

## Assignment 1 – CS 301 - Theory of Automata – Spring 2019

**Total Marks: 110**

**Due: September 12, 2018 (in class)**

**Note: Late submissions will have 25% deduction.**

1. [6\*5] Give DFA for the following languages, over the alphabet  $\{0,1\}$ 
  - a) All strings that contain three consecutive 1's  
<http://theory.stanford.edu/~rajeev/CS154/solution1.pdf>
  - b) All strings that do not end with 00  
<http://theory.stanford.edu/~rajeev/CS154/solution1.pdf>
  - 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  
[https://courses.engr.illinois.edu/cs373/sp2010/problem\\_sets/hw\\_01\\_sol.pdf](https://courses.engr.illinois.edu/cs373/sp2010/problem_sets/hw_01_sol.pdf)
  - e) All strings that are at least of length 4 and contains even number of 1's  
<http://suraj.lums.edu.pk/~cs311w05/hw/hw02Sol-updated.pdf>
  - f) All strings such that every 00 is followed by a 1.  
<http://suraj.lums.edu.pk/~cs311w02/Quizes/CS311quiz1s1.pdf>
  - g) All strings such that each '0' is immediately preceded and followed by a '1'  
<https://www.cs.utexas.edu/users/cline/ear/automata/CS341-Fall-2004-Packet/2-Homework.pdf>
  - h) All strings have 0101 as a substring  
<https://www.cs.utexas.edu/users/cline/ear/automata/CS341-Fall-2004-Packet/2-Homework.pdf>

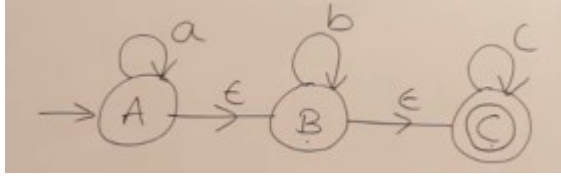
The language of all strings containing no more than one occurrence of the string aa. (the string aaa should be viewed as containing 2 occurrences of aa)

**(Ms Noshaba notes)**

2. [10+10]
  - a) Draw a DFA over  $\Sigma = \{0, 1\}$  that accepts the set of all strings that, when interpreted in reverse as a binary number, is divisible by 3. Examples: 011 (110 = 6), 0, 0011 (1100 = 12), 01001 (10010 = 18), etc.  
[https://courses.engr.illinois.edu/cs373/sp2010/problem\\_sets/hw\\_01\\_sol.pdf](https://courses.engr.illinois.edu/cs373/sp2010/problem_sets/hw_01_sol.pdf)
  - b) Find DFA for the following language on  $\Sigma = \{a, b\}$ . (Try and do this in as few states as possible)  $L = \{w: (na(w) - nb(w)) \bmod 3 > 0\}$   
[http://suraj.lums.edu.pk/~cs311w02/Assignments/cs311Assignment1\\_Solution.pdf](http://suraj.lums.edu.pk/~cs311w02/Assignments/cs311Assignment1_Solution.pdf)
3. [25] Consider the following two languages over the alphabet  $\{0, 1\}$ .  
 $L_1 = \{w \mid w \text{ contains odd number of 0s}\}$   
 $L_2 = \{w \mid w \text{ neither contains two consecutive 0s nor two consecutive 1s}\}$   
Construct DFA's for both the languages and then find another DFA using these two DFAs, which represent  $L_1 - L_2$
4. [20] Draw and convert the following epsilon-NFA (or lambda-NFA) to corresponding DFA  
 $L = \{a^n \mid n \text{ is even or divisible by 3}\}$

<http://web.cecs.pdx.edu/~sheard/course/CS311/Fall2013/ppt/NfaEpsilonDefined.pdf>

Epsilon-NFA is already given below:



[https://www.youtube.com/watch?v=FYk8EpDR3XM&list=PLEbnTDJUr\\_IdM\\_FmDFBz0zCsOFxfK&index=58](https://www.youtube.com/watch?v=FYk8EpDR3XM&list=PLEbnTDJUr_IdM_FmDFBz0zCsOFxfK&index=58)

5.