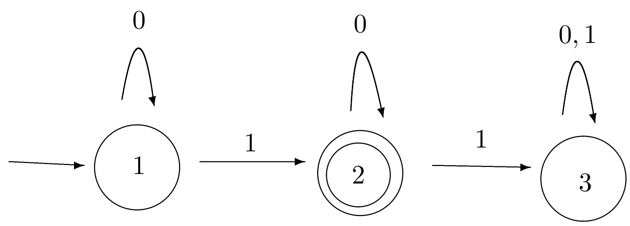
CS 420, Soringl 2019
Homework 2 Solutions

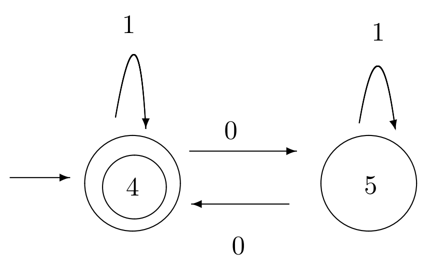
1. Let $L = \{w \in \{0,1\}^* | w$ contains exactly one 1 and an even number of 0's$\}$. Starting with DFAs for two simpler languages, use the intersection construction to give a DFA that recognizes L.

   Solution:

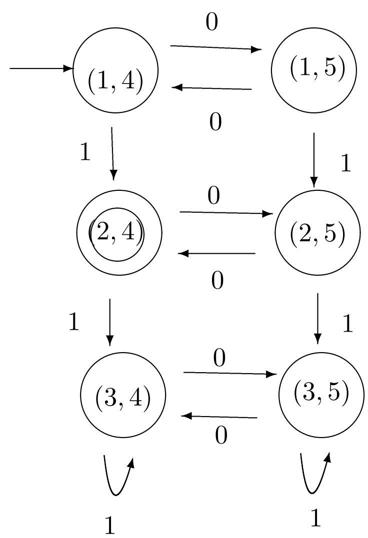
   Let $L_1 = \{w \in \{0,1\}^* | w$ contains exactly one 1$\}$ and $L_2 = \{w \in \{0,1\}^* | w$ contains ann even number of 0's$\}$. Then, $L = L_1 \cap L_2$. A DFA recognizing L_1 is given by



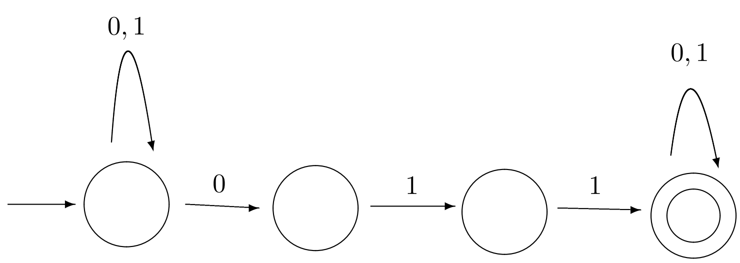
   and a DFA recognizing L_2 is given by



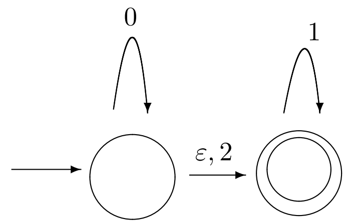
   The intersection construction gives the following DFA that recognizes $L_1 \cap L_2 = L$.



2. (a) Give an NFA with four states that recognizes $L_1 = \{w \in \{0,1\}^* | w$ contains 011 as a substring $\}$.
[You can give a DFA with four states that recognizes L_1, but you should use nondeterminism to give an NFA that is simpler than the DFA.]
Solution:

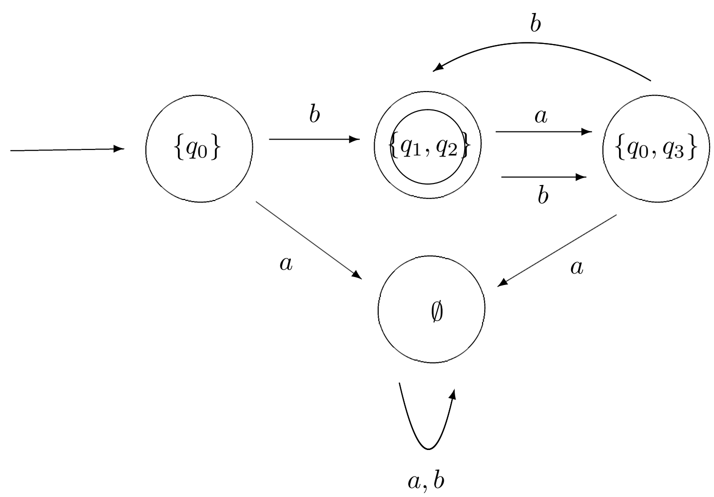


(b) Give an NFA with two states and only one accept state that recognizes the language $L_2 = 0^*1^* \cup 0^*21^*$.
Solution:



3. Convert the NFA given in Slide 91 of the slides into a DFA. Show only the reachable states of the DFA.

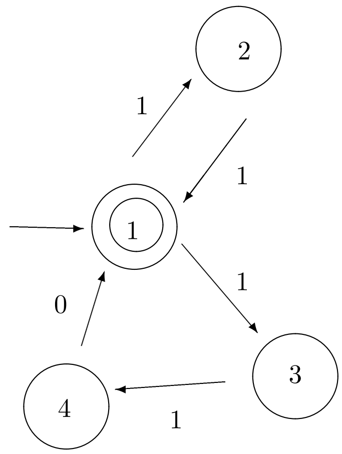
   Solution:



