CSE331 Assignment 1 Solution
Spring 2025

Problem 1

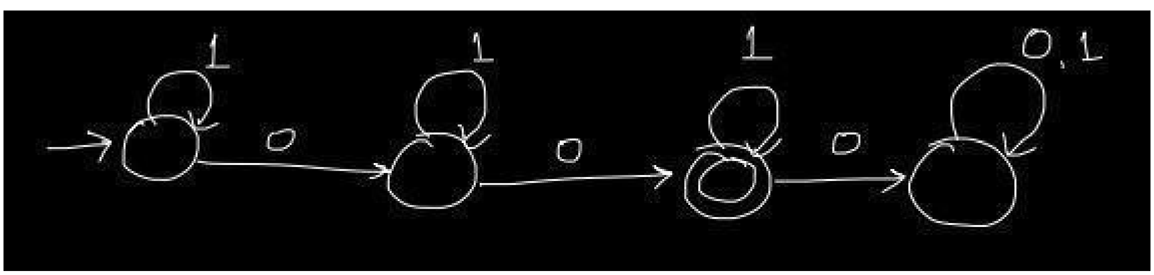
a) $(0 \mid 1)^* (0 \mid 11 \mid 001) \mid \epsilon \mid 1 \mid 01$
b) $abba\ (a|b|c)^*\ bac \mid abbac$
c) $(0 \mid 1)\ (0 \mid 1)\ 0\ (0 \mid 1)^*$
d) $(1^*01^*01^*)^* \mid 0^*10^*10^*$
e) $(b^*ab^*ab^*ab^*)^*\ b^*ab^*$

Problem 2

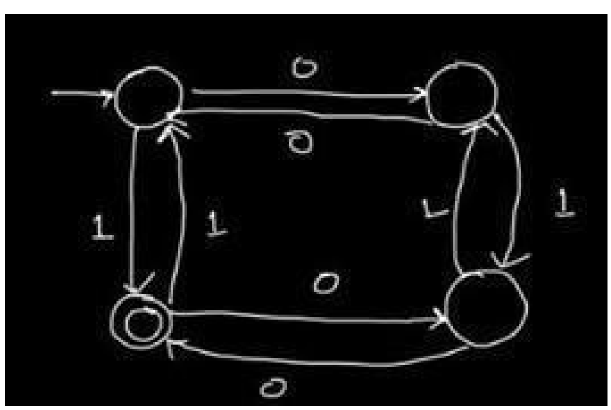
a) Strings over {0,1} that start with 01
b) Strings over {0,1} that start with 0 or end with 1
c) Strings over {0,1} that do not contain 00 as a substring
d) Strings over {0,1} that have neither consecutive 0's, nor consecutive 1's
e) Strings over {0,1} that may have consecutive 0's, or consecutive 1's, but not both

Problem 3

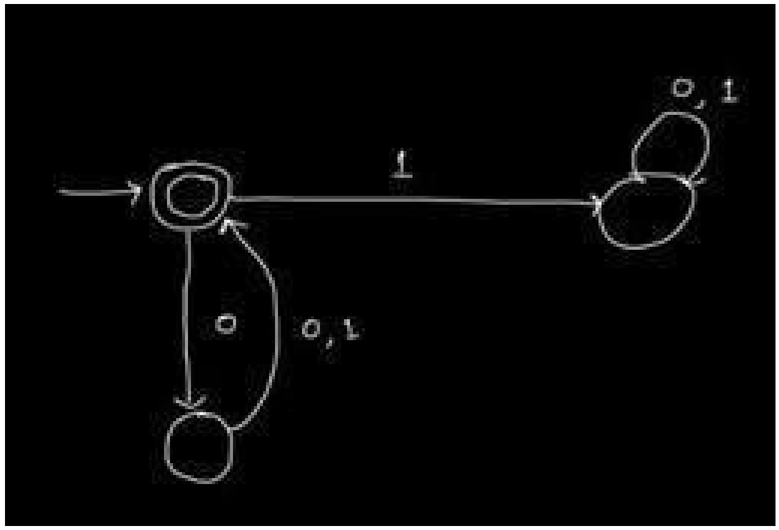
a)



