



Mahindra University Hyderabad
École Centrale School of Engineering
Minor - 2

Program: B. Tech Branch: CSE/ARI/CAM/ECM/ECE Year: II Semester: 2
Subject:- Theory of Computation (CS/AI 2204)

Date: 19/04/2024
Time Duration: 1 h 30 m

Start Time: 10:00 AM
Max. Marks: 50

Instructions:

- Answer all the questions.
- All the sub-questions belonging to a question should be answered together and in the given order.
- Write less and write only that is needed.

Q1: Regular vs Non-regular

(10 M)

Consider the following languages:

1. $L_1 = \{a^m b^n | m, n \in \mathbb{N}\}$
2. $L_2 = \{a^p b^2 | p \text{ is a perfect square}\}$
3. $L_3 = \{a^m b^n | m + n \text{ is odd}\}$
4. $L_4 = \{a^m b^n | 2m + n = 55\}$
5. $L_5 = \{w \in \{0, 1\}^* | w \text{ has equal number of 0's and 1's}\}$

1. Which among $\{L_1, L_2, L_3, L_4, L_5\}$ are regular? (5)

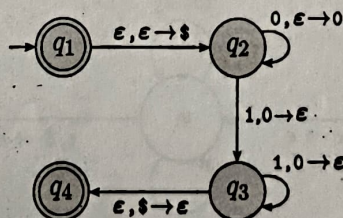
2. Pick a language that is non-regular from the above and justify your claim using *pumping lemma for regular languages*. (5)

Q2: Context Free Languages

(10 M)

Following is a (N)PDA designed to recognize the language

$$L = \{0^n 1^n | n \geq 0\}$$



Make necessary modifications to it so it recognizes the following language instead.

$$L = \{0^n 1^n | n > 2\}$$

Hint: You will only need to introduce one new state apart from the other modifications.

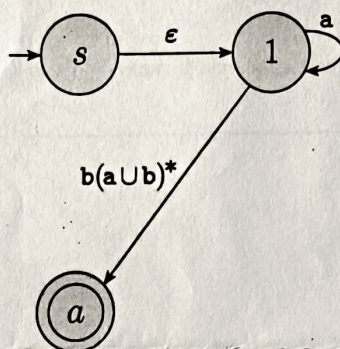
Q3: Regular Expressions

(10 M)

✓ 1. Let $G = (Q, \Sigma, \delta, q_{start}, q_{acc})$ be a Generalized Non-deterministic Finite Automaton (GNFA). What are the domain and range of the transition function δ ? (5)

$$\delta : _ _ ? _ _ \rightarrow _ _ ? _ _$$

2. Given below is a GNFA (G) with 3 states $\{S, 1, a\}$. (5)



Pluck out the state ① and draw the updated GNFA. What is the regular expression for the language that is intended to be recognized by G ? (5)

Q4: Pushdown Automata

(10 M)

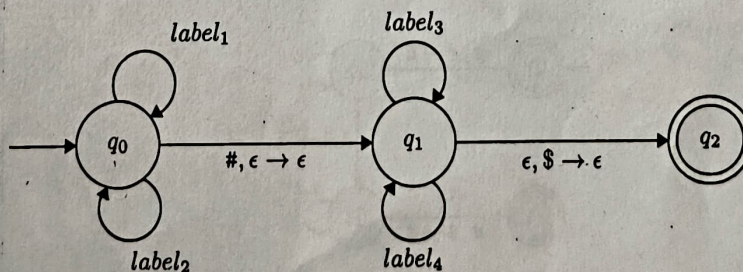
✓ The following PDA is supposed to recognize the language L , which is defined as

$$L = \{w\#w^R | w \in \{0, 1\}^*\}$$

where

- w is some string in binary,
- w^R is the reverse of the string w , and
- $\#$ is a special symbol to separate w and w^R .

A typical string in L would look something like 010011#110010.



Finish the design of the PDA by filling the four labels appropriately. Don't write anything more than what's asked for.

Q5: True or False

5 × 2 = 10

Only provide the answer.

- ✓ 1. If L is a regular language, the language $\{xy \mid x, y \in L\}$ is also regular. (True / False)
 - ✓ 2. The pumping lemma is a useful tool to show that a language is regular. (True / False)
 - ✓ 3. If N is an NFA then the language $L(N)^*$ can be accepted by a DFA. (True / False)
 - ✓ 4. Every context-free language is also a regular language. (True / False)
 - ⑤ 5. Every non-deterministic pushdown automaton has an equivalent deterministic variant. (True / False)
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