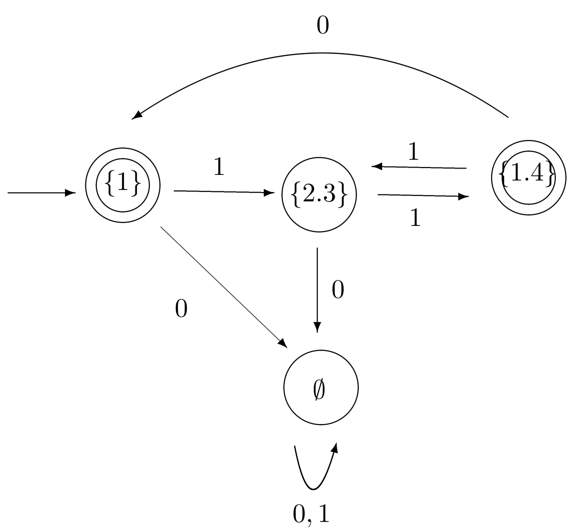
4. Let $L = \{11, 110\}^*$.

   (a) Give an NFA N with four states that recognizes L. Your NFA should be similar to the NFA we gave in class to recognize $\{01, 010\}^*$.

   Solution:



(b) Using the method from class, convert N to a DFA M.
Solution: (We show only the reachable states of M.)

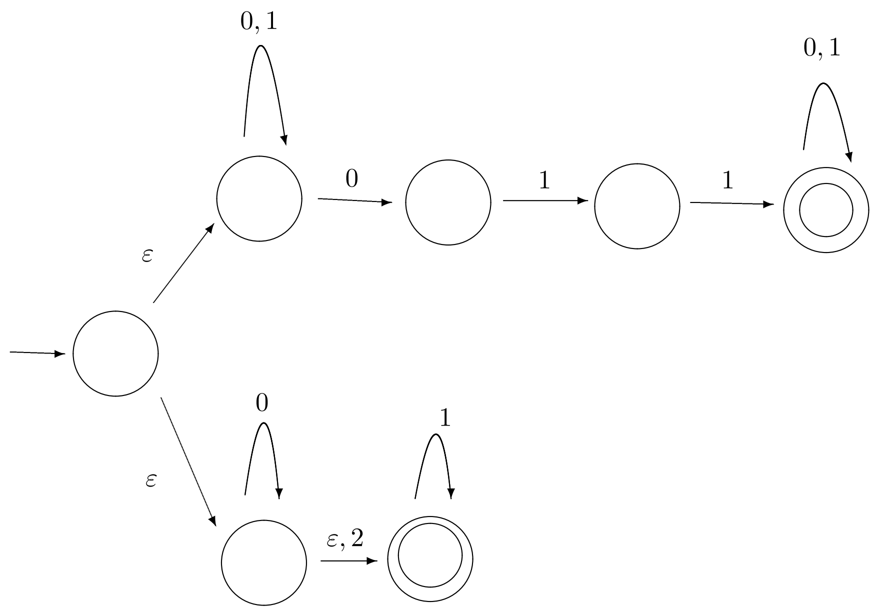


(c) How does M compare with the DFA given in the solutions to Exercise 1c of Homework 1?

Solution: The full DFA M has 16 states, so is not the same as the DFA in the solutions to Exericse 1c of Homework 1, but once unreachable states are removed from M, we get the same DFA as in the solutions.

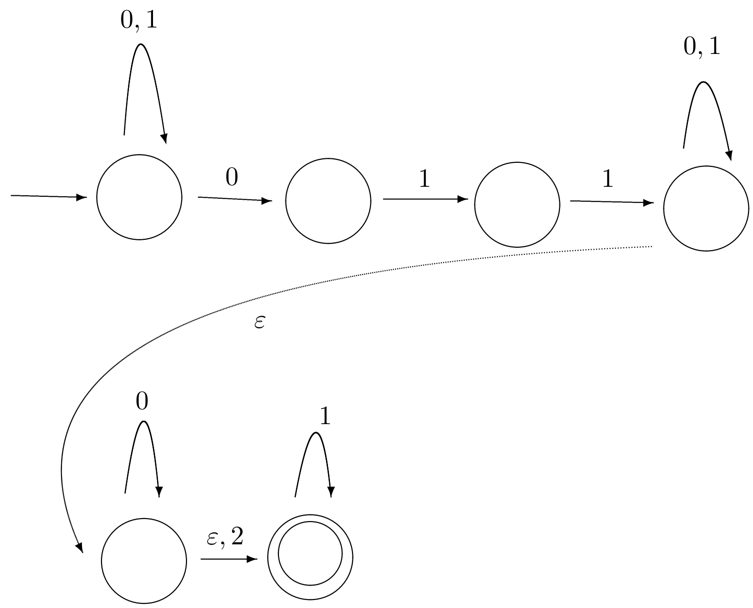
5. Using the method from class, give an NFA that recognizes $L_1 \cup L_2$, where L_1 and L_2 are the languages from Exercise 2.

Solution:



6. Using the method from class, give an NFA that recognizes $L_1 \circ L_2$, where L_1 and L_2 are the languages from Exercise 2.

   Soluition:



7. Using the method from class, give an NFA that recognizes L_2^*, where L_2 is the language from Exercise 2.

   Solution: