Automata Tutorial

Last Updated : 30 Jan, 2025

Automata Theory is a branch of the Theory of Computation. It deals with the study of abstract machines and their capacities for computation. An abstract machine is called the automata. It includes the design and analysis of automata, which are mathematical models that can perform computations on strings of symbols according to a set of rules.

Why we study Theory of Computation?

- **Regular Expressions (RE) :** Used for pattern matching in Linux/Unix command prompt, programming languages and XML/DTD to describe structure.
- **Finite Automata in Modeling Systems :** Used in designing and checking models and electronic circuits that operate based on certain rules.

TOC Quiz and

- **Context-Free Grammars (CFG) :** Used in Compiler / Programming Language design to describe syntax and natural language processing to describe structure.
- **Mathematical Models** : Mathematical understanding of computing devices by mathematically modeling them.
- **Building Block for Quantam Computing:** Turing Machines (we study in this subject) are considered a fundamental building block for understanding quantum computation models.
- **Optimizing Algorithm Efficiency** : Helps classify problems based (e.g., **P, NP, NP-complete, and NP-hard**), proving that some problems have no efficient solutions.
- **Understanding Computability** : Study of which problems can be solved using algorithms, essentially defining the boundaries of what a computer can calculate.. Problems like the "Halting Problem" which are demonstrably impossible to solve with a general algorithm.

Please refer Why we Study Theory of Computation? for details.

Skip to content

Automata – Introduction

1. Introduction
2. Chomsky Hierarchy
3. Applications of various Automata

Regular Expression and Finite Automata

1. Finite Automata Introduction
2. Arden's Theorem
3. L-graphs and what they represent
4. Hypothesis (language regularity) and algorithm (L-graph to NFA)
5. Regular Expressions, Regular Grammar and Regular Languages
6. How to identify if a language is regular or not
7. Designing Finite Automata from Regular Expressions
8. Star Height of Regular Expression and Regular Language
9. Generating regular expression from finite automata
10. Designing Deterministic Finite Automata (Set 2)
11. NFA to DFA Conversion

12. Program to Implement NFA with epsilon move to DFA Conversion
13. Minimization of DFA
14. Kleene's Theorem Part-1
15. MEALY and MOORE Machines
16. Difference between Mealy machine and Moore machine
17. Problems on Finite Automata
18. Operations on DFA

>> Quiz on Regular Languages and Finite Automata

CFG (Context Free Grammar)

1. Relationship between grammar and language
2. Simplifying Context Free Grammars
3. Closure Properties of Context Free Languages(CFL)
4. Union & Intersection of Regular languages with CFL
5. Converting Context Free Grammar to Chomsky Normal Form
6. Converting Context Free Grammar to Greibach Normal Form
7. Pumping Lemma
8. Check if the language is Context Free or Not

9. Ambiguity in Context Free Grammar
10. Operator grammar and precedence parser
11. Context-sensitive Grammar (CSG) and Language (CSL)

PDA (Pushdown Automata)

1. Pushdown Automata
2. Pushdown Automata Acceptance by Final State
3. Detailed Study of PushDown Automata
4. Problems on Pushdown Automata

>> Quiz on Context Free Languages and Pushdown Automata

Turing Machine

1. Turing Machine
2. Halting Problem
3. Theory of Computation | Applications of various Automata
4. Turing Machine as Comparator
5. Problems on Turing Machine

>> Quiz on Turing Machines and Recursively Enumerable Sets

Decidability

1. Decidable and