University of Moratuwa, Sri Lanka

Faculty of Engineering

DEPARTMENT OF COMPUTER SCIENCE & ENG.
B. Sc Engineering Honors Degree

CS3063 Theory of Computing (2 credits)
Semester 4, 21 Intake (Jan – Apr 2024)

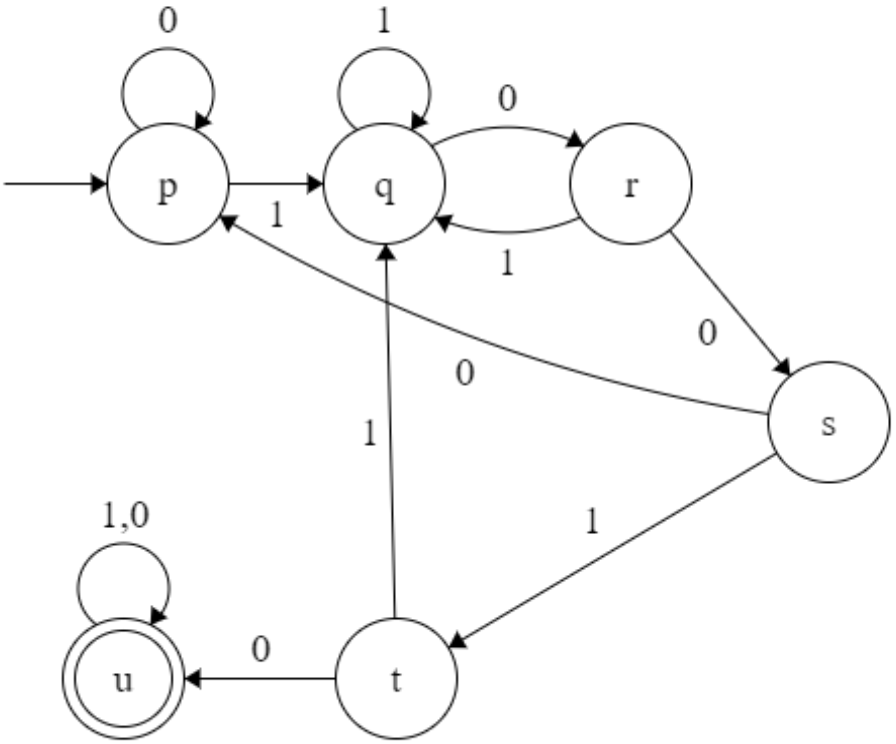
Assignment 1 (Worth: 8%, Due: 04/03/2024 at 11:59 PM)

Read the following instructions carefully.

- Answer all the questions.
- You are allowed to discuss with your colleagues; however, plagiarism will lead to severe penalties.
- If you work with your colleagues to complete the assignment, mention their name and registration number.
- If you refer to other sources (books, web pages, etc.) to complete the assignment, provide references to those sources at the end of your answer script.
- This Assignment consists of 7 questions. Answer all questions.
- Maximum total marks for this Assignment is 100. Marks allocated for each question is indicated at the beginning of each question.
- Create a PDF file containing your answers to Questions 1-6. The file name should be your registration number (e.g., 210196B). Submit the PDF file to Moodle at the relevant Assignment activity.
- Question 7 (programming question) must be done on Moodle, as a Quiz/CodeRunner activity. Go through the instructions carefully before answering the question.

Question 1 [15 marks]

Consider the following DFA (M1).



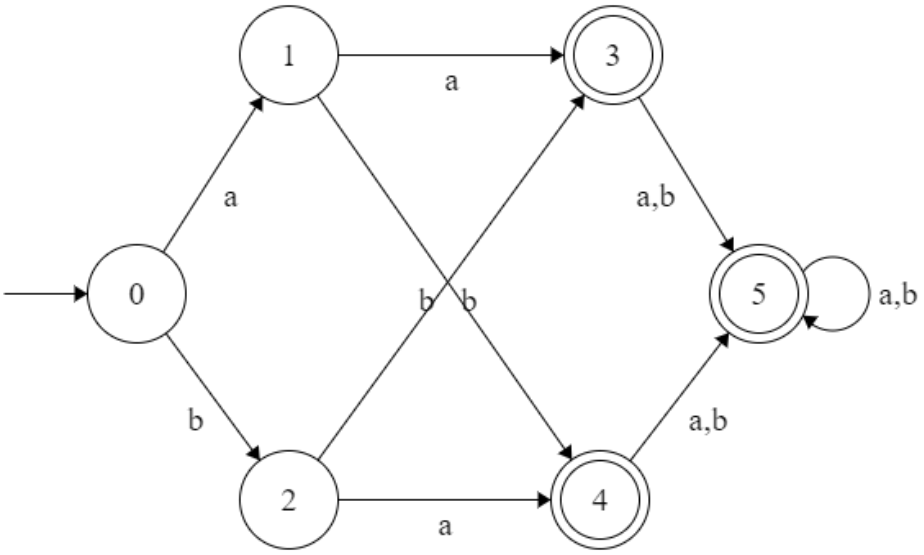
a) In simple terms, describe the language L1 accepted by the above DFA.
b) Consider L2 where L2 = Σ* - L1 (i.e. L2 is the complement of L1, that is L2 contains strings not in L1). Provide 2 strings accepted by the language represented by L2.
c) Deduce a DFA for L2 using the given M1. Explain how you obtained it.

Question 2 [15 marks]

a) Using Thompson's construction, create NFA-Λ for the following languages.
   i) L1 = **$cb^+b(a|b)^*$**
   ii) L2 = **$(ab|c)^*c^+c$**
b) Using the above created NFA-Λ, create NFA-Λ for L1|L2 (which is the Union of L1 and L2, or L1 ∪ L2).

Question 3 [15 marks]

Consider the following DFA:



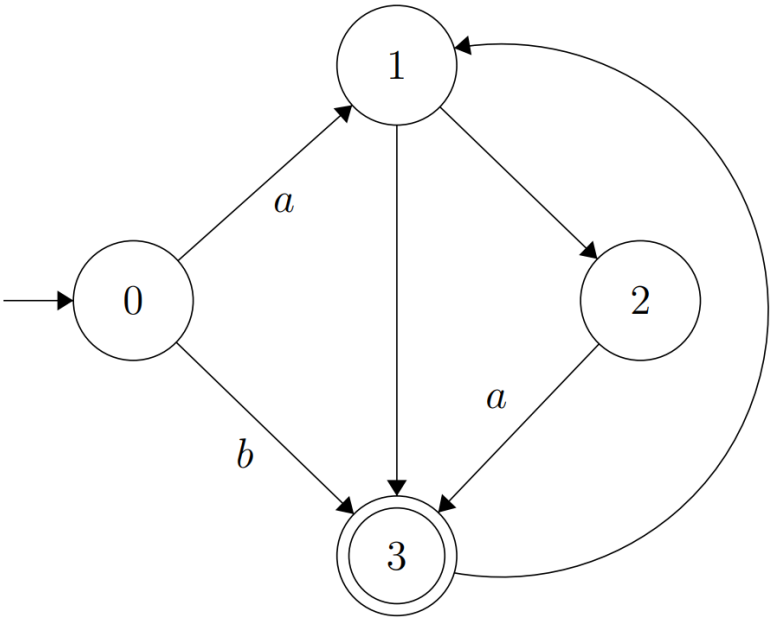
a) Determine the equivalence classes among the set of states. Show your work.

b) Minimize the DFA using a suitable method. Clearly show your work. Show the transition diagram of the minimized DFA.

c) In simple terms, describe the language accepted by the given DFA.

Question 4 [20 marks]

Consider the following NFA-Λ:



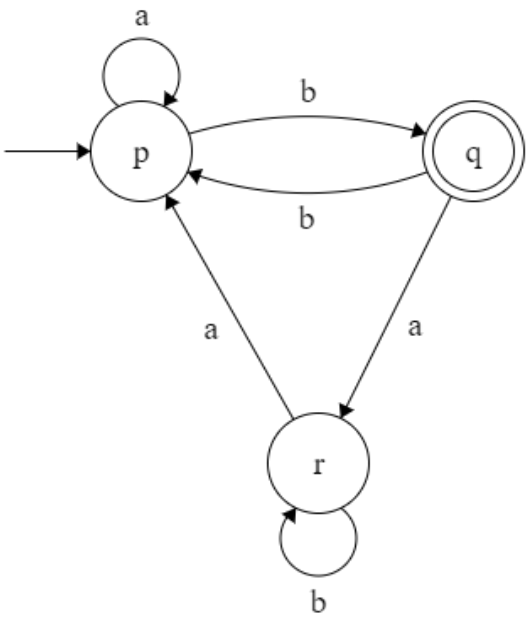
a) For the given NFA-Λ, derive an equivalent NFA. Clearly show the steps.

b) For the NFA you obtain in (a), derive an equivalent DFA. Clearly show the steps.

