QUEENS COLLEGE Department of Computer Science
CSCI 320 Midterm Exam Winter 2023 1.13.23
Instructor: Alex Ryba

10.00am – 11.30am, Friday, January 13, 2023

Complete all of the following information.

STUDENT LAST NAME (PRINT): _____

STUDENT First NAME (PRINT): _____

Cuny 1st ID#: _____

SIGNATURE: _____

THIS IS A CLOSED BOOK TEST. NO BOOKS, NOTES, COMPUTERS, CELL PHONES, OR CALCULATORS ARE ALLOWED.

It is department policy to give a grade of F to any student who helps or receives help from any other student during an exam.

The exam has 6 problems, you should answer all of them.

If your printed exam is missing any problem please notify the proctor as soon as possible.

Answer the problems in the spaces provided.

 # 1 *w23-320-1*

problem:	01	02	03	04	05	06	Σ
grade:							

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Problem 1 *(10 points)* **(a)** Give an example of a finite language that is not regular. Give a precise definition of this language and explain your answer briefly. If such a language does not exist, explain why.

Answer:

(b) Give an example of a regular language that is not finite. Give a precise definition of this language and explain your answer briefly. If such a language does not exist, explain why.

Answer:

(c) Give an example of an infinite uncountable language. Give a precise definition of this language and explain your answer briefly. If such a language does not exist, explain why.

Answer:

Name and CUNY ID#:

Problem 2 *(10 points)* Let L_1 be the language defined by the regular expression:

$$(\boldsymbol{a} \cup \boldsymbol{ba})^*$$

and let L_2 be the language defined by the regular expression:

$$(\boldsymbol{b} \cup \boldsymbol{ba})^*$$

(a) Let $S_1 = L_1 \cup L_2$. Write a regular expression that defines S_1. If such a regular expression does not exist, explain why.

Answer:

(b) Complete the following sentence, using at most 4 words.

"The language L_1 consists of strings over the alphabet $\{a, b\}$ in which every b is ... ".

Answer:

(c) Let $S_2 = L_1 \cap L_2$. Write five strings that belong to S_2. If such strings do not exist, explain why. (Hint: Think of a sentence that describes L_2 that is similar to your answer to (b)).

Answer:

(d) Write a regular expression that defines S_2. If such a regular expression does not exist, explain why. (Hint: Use your answer to (c) as a guide).

Answer:

(e) Let $S_3 = L_1 \setminus L_2$. Write a regular expression that defines S_3. If such a regular expression does not exist, explain why. (Hint: Think of some strings that belong to this language as a guide).

Answer:

Name and CUNY ID#:

Problem 3 *(10 points)* Let L be the set of strings over alphabet $\{a, b\}$ that have odd length and have b for the middle character.

(a) Write a complete formal definition of a context-free grammar that generates L. If such a grammar does not exist, prove it.

Answer:

(b) Write a regular expression that defines L. If such a regular expression does not exist, prove it.

Answer:

Name and CUNY ID#:

Problem 4 *(10 points)* Let L be the set of strings over alphabet $\{a, b\}$ that have length at least 2 and have identical characters in the first and last positions.

(a) Write a complete formal definition of a context-free grammar that generates L. If such a grammar does not exist, prove it.

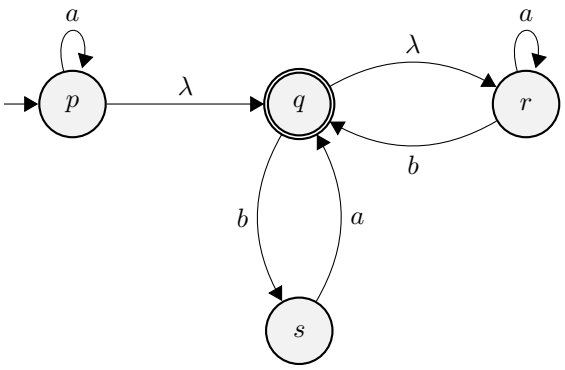
Answer:

(b) Draw a state transition graph that represents a finite automaton that accepts L. If such an automaton does not exist, prove it.

Answer:

Name and CUNY ID#:

Problem 5 *(10 points)* Let L be the language accepted by the NFA with the following state transition graph.

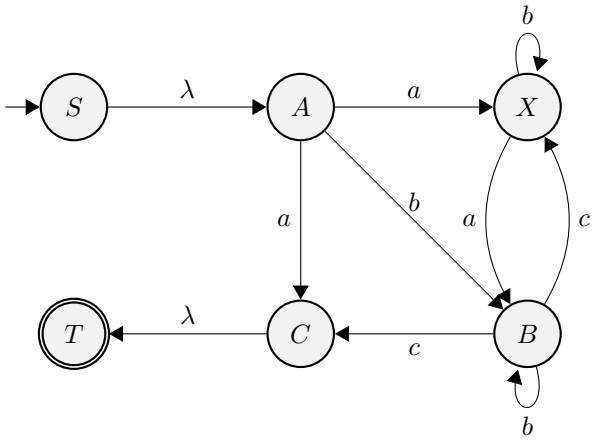


Draw a state-transition graph of a deterministic finite automaton that accepts L. If such an automaton does not exist, prove it.

Answer:

Name and CUNY ID#:

Problem 6 *(10 points)* Consider the following finite automaton.



Draw the regular expression graph obtained from this automaton when the node X is eliminated using one step of the algorithm for conversion of a finite automaton to a regular expression. (Only show how to remove the node X. Do not complete the algorithm to obtain a regular expression that corresponds to the automaton.)

Answer: