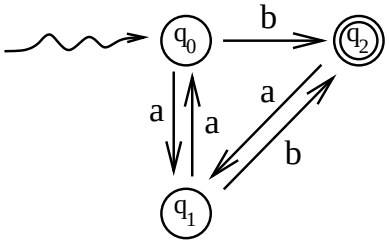
University of Nevada, Las Vegas Computer Science 456/656 Spring 2021

Assignment 1: Due Friday September 1, 2023, 11:59 PM

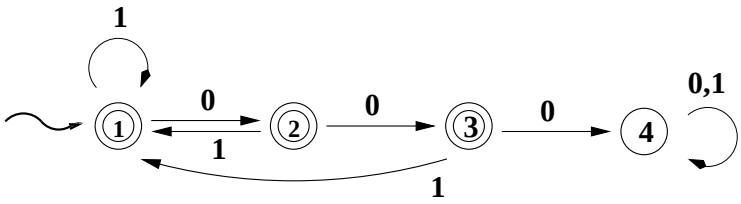
Name:_____

You are permitted to work in groups, get help from others, read books, and use the internet. You will receive a message from the graduage assistant, Sepideh Farivar, telling you how to turn in the assignment.

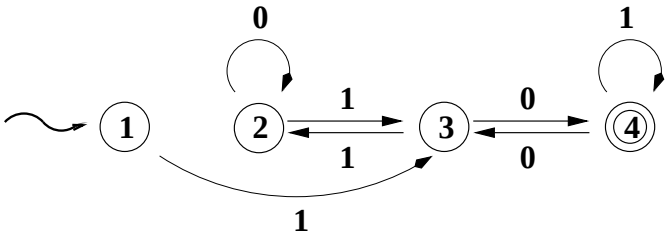
1. Let M_1 be the DFA shown below.



Let M_2 be the DFA shown below.



Let M_3 be the DFA shown below.



Which of the following languages is accepted by M_1? By M_2? By M_3?

(a) The language of all binary strings in which every substring 00 is followed by 1.

(b) All strings over $\{a, b\}$ which end in b and which do not contain the substring bb.

(c) The language of all binary numerals for positive integers equivalent to 2 modulo 3.

(d) The language of all strings over $\{a, b\}$ in which every b is followed by a.

Construct a DFA which accepts the language $\{b^i a b^j : i, j \geq 0\}$, the language of all strings over $\{a, b\}$ which contain exactly one a. Your figure need not show the dead state.

2. Recall that $\emptyset$ is the empty language. If L is some language, what is the concatenation $\emptyset L$?

3. Let $L_1 = \{\lambda\}$. the language consisting of only the empty string. If L_2 is some other language, what is the concatenation $L_1 L_2$?

4. Is concatenation of languages commutative? That is, is the equation $L_1 L_2 = L_2 L_1$ always true?

5. Is it true that, for any language, $L^n L = L^{n+1}$?

6. Which of the following is true:

   (a) If L is any language, $L^0 = L$.

   (b) If L is any language, $L^0 = \emptyset$.

   (c) If L is any language, $L^0 = \{\lambda\}$.

   Hint: Think!

7. Does concatenation of languages distribute over union? That is, is $L_1(L_2 + L_3) = L_1 L_2 + L_1 L_3$ always true?

8. What is $\emptyset^*$, the Kleene closure of the empty language?

9. What is L^{**}?

10. Is the union of two regular languages always regular?

11. Is the intersection of two regular languages always regular?

12. Is the complement of a regular language always regular?

13. Is the Kleene closure of a regular language always regular?

14. The DFA M_1 shown in Problem 1 is not minimal, that is, it's equivalent to a DFA with fewer states. Can you draw a state diagram of that DFA? Your figure need not show the dead state.