

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

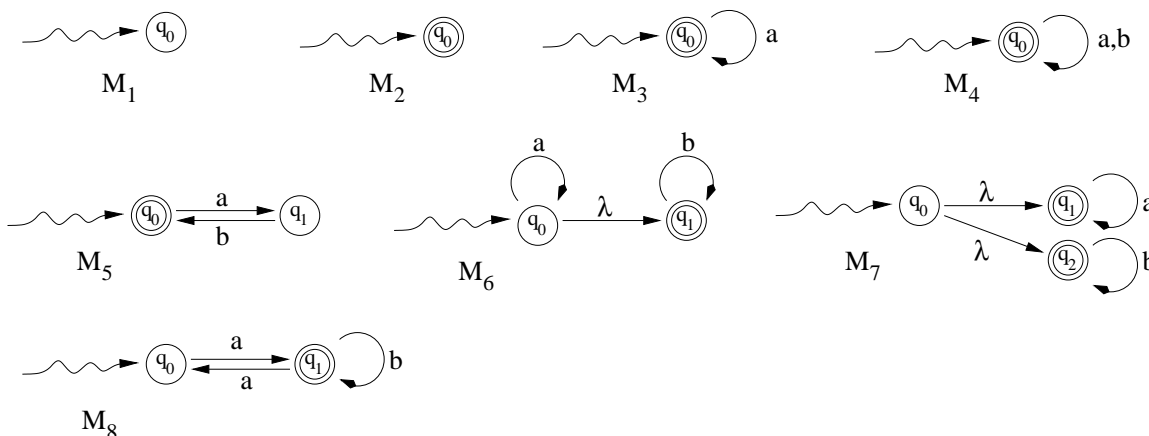
Answers to Assignment 2: Due Friday September 13, 2024

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 graduate assistant, Zachary Edwards, telling you how to turn in the assignment.

1. Identify which machine accepts the language defined by each regular expression.

- |                        |                         |
|------------------------|-------------------------|
| (i) $a^* + b^*$ $M_7$  | (v) $a(aa + b)^*$ $M_8$ |
| (ii) $\lambda$ $M_2$   | (vi) $a^*b^*$ $M_6$     |
| (iii) $a^*$ $M_3$      | (vii) $(a + b)^*$ $M_4$ |
| (iv) $\emptyset$ $M_1$ | (viii) $(ab)^*$ $M_5$   |



2. True or False.

- (i) **T** If  $L$  is any language,  $L + L = L$
- (ii) **T** If  $L$  is any language,  $L \cap L = L$
- (iii) **F** If  $L$  is any language,  $\{\lambda\} \in L^*$ .

Actually,  $\lambda \in L^*$ .

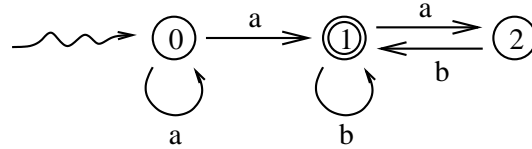
3. Let  $L_1 = \{a, ab\}$  and  $L_2 = \{a, ba\}$ . How many strings are there in the language  $L_1L_2$ ? 3  
 How many strings are there in the language  $L_2L_1$ ? 3

4. True or False. These are harder.

- (a) **T** Any language consisting of all decimal numerals of an arithmetic sequence (for example:  $L = \{5 + 8n : n \geq 0\} = \{5, 13, 21, 29, 37, 45, \dots\}$ ) is regular. Note: the members of  $L$  are numerals, not numbers.

(b) **T** Let  $L_1$  be a regular binary language. Let  $L_2$  be the language of all strings obtained from members of  $L_1$  by substituting  $ab$  for 0 and  $c$  for 1. Then  $L'$  must be regular. For example, if  $L_1 = \{0, 10, 10011\}$  then  $L' = \{ab, cab, cababcc\}$ .

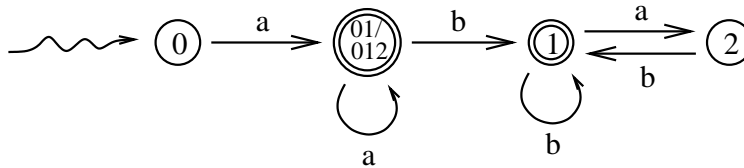
5. Any NFA with  $n$  states is equivalent to some DFA with at most  $2^n$  states, counting the dead state. Draw a minimal DFA equivalent to the following three state NFA.



Show your work. Add extra pages if needed.

	a	b
0	01	$\emptyset$
1	2	1
2	$\emptyset$	1
01	012	1
012	012	1

	0	1	2	01	012
0	$\emptyset$	X	X	X	$\emptyset$
1	X	$\emptyset$	X	X	X
2	X	X	$\emptyset$	X	X
01	X	X	X	$\emptyset$	$\emptyset$
012	X	X	X	$\emptyset$	$\emptyset$



6. The following True/False questions are much harder. I have not given the answers in class, and you may have to really hunt to find them on the internet.

- (i) **T** DFA equivalence is  $\mathcal{P}$ -TIME.
- (ii) **O** NFA equivalence is  $\mathcal{P}$ -TIME.
- (iii) **O** NFA equivalence is  $\mathcal{NP}$ -TIME.
- (iv) **O** Regular expression equivalence is  $\mathcal{NP}$ -TIME.
- (v) **T** Regular expression equivalence is  $\mathcal{P}$ -SPACE.