

02 MAY 2023

KATHMANDU UNIVERSITY  
End Semester Examination [C]  
April/May 2023

Marks Scored:

Level : B.Sc.  
Year : III

Course : COMP 316  
Semester : I

Exam Roll No.:

Time: 30 mins.

F. M. : 10

Registration No.:

Date :

SECTION "A"

[20Q.  $\times$  0.5 = 10 marks]

**Encircle the most appropriate alternative from each set of choices.**

- Finite State Machine can recognize
  - Any Grammar
  - Only CFG
  - Regular Grammar
  - Unambiguous Grammar
- Which of the following statement is wrong?
  - A Finite State Machine with 3 stacks is more powerful than Finite State Machine with 2 stacks.
  - A Turing Machine cannot solve halting problem.
  - Set of recursively enumerable languages is closed under union.
  - Context sensitive grammar can be recognized by a linearly bounded memory machine.
- The transition function  $\delta$  of NFA is
  - $\delta: Q \times \Sigma \rightarrow Q$
  - $\delta: Q \times \Sigma \rightarrow 2^Q$
  - $\delta: Q \times \Sigma \rightarrow Q^2$
  - $\delta: Q \times \Sigma \rightarrow \Sigma$
- Language of an DFA  $L(D)$  is defined as
  - $L(D) = \{w \in \Sigma^* \mid \delta(q_0, w) \cap F \neq \Phi\}$
  - $L(D) = \{w \in \Sigma^+ \mid \delta(q_0, w) \cap F \neq \Phi\}$
  - $L(D) = \{w \in \Sigma^* \mid \delta(q_0, w) \in F\}$
  - $L(D) = \{w \in \Sigma^+ \mid \delta(q_0, w) \in F\}$
- Which of the following is true for grammar  $A \rightarrow A\alpha/\beta$ 
  - $A \rightarrow \beta A' / \alpha, A' \rightarrow \alpha A' / \beta$
  - $A \rightarrow A' \beta / \alpha, A' \rightarrow \alpha A' / \beta$
  - $A \rightarrow A' \beta, A' \rightarrow \alpha A' / \epsilon$
  - $A \rightarrow \beta A' / \beta, A' \rightarrow \alpha A' / \alpha$
- If  $p$  and  $q$  be two R.E, the unique solution for  $r=q+rp$  is
  - $r = qp^*$
  - $r = qp$
  - $r = qp^+$
  - $r = qp + qp^*$
- RE to represent the set of all possible strings over  $\Sigma = \{a, b\}$  is
  - $(a + b)^*$
  - $(ab)^*$
  - $(a+b)(a+b)$
  - $(a + b)^+$
- Basic step for extended transition function  $\delta$  of NFA is
  - $\delta(q, a) = \{q\}$
  - $\delta(q, \epsilon) = \{\epsilon\}$
  - $\delta(q, \epsilon) = \{q\}$
  - $\delta(q, a) = \{\epsilon\}$
- What is the equivalence of DFA and NFA?
  - Both can process and recognize the regular language.
  - Both can generate the similar strings.
  - Both are finite state machine with output.
  - Both are finite state machine that can process Context Free Grammar.
- Pumping Lemma is generally used for proving
  - A given grammar is regular
  - A given grammar is not regular
  - Whether two given regular expressions are equivalent or not.
  - A grammar is context sensitive.

11. Which of the following algebraic rules are true for Regular Expression?
- $p.(q.r) = (p.q).r$
  - $\Phi + p = p + \Phi = p$
  - Both A and B
  - $p + p = p^*$
12. Any string of terminals that can be generated by the following CFG is
- $$S \rightarrow XY$$
- $$X \rightarrow ax \mid bx \mid a$$
- $$Y \rightarrow Ya \mid Yb \mid a$$
- Has no consecutive a's or b's
  - Has at least one 'b'
  - Has at least two a's
  - Should end in a 'a'
13. The variable  $X \in V$  is generating symbol if
- $X \Rightarrow^* w$
  - $X \Rightarrow^* V^*$
  - $X \Rightarrow^* T^*V^*$
  - $X \Rightarrow^* w^*V^*$
14. Which of the following grammar is right linear?
- $S \rightarrow S10/0$
  - $S \rightarrow 0A, A \rightarrow 10A/\epsilon$
  - $S \rightarrow 0S1/1S0/0$
  - $S \rightarrow 1S1/0$
15. Which of the following condition must be satisfied before converting the grammar into GNF?
- The grammar must be simplified and productions are of the form  $A \rightarrow aB_1B_2 \dots B_n$  or  $A \rightarrow a$ .
  - The grammar must be in CNF.
  - The grammar must be without left recursion.
  - The grammar must be in CNF and productions are of the form  $A \rightarrow BC$  or  $A \rightarrow a$ .
16. The transition function of PDA  $P = \{Q, \Sigma, \tau, \delta, q_0, z_0, F\}$  is defined as
- $\delta: Q \times \Sigma \rightarrow Q \times \tau^*$
  - $\delta: Q \times \{\Sigma \cup \epsilon\} \times \tau \rightarrow Q \times \tau^*$
  - $\delta: Q \times \{\Sigma \cup \epsilon\} \rightarrow Q \times \tau^*$
  - $\delta: Q \times \Sigma \times \tau \rightarrow Q \times \tau^*$
17. Which statement is true?
- The PDA must have one accept state and one reject state
  - The PDA must have one accept state and two reject state
  - The PDA must have two accept state and two reject state
  - There is no reject state in the PDA.
18. Sentential form of the CFG is
- Any string from  $(V \cup T)^*$  that can be derived from any variable.
  - Any string from  $(V \cup T)^+$  that can be derived from any variable.
  - Any string from  $(V \cup T)^*$  that can be derived from start variable.
  - Any string from  $(V \cup T)^+$  that can be derived from start variable.
19. An ID of Turing Machine consists of
- present state and entire input to be processed
  - present input only
  - entire input to be processed
  - input to be processed
20. A Turing Machine that can simulate the other Turing Machine is
- Nested Turing Machine.
  - Counter Machine.
  - Multi-Tape Turing Machine.
  - Universal Turing Machine.

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SECTION "B"  
[6Q. × 4 = 24 marks]

Attempt *ANY SIX* questions.

1. Construct a DFA with transition diagram and transition table over alphabet  $\Sigma = \{0,1\}$  that accepts the language  $L = \{w \mid w \text{ is string that start with 1 and end with } 01\}$
2. Prove that for any NFA  $N$  accepting a Language  $L$  there is DFA  $D$  that also accepts  $L$ . i.e.  $L(N) = L(D)$ .
3. Prove that  $L = \{0^n 1^n \mid n > 0\}$  is not regular language.
4. Explain the different derivation approaches of Context Free Grammar.
5. Convert the following grammar into Finite Automata.  
 $A \rightarrow 0A \mid 1D \mid 0$   
 $B \rightarrow 1C \mid 0D$   
 $C \rightarrow 0B \mid 1D \mid 0$   
 $D \rightarrow D \mid 1D$
6. Define Parse Tree and Yield of Parse Tree with example.
7. Explain Instantaneous Description (ID) of Turing Machine with suitable example.

SECTION "C"  
[2Q. × 8 = 16 marks]

Attempt *ANY TWO* questions.

8. Convert the following  $\epsilon$ -NFA into equivalent DFA.

	$\epsilon$	a	b	c
$\rightarrow A$	B	A		
B	C		C	
*C				C

9. Simplify the following CFG

$S \rightarrow ABC$   
 $A \rightarrow BB \mid \epsilon$   
 $B \rightarrow CC \mid a$   
 $C \rightarrow AA \mid b$

10. Write short notes with example.
  - a. Chomsky Normal Form
  - b. Equivalence of PDA and CFG

[2 × 4 = 8]

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