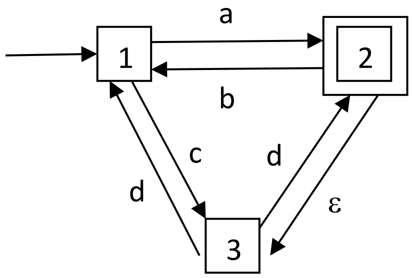
CS 475/575 Quiz 1 **Fall 2013** **Solution**

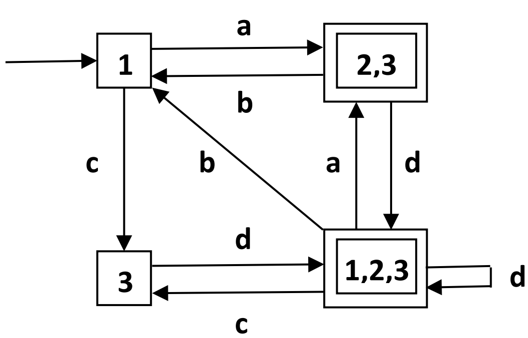
1. Given this non-deterministic finite-state machine:



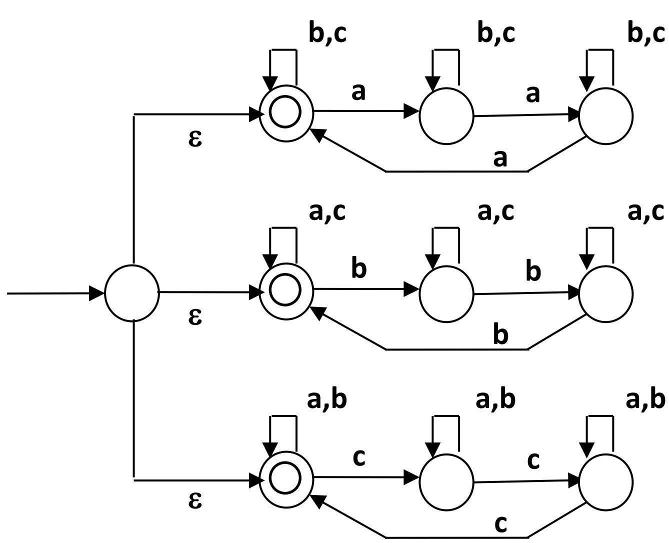
   a. Write all the accepted strings that have length 4. **[12 points]**

abad	**adad**	**adba**	**adcd**	**adda**	**addd**
abcd	**cdad**	**cdba**	**cdcd**	**cdda**	**cddd**

   b. Draw an equivalent deterministic finite-state machine. **[15 points]**



2. Let L denote the set of all strings over alphabet {a, b, c} such that the number of a's is divisible by 3, or the number of b's is divisible by 3, or the number of c's is divisible by 3. Draw a non-deterministic finite-state machine with fewest states that accepts L. **[15 points]**



3. Again let L denote the set of all strings over alphabet {a, b, c} such that the number of a's is divisible by 3, or the number of b's is divisible by 3, or the number of c's is divisible by 3.

   a. Consider a deterministic finite-state machine with fewest states that accepts L. It is not necessary for you to draw this deterministic machine. How many states are needed? Specify a unique label for each state, and explain what each state represents. Which are the start state and final states? Also specify which transitions should exist. **[16 points]**

   27 states with labels [x,y,z] where $0 \le x \le 2$ and $0 \le y \le 2$ and $0 \le z \le 2$.
   Here x = (number of a's) % 3, y = (number of b's) % 3, and z = (number of c's) % 3.
   Start state is [0,0,0], and final states are [x,y,z] where x=0 or y=0 or z=0.

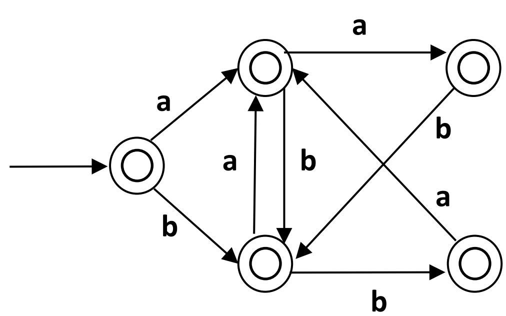
   Transitions $[x,y,z] \xrightarrow{a} [(x+1)\%3,y,z]$ **and** $[x,y,z] \xrightarrow{b} [x,(y+1)\%3,z]$ **and** $[x,y,z] \xrightarrow{c} [x,y,(z+1)\%3]$**.**

   b. Write an accepting computation sequence for string abcbab using this DFSM. **[12 points]**

$$[0,0,0] \xrightarrow{a} [1,0,0] \xrightarrow{b} [1,1,0] \xrightarrow{c} [1,1,1] \xrightarrow{b} [1,2,1] \xrightarrow{a} [2,2,1] \xrightarrow{b} [2,0,1].$$

4. Draw deterministic finite-state machines that accept each of these languages.

   a. The set of all strings over alphabet {a, b} that do not contain substring aaa and also do not contain substring bbb. **[15 points]**



   b. The set of all strings over alphabet {a, b} that contain exactly one occurrence of the substring aa and also exactly one occurrence of the substring bb. **[15 points]**