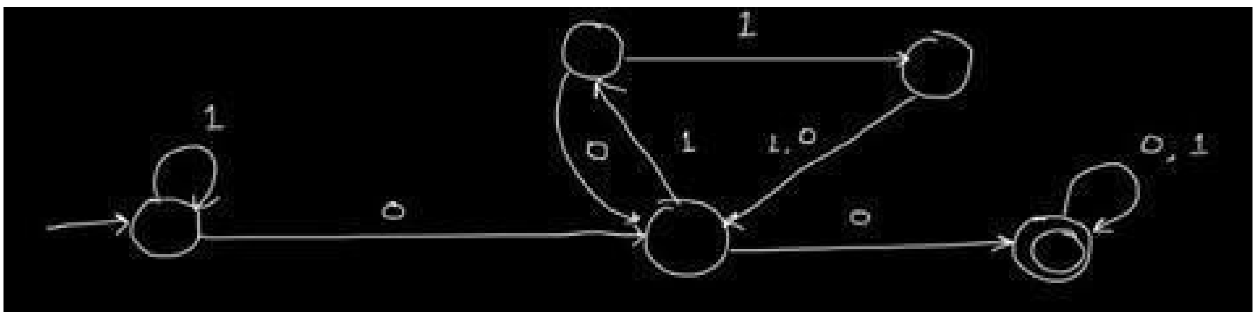
b)



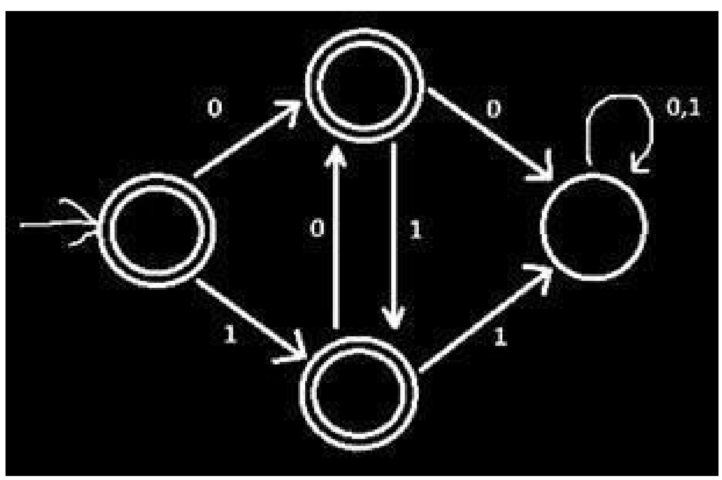
c)



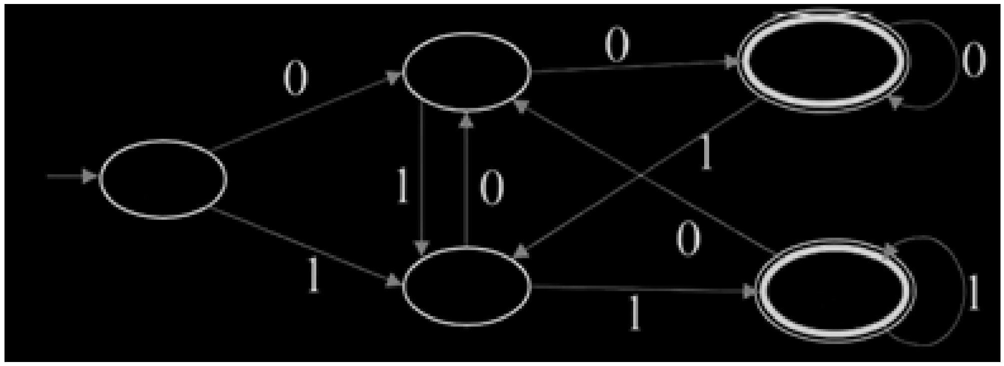
d)



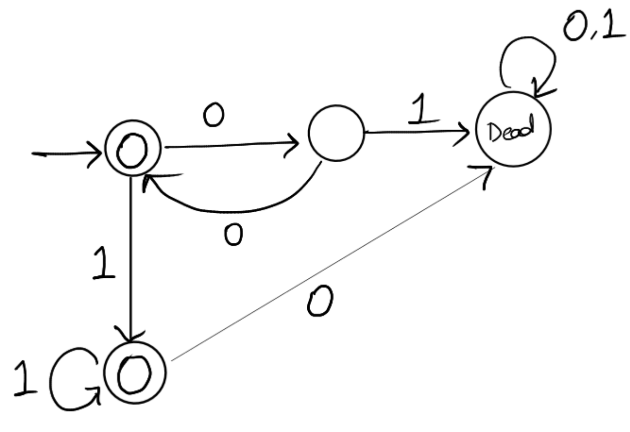
e)



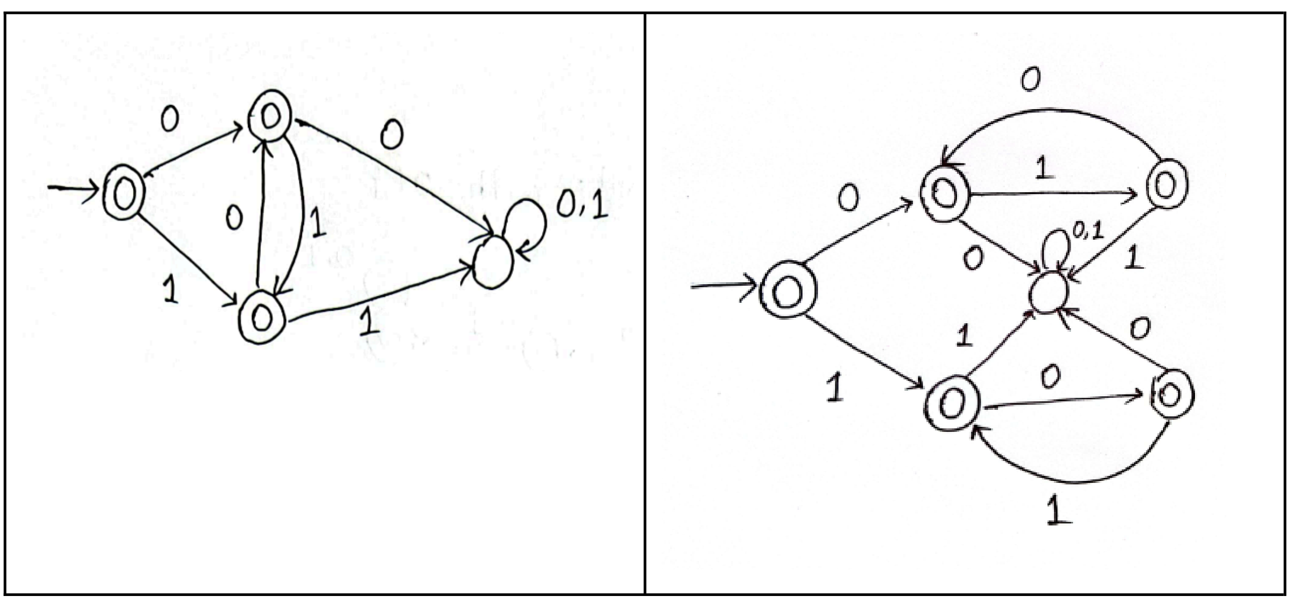
f)



g)

