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50 (FLA)

[18-HRGPKAC-M3S]

MCA/MSc IT Exam., 2018

FORMAL LANGUAGES AND AUTOMATA

[MCA/MSc IT (S3) 11]

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Answer any *five* from the following questions : 2×5=10

(a) Define finite automata.

(b) Define null string. Which technique is used to prove that certain languages are not regular?

(c) What is the significance of Turing's thesis?

(d) Consider a CFG generating CFL, $L = \{a^n b^n : n = 4\}$ for $G = (\{s\}, \{a, b\}, S, P)$ where P is given as $S \rightarrow aSb$, $S \rightarrow ab$. Construct a derivation tree.

(e) What is predictive parsing?

(f) Define Kleene closure and Positive closure.

2. Answer any *three* from the following questions : 4×3=12

(a) Design a DFA that recognizes the language

$$L = \{a^n b : n \geq 0\}$$

(b) Obtain the language generated by $L(G)$ for a Context-free Grammar (CFG) given by $G = \{V, T, P, S\}$ with $V = \{S\}$, $T = \{a\}$ and $P: S \rightarrow SS,\ S \rightarrow a$. Distinguish between top-down and bottom-up parsing. 2+2=4

(c) Give the definition of a Turing machine. Write the transition function for a multitape Turing machine.

(d) What is a primitive recursive function? Give a suitable example. Is every μ-recursive function computable by a Turing machine? Define μ-recursive function.

3. Answer any *three* from the following questions : 6×3=18

(a) Define computability and decidability. Which problems are said to be tractable and which are intractable? 3+3=6

(b) Give the formal definition of NFA. Differentiate between NFA and DFA.

(c) Given a grammar G with production rules

$S \rightarrow aB \mid bA$

$A \rightarrow aS \mid bAA \mid a$

$B \rightarrow bS \mid aBB \mid b$

Obtain the leftmost derivation and rightmost derivation for the string '*aaabbabbba*'.

(d) Briefly describe the applications of Church thesis. Define Gödelization.

(Continued)

4. Answer any *four* from the following questions : 10×4=40

(a) Explain the closure properties of Context-free Grammars.

(b) Write short notes on the following (any *two*) : 5×2=10

(i) Post Correspondence Problem

(ii) Chomsky Hierarchy

(iii) The Halting Problem

(c) Define regular expression and regular grammar. Describe the following language by regular expression :

(i) Set of all strings over $\Sigma = \{a, b\}$ that begins with a and ends with a.

(ii) The regular expression for $\{b^2, b^5, b^8, \cdots\}$ over the alphabet $\Sigma = \{b\}$.

(iii) Set of strings over $\Sigma = \{0, 1\}$ that has at least one pair of consecutive zeroes.

(d) Define the language accepted by a Turing machine. What are the moves in a Turing machine? Give one application of Turing machine. What are the limitations of Turing Machine?

(e) Define the following terms :

(i) NP and P class

(ii) Ambiguity

(iii) Power of an alphabet

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