Formal Languages and Automata

MCS-E13

Block-I

UNIT-I

INTODUCTION TO FORMAL LANGUAGES AND AUTOMATA

Alphabets Strings and Languages, Languages, Symbols, Alphabets, Strings or Words over Alphabets, Length of a string, Convention, Some String Operations, Powers of Strings, Powers of Alphabets, Reversal, Language, Set operations on languages, Reversal of a language, Language concatenation, Iterated concatenation of languages, Kleene's Star operation, Automata and Grammars, Grammar.

UNIT-II

FINITE AUTOMATA

Finite Automata, States, Transitions and Finite-State Transition System, Deterministic Finite (-state) Automata, Deterministic Finite State Automaton, Acceptance of Strings, Language Accepted or Recognized by a DFA, Extended transition function, Transition table, (State) Transition diagram, Removing $\in$ Transition, Equivalence of NFA and DFA, Multiple Next State, $\in$- transitions, Acceptance, The Extended Transition function $\hat{\delta}$

Formal definition of NFA, The Language of an NFA

UNIT-III

REGULAR EXPRESSIONS (RE)

Regular Expressions (RE), Regular Expression and Regular Language, Regular Grammars, Some Decision Algorithms for CFLs.

UNIT-IV

MINIMIZATION OF DETERMINISTIC FINITE AUTOMATA (DFA)

Minimization of Deterministic Finite Automata (DFA), DFA Isomorphisms, Showing that and M are isomorphic, The minimal DFA, A Minimization Algorithm, Some decision properties of Regular Languages, Finite Automata with output, Moore machines, Mealy machines, Equivalence of Moore and Mealy machines.

Block-II

UNIT-V

PUSHDOWN AUTOMATA

Pushdown Automata, Formal Definitions, Explanation of the transition function, Configuration or Instantaneous Description (ID), Nondeterministic Finite Automata (NFA), Language accepted by a PDA, Equivalence of PDAs and CFGs, CFA to PDA, Some Useful Explanations, PDA and CFG, PDA to CFG, Inductive Hypothesis, Inductive Step.

UNIT-VI

DETERMINISTIC PUSHDOWN AUTOMATA (PDA)

Deterministic Pushdown Automata (DPDA) and Deterministic Context-free Languages (DCFLs), DPDAs and FAs: DCFLs and Regular languages, CFLs and DCFLs, Standard forms of DPDAs, Acceptance by final state and empty stack, Unambiguous CFGs and DPDAs, Parsing and DPDAs.

UNIT-VII

SIMPLIFICATION OF CFG

Chomsky Normal Form (CNF), Greibach Normal Form (GNF)

UNIT-VIII

CONTEXT FREE LANGUAGES

Pumping Lemma for Context Free Languages (CFLs), Closure Property of Context Free Languages (CFLs), Some Decision Algorithms for CFLs, Testing Emptiness, Testing Membership, CYK Algorithm to decide membership in CFL, Testing Finiteness of a CFL Decision algorithm for testing finiteness of a CFL

Block-III

UNIT-IX

TURING MACHINES

Informal Description, Formal Definition, Transition Function, Instantaneous Description (IDs) or Configurations of a TM, Moves of Turing Machines, Special Boundary Cases, More about Configuration and Acceptance

UNIT-X

RECURSIVELY ENUMERABLE LANGUAGE

Recursive language, Recursively Enumerable (R.E) Language, Recursive (Or Decidable) Languages, Examples, Closure Properties, Post Correspondence Problem, Proof Sketch of Undecidability.

UNIT-XI

POST'S CORRESPONDENCE PROBLEM

Post's Correspondence Problem (PCP), Post's Correspondence System (PCS)

UNIT-XII

CHOMSKY HIERARCHY

Chomsky Hierarchy, Equivalence of Unrestricted grammars and TMs, Context-Sensitive Language and LBAs, Equivalence of Linear-bounded Automata and Context-sensitive Grammars.

SUGGESTED READINGS

- Hopcroft, John and Jeffery Ullman. 1987. "Introduction to Automata theory, languages and computation." Indian Student Edition:Narosa Publishing House.
- Jäger, Gerhard and James Rogers. 2012. "Formal language theory: refining the Chomsky hierarchy." Philos Trans R Soc Lond B Biol Sci., vol. 367, no. 1598, pp. 1956–1970, July 19. Accessed 2019-08-2019.
- Martin J. C., “Introduction to Languages and Theory of Computations”, TMH
- Papadimitrou, C. and Lewis, C.L., “Elements of theory of Computations”, PHI
- Cohen D. I. A., “Introduction to Computer theory”, John Wiley & Sons
- Kumar Rajendra, “Theory of Automata (Languages and Computation)”, PPM
- Roberts, Eric. 2004. "Basics of Automata Theory." Automata Theory, Stanford University, September. Accessed 2019-10-16.