

## CS375 Homework Assignment 2 (40 points)

Due Date: January 28, 2025

(The red boxes are text boxes. You can put your answers into the boxes directly)

1. For each of the following regular expressions find a language (i.e., a set of strings) over  $A = \{a,b,c\}$  that can be represented/described by that expression. (8 points)

a.  $ab^* + a^*bc$       b.  $a^*bbbc^*$

a.

b.

2. Find a regular expression to describe the following language. If it has no regular expression, say so and explain why.

$\{a, b, bac, bc, b^2ac^2, bc^2, \dots, b^nac^n, bc^m, \dots\}$  (2 points)

3. A regular expression for the language over the alphabet  $\{a, b\}$  with each string containing exactly one 'ab' substring is  $b^*a^*abb^*a^*$ . Use this result to find regular expressions for the following languages

- a. a language over the same alphabet with each string containing two 'ab' substrings. (2 points)

- b. a language over the alphabet  $\{a, b, c\}$  with each string containing exactly one 'abc' substring. (6 points)

4. If a regular expression for the language over the alphabet  $\{a, b\}$  with no string containing the substring  $aa$  is  $(b+ab)^*(\Lambda+a)$ , then what is the regular expression for the language over the alphabet  $\{a, b, c\}$  with no string containing the substring  $aaa$ ? (4 points)

5. The following proof shows that

$$b(a+b)^* + bb(a+b)^* + bbb(a+b)^* = b(a+b)^*$$

Put the reason for each step in the blank on the right-hand side of that step. If an example in the notes can be used for a step, quote that example. (5 points)

$$b(a+b)^* + bb(a+b)^* + bbb(a+b)^*$$

$$= b(a+b)^* + (bb+bbb)(a+b)^*$$

$$= b(a+b)^* + b(bb+bb)(a+b)^*$$

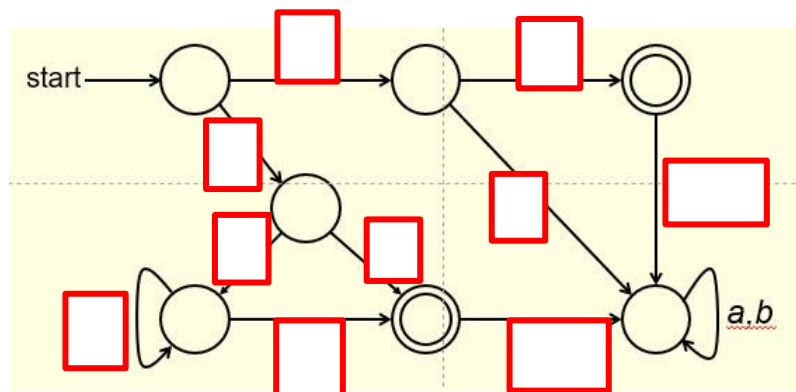
$$= b(a+b)^* + bb(a+b)^*$$

$$= (b+bb)(a+b)^*$$

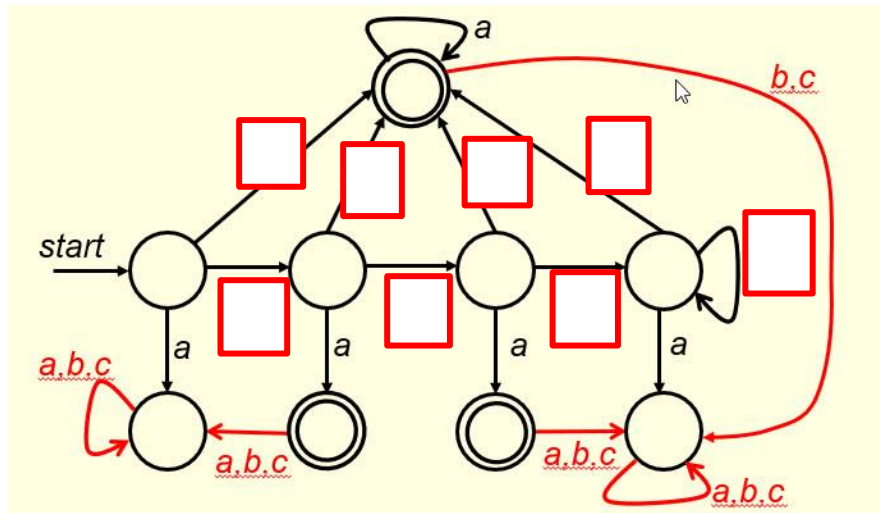
$$= b(a+b)^*$$

6. Fill out the blanks in the following figure to make it a DFA that recognizes the expression

$$ab + bb^*a. \quad (5 \text{ points})$$



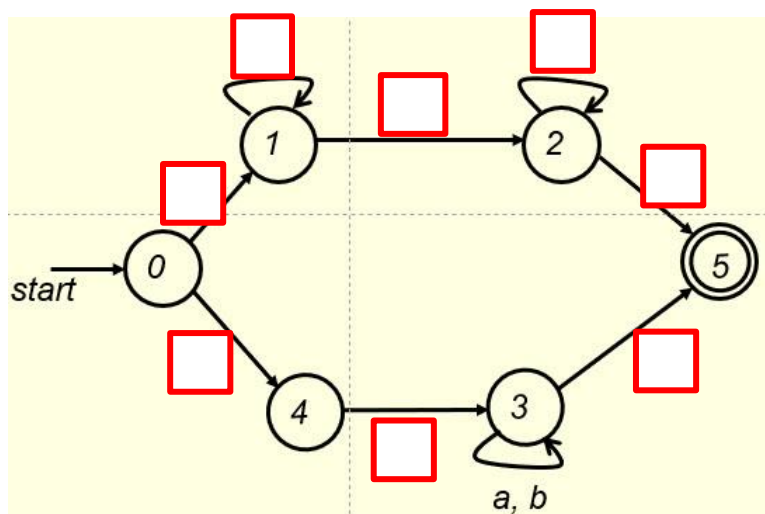
7. Fill out the blanks in the following figure to make it a DFA for the expression  $b^*ca^* + bba + ba$  (4 points)



8. Fill out the blanks in the following figure to make it an NFA for the expression

$$a^* + b^*a^* + b(a+b)^*$$

If it is possible, simplify the given expression first. (4 points)



- Solutions must be typed (word processed) and submitted to Canvas both as a pdf file and a word doc (or docx) file before 23:59 on 01/28/2025.
- Please name your files the following way:

CS375\_2025s\_HW2\_LastName.docx / CS375\_2025s\_HW2\_LastName.pdf

