Theory of Automata

Assignment No.2

(25 marks)

Question 1. (10 marks)

Find a Transition Graph (TG) corresponding to each of the following subsets of {a, b}∗.

1) The language of all strings containing exactly two a's.
2) The language of all strings containing at least two a's.
3) The language of all strings that do not end with ab.
4) The language of all strings that begin or end with aa or bb.
5) The language of all strings not containing the substring aa.
6) The language of all strings in which the number of a's is even.
7) The language of all strings containing no more than one occurrence of the string aa. (The string aaa should be viewed as containing two occurrences of aa.)
8) The language of all strings in which every a is followed immediately by bb.

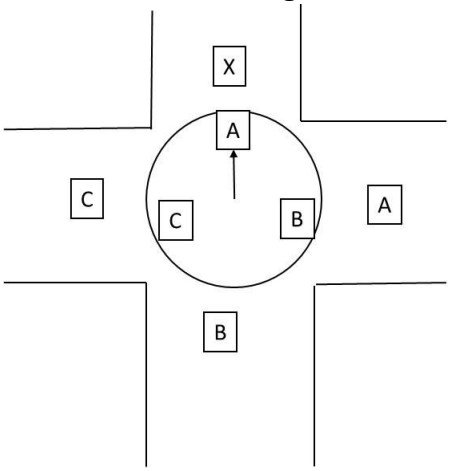
Question 2. (10 marks)

Find a Finite Automaton (FA) corresponding to each of the following subsets of {a, b}∗.

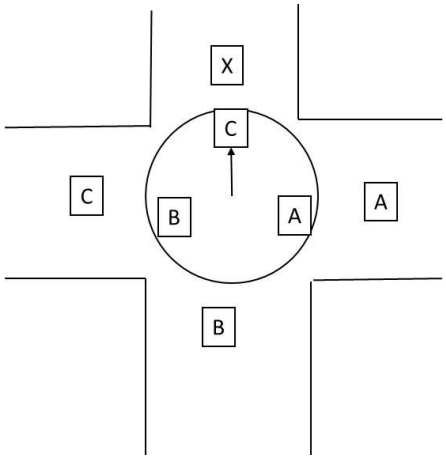
1) The language of all strings not containing the substring bba.
2) The language of all strings in which the number of a's is even and the number of b's is odd.
3) The language of all strings in which the total number of a's is divisible by three, such as aabaabbaba.
4) $\{w \in \{0,1\}* : w \text{ corresponds to the binary encoding, without leading } 0s, \text{ of natural numbers that are evenly divisible by } 4\}$
5) $\{w \in \{0,1\}* : w \text{ corresponds to the binary encoding, without leading } 0s, \text{ of natural numbers that are powers of } 4\}$

Question 4. (5 marks)

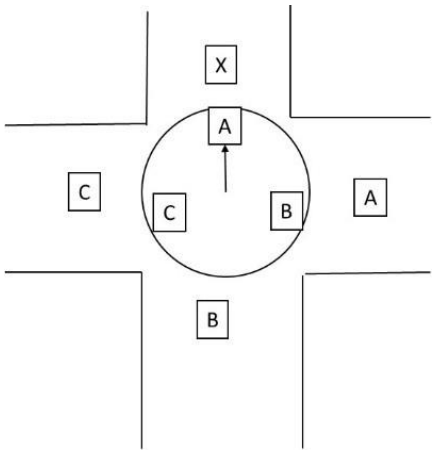
We have a road intersection, where either blue or red cars enter at X. There is a dial at the center with a sensor attached to it that detects the color of a car. If a red car is detected the dial moves clockwise and the car goes in the direction pointed to by the arrow on the dial. If a blue car is detected the dial move anticlockwise and the car goes in the direction pointed to by the vertical arrow. All cars enter at X and exit at either A,B or C depending upon what the arrow points to. If at the end of a car sequence the last car exits at C, we say that we have won the game. If at the end of a car sequence, the last car exits at A or B, we say that the game is lost. An example is given below:



(a) Initial configuration



(b) A red car enters at X, the dial moves clockwise and pointer is at C. The car exits at C



(c) A blue car enters at X. The dial moves anticlockwise and the arrow points at A. The car exits at A

The initial configuration of the dial is shown in figure (a), where the arrow points at A. The figures (a, b, c) shows an example of the car sequence **Red, Blue**. As the last car exits at A, we have lost. Note the sequence **Red** would win and the sequence **Red, Blue, Red** would win. Also, the sequences **Blue, Blue** and the sequence **Red, Red, Blue** would win. We can have any finite number of cars in the sequence. Model the entire game using a **DFA**, making a minimum number of states.