b’. (Alphabet is $\{a,b\}$)
 - b. The complement of the language $a^n b^n$ such that $n > 0$ (The big set of $\{a,b\}^*$, Alphabet is $\{a,b\}$)