

Theory of Computation

Course Objectives: The course begins with the basic mathematical preliminaries and goes on to discuss the general theory of automata, properties of regular sets and regular expressions, and the basics of formal languages. Besides, sufficient attention is devoted to such topics as pushdown automata and its relation with context free languages, Turing machines and linear bounded automata, the basic concepts of computability such as primitive recursive functions and partial recursive functions.

Pre-requisites: Mathematical Basics: familiarity with proofs, discrete math, and algorithms.

Course Contents/Syllabus:

Module I: Introduction to Languages and Automata
Formal Grammars and Chomsky Hierarchy, Regular Expression Deterministic and Nondeterministic Finite Automata, Regular Expression, Regular Expression to Finite Automata and vice versa, Arden's Theorem , Two way Finite Automata, Finite Automata with output, Properties of regular sets, pumping lemma for regular sets, My-Hill-Nerode Theorem .
Module II: Context Free Grammars and Pushdown Automata
CFG: Formal Definition, Derivation and Syntax trees, Simplification Forms, Ambiguous Grammar, Properties of CFL, Normal Forms (CNF and GNF), Pushdown Automata: Definitions, Relationship between PDA and context free language, Decision Algorithms
Module III: Turing Machine
The Turing Machine Model, Language acceptability of Turing Machine, Design of TM, Variation of TM, Universal TM, Church's Machine. Recursive and recursively enumerable language, unrestricted grammars, Context Sensitive Language, Linear Bounded Automata (LBA).
Module IV: Un-decidability
Turing machine halting Problem, undecidable problems for recursive enumerable language, Post correspondence problems (PCP) and Modified Post correspondence problems, Undecidable problems for CFL.
Module V: Computability
Partial and Total Functions, Primitive Recursive functions, Recursive functions.

Text Reading:

1. K.L.P. Mishra and N.Chandrasekaran, “Theory of Computer Science : Automata, Languages and Computation”, PHI.
2. Introduction to theory of computation by Michael sipser.
3. An introduction to formal languages and Automata by Peter Linz, Narosa Publication Papadimitrou, C. and Lewis, C.L., “Elements of the Theory of Computation”, PHI
4. Martin J. C., “Introduction to Languages and Theory of Computations”, TMH
5. Hopcroft and Ullman, “Introduction to Automata Theory, languages and computation”, Addison Wesley.
6. Formal Languages and Automata Theory by C.K Nagpal