Assignment 1 – CS 301 - Theory of Automata – Fall 2020

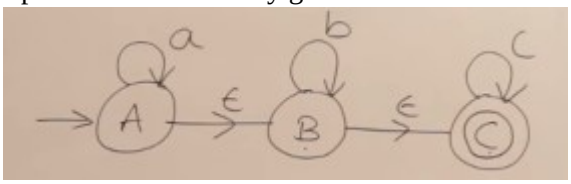
Total Marks: 100 **Due: Tuesday, September 22, 2020 (in class)**

Note: Late submissions will have 25% deduction. Submission after Thursday (Sept 24 – 3 PM) will not be accepted.

1. [10*5] Give DFA for the following languages, over the alphabet {0,1}
   a) All strings that contain three consecutive 1's
   b) All strings that do not end with 00
   c) All strings with even number of 0's and odd number of 1's
   d) All strings with even number of 0's and exactly 2 1's
   e) All strings with length at least 4 and even number of 1's
   f) All strings such that every 00 is followed by a 1.
   g) All strings such that each '0' is immediately preceded and followed by a '1'
   h) All strings have 0101 as a substring
   i) All strings such that {(# 0's(w) - # 1's(w))mod 3 > 0}
      Hint for i): consider the possible number of states and transit between them. Just as we did for even/odd case.
   j) The language of all strings containing no more than one occurrence of the string aa. (the string aaa should be viewed as containing 2 occurrences of aa)

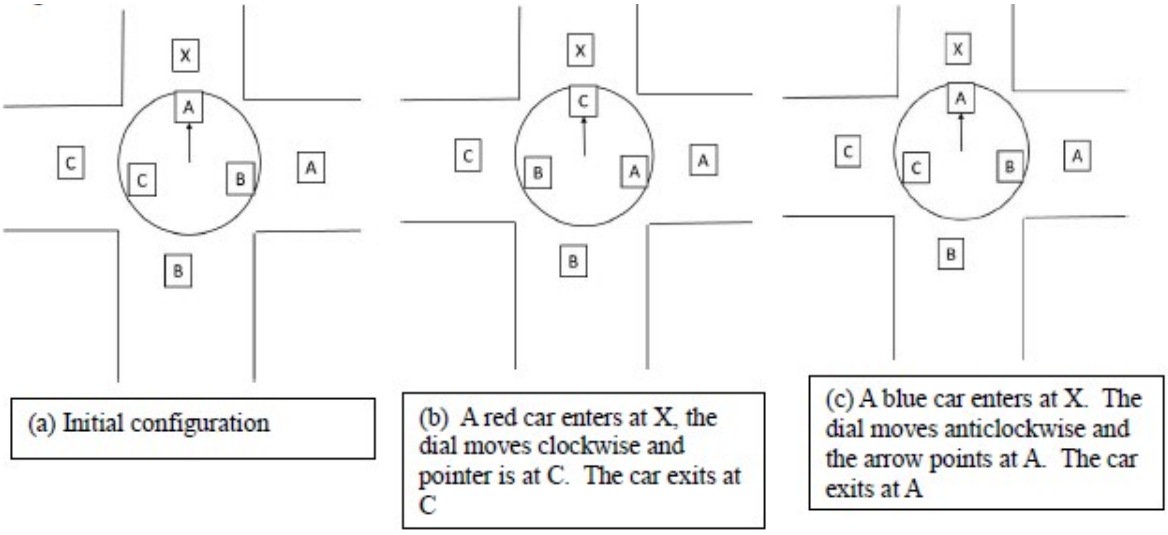
2. [15] Consider the following two languages over the alphabet {0, 1}.
   L1 = {w | w contains odd number of 0s}
   L2 = {w | w neither contains two consecutive 0s nor two consecutive 1s}
   Construct DFA's for both the languages and then find another DFA using these two DFAs, which represent L1 - L2. Convert – into expression with union, intersection and/or complement.

3. [20] Draw and convert the following epsilon-NFA (or lambda-NFA) to corresponding DFA
   a) L = {a^n | n is even or divisible by 3}
   b) Epsilon-NFA is already given below:



4. [15] [**from a previous midterm exam**]

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:



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.