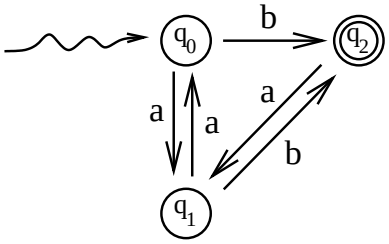
University of Nevada, Las Vegas Computer Science 456/656 Fall 2024

Assignment 1: Due Friday January 26, 2024, 11:59 PM

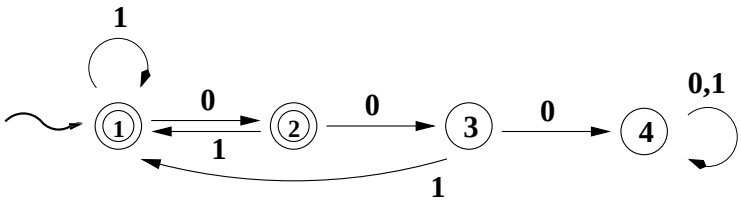
Name:_____

You are permitted to work in groups, get help from others, read books, and use the internet. Turn in the assignment as instruced by the Teachiing Assistant, Zachary Edwards.

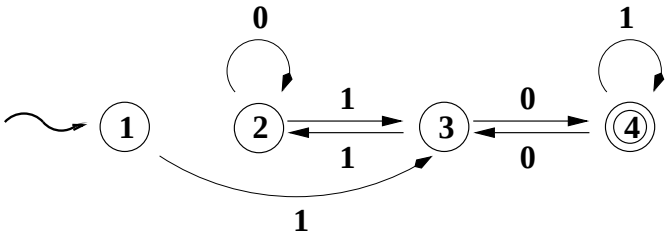
1. Let M_1 be the DFA shown below.



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. 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!

6. 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?

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

8. True(T) or False(F).

   i _____ Concatenation is commutative. That is, $L_1 L_2 = L_2 L_1$ for any languages L_1 and L_2.

   ii _____ Concatenation is associative. That is, $(L_1 L_2)L_3 = L_1(L_2 L_3)$ for any languages L_1, L_2, and L_3.

   iii _____ The intersection of any two regular languages is regular.

   iv _____ The complement of any regular languages is regular.

   v _____ The Kleene closure of any regular languages is regular.

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