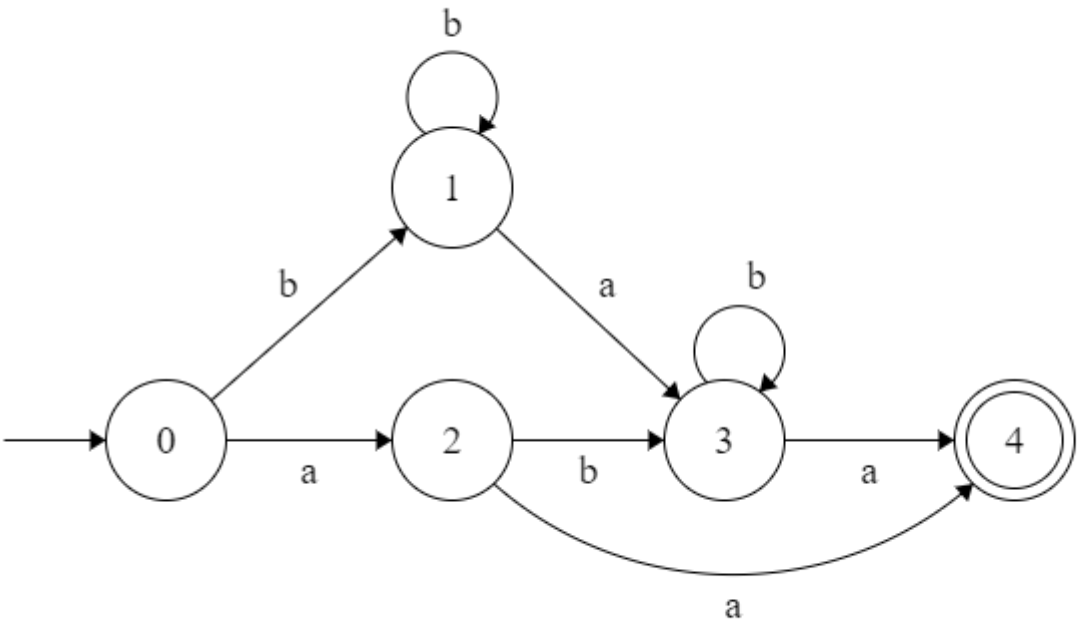
Question 5 [15 marks]

Give regular expressions corresponding to the language accepted by each FA in the following. State any assumptions made.

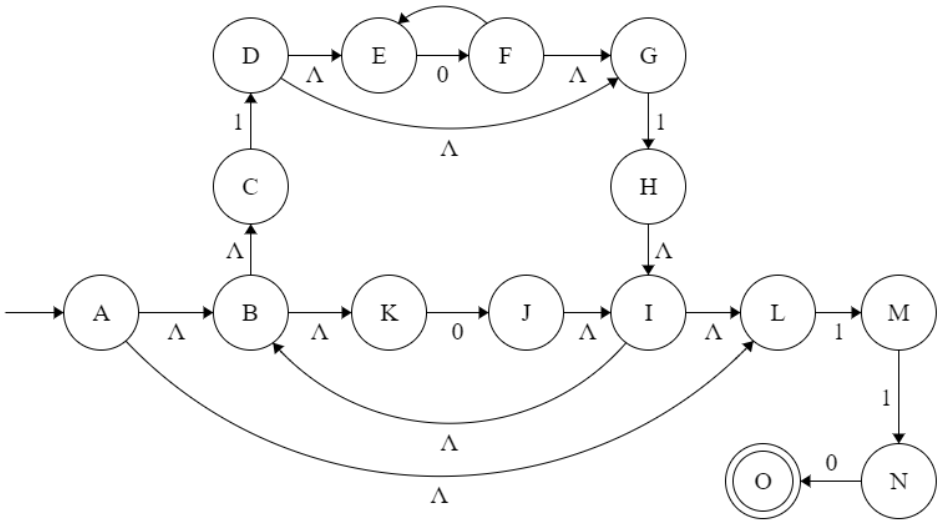
(a)



(b)



(c)



Question 6 [10 marks]

Design a Mealy machine that takes strings consisting of 1s and 0s as input and detects (recognizes) the patterns 101 and 010. The machine should output 1 as soon as either of these patterns is identified and output 0 for all other instances. Overlapping occurrences of these patterns should also be detected. Assume that the string is processed by the Mealy machine from left to right.

For instance, if the input string is:
`001001011010`
the expected output pattern should be:
`000100110011`

Draw the Mealy machine with edge labels adhering to Input/Output convention. Your Mealy machine should not have more than 5 states. It should be deterministic and should not contain Λ transitions.

Question 7 [15 marks]

This is a programming question. The question is available on Moodle as Quiz/CodeRunner activity labeled as "Assignment-1 Q7 (Programming Q)". You must go through the instructions in the Moodle question.

Note: In this question, you are required to complete the question using Python's Regex (regular expression) library (i.e., using any other method is not acceptable). This requirement would be manually checked.

------ END OF THE ASSIGNMENT ------