JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech II - II sem (C.S.E)   T   Tu   C
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(15A05404) FORMAL LANGUAGES AND AUTOMATA THEORY

Course Objective:
- *Understand formal definitions of machine models.*
- *Classify machines by their power to recognize languages.*
- *Understanding of formal grammars, analysis*
- *Understanding of hierarchical organization of problems depending on their complexity*
- *Understanding of the logical limits to computational capacity*
- *Understanding of undecidable problems*

Learning Outcome:
At the end of the course, students will be able to
- *Construct finite state diagrams while solving problems of computer science*
- *Find solutions to the problems using Turing machines*
- *Design of new grammar and language*

UNIT I

Introduction: Basics of set theory, Relations on sets, Deductive proofs, Reduction to definitions, Other theorem forms, Proving equivalences about sets, The Contrapositive, Proof by contradiction, Counter examples, Inductive proofs, Alphabets, Strings, Languages, Problems, Grammar formalism, Chomsky Hierarchy

Finite Automata: An Informal picture of Finite Automata, Deterministic Finite Automata (DFA), Non Deterministic Finite Automata (NFA), Applying FA for Text search, Finite Automata with

Epsilon transitions (ϵ-NFA or NFA- ϵ), Finite Automata with output, Conversion of one machine to another, Minimization of Finite Automata, Myhill-Nerode Theorem.

UNIT II

Regular Languages: Regular Expressions (RE), Finite Automata and Regular Expressions,

Applications of Regular Expressions, Algebraic laws for Regular Expressions, The Arden's Theorem, Using Arden's theorem to construct RE from FA, Pumping Lemma for RLs, Applications of Pumping Lemma, Equivalence of Two FAs, Equivalence of Two REs, Construction of Regular Grammar from RE, Constructing FA from Regular Grammar, Closure properties of RLs, Decision problem's of RLS, Applications of REs and FAs

UNIT III

Context Free Grammars and Languages: Definition of Context Free Grammars (CFG), Derivations and Parse trees, Ambiguity in CFGs, Removing ambiguity, Left recursion and Left factoring, Simplification of CFGs, Normal Forms, Linear grammars, Closure properties for CFLs, Pumping Lemma for CFLs, Decision problems for CFLs, CFG and Regular Language..

UNIT IV

Push Down Automata (PDA): Informal introduction, The Formal Definition, Graphical notation, Instantaneous description, The Languages of a PDA, Equivalence of PDAs and CFGs, Deterministic Push Down Automata, Two Stack PDA.

UNIT V

Turing Machines and Undecidability: Basics of Turing Machine (TM), Transitional Representation of TMs, Instantaneous description, Non Deterministic TM, Conversion of Regular Expression to TM, Two stack PDA and TM, Variations of the TM, TM as an integer function, Universal TM, Linear Bounded Automata, TM Languages, Unrestricted grammar , Properties of Recursive and Recursively enumerable languages, Undecidability, Reducibility, Undeciadable problems about TMs, Post's Correspondence Problem(PCP), Modified PCP.

Text Books:

1. *Introduction to Automata Theory, Formal Languages and Computation, Shyamalendu kandar, Pearson.*
2. *Introduction to Automata Theory, Languages, and Computation, Third Edition, John E.Hopcroft, Rajeev Motwani, Jeffery D. Ullman, Pearson.*

Reference Books:

1. *Introduction to Languages and the Theory of Computation, John C Martin, TMH, Third Edition.*
2. *Theory of Computation, Vivek Kulkarni, OXFORD.*
3. *Introduction to the Theory of Computation., Michel Sipser, 2nd Edition, Cengage Learning*
4. *Theory of computer Science Automata, Languages and Computation, K.L.P. Mishra, N. Chandrasekaran, PHI, Third Edition.*
5. *Fundamentals of the Theory of Computation, Principles and Practice, Raymond Greenlaw, H. James Hoover, Elsevier, Morgan Kaufmann.*
6. *Finite Automata and Formal Language A Simple Approach, A.M. Padma Reddy, Pearson*