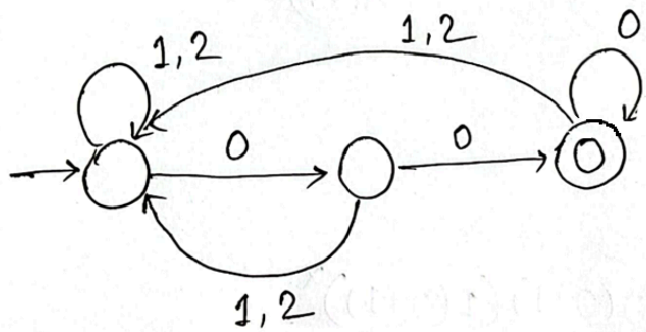


h)



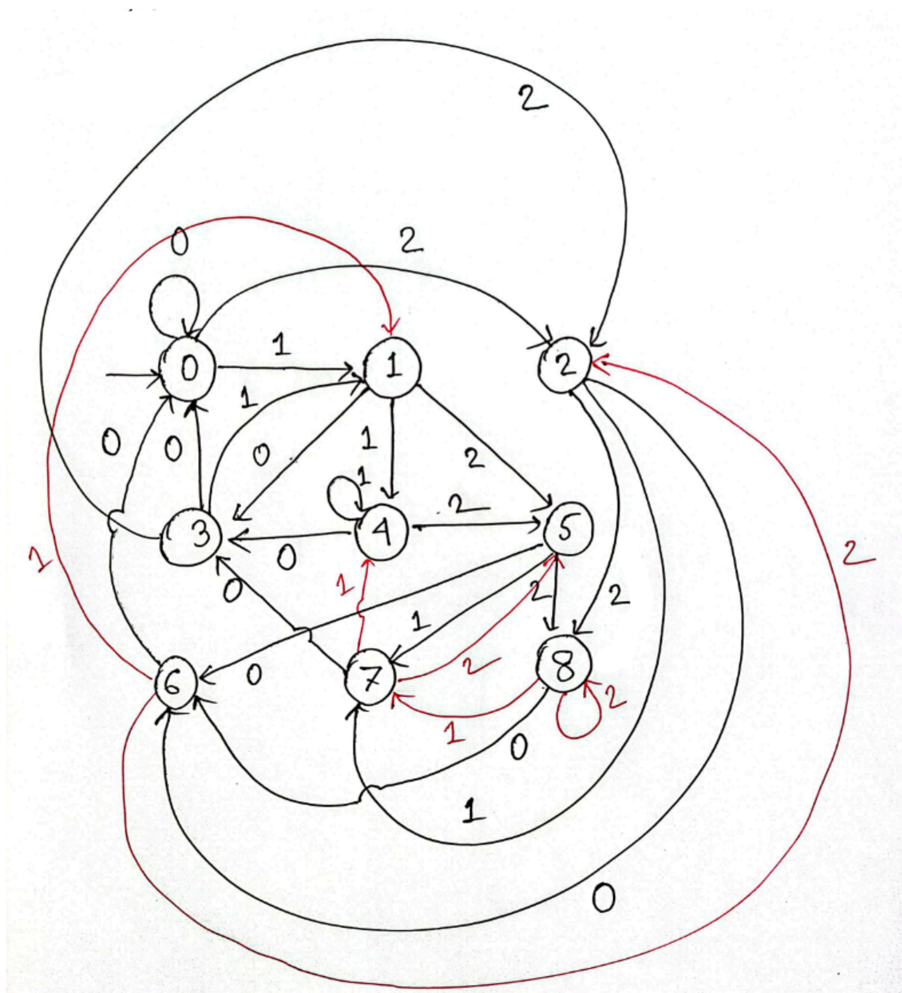
i)

In three base number system, the numbers which ends with 00, only those numbers are divisible by 9.

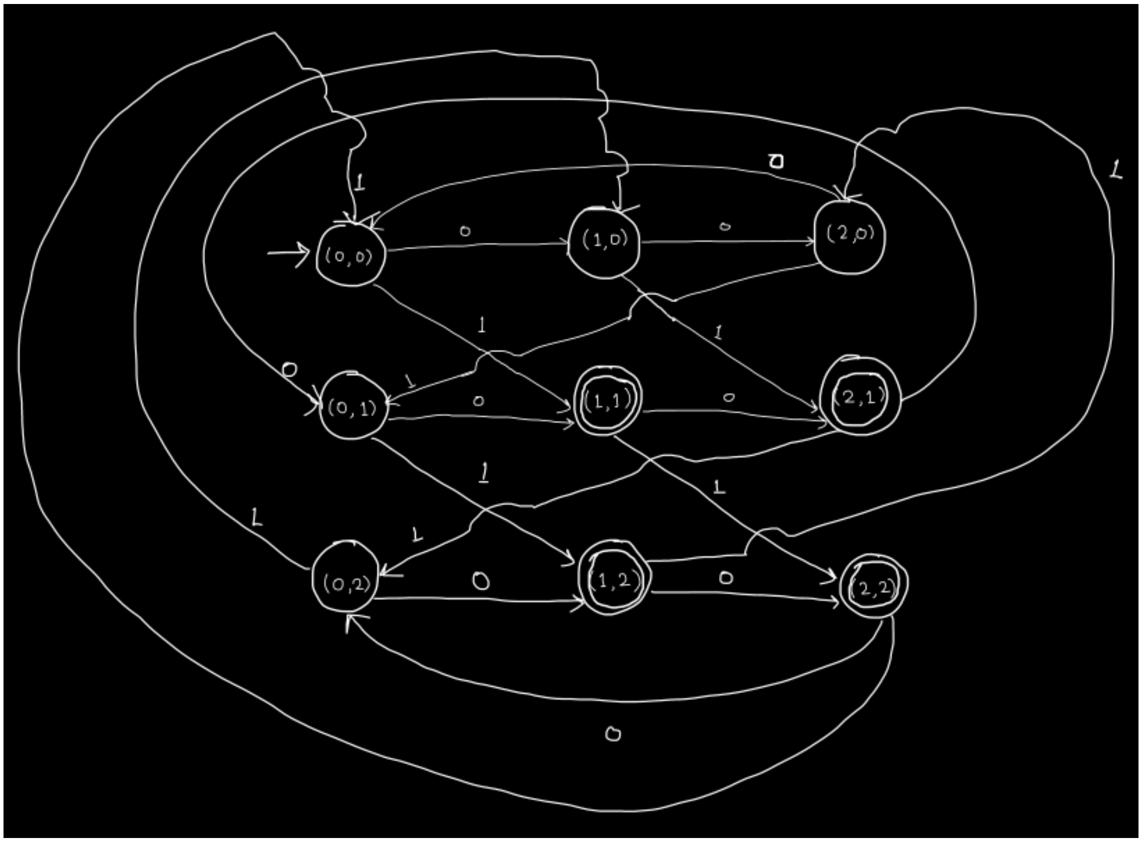


There is also a DFA with 9 states and 27 transitions - which is also correct.

The logic is - if there is a number x, in ternary representation, adding a 0 at the end will make the number 3x, adding 1 at the end will make it 3x+1 and for 2 it will become 3x+2.



j)



A correct solution is anything equivalent to the above. The DFA diagram is a bit clunky due to there being a lot of states and transitions. However, the idea is simple: the states are indexed by a pair (i, j) where 0 <= i, j <= 2, and i, j are the length and the number of 1s seen so far modulo 3. Upon seeing a new letter i goes up by 1, while j goes up by 1 only if the new letter is a 1.

The main observation is that i^2 + j^2 = 2 mod 3 iff i = 1, 2 and j = 1, 2 mod 3. This gives us four accepting states.

Any DFA for this language necessarily requires 9 states. So, any DFA with fewer states is wrong.

Problem 4

a) Yes
b) 1100
c) 0100
d) Yes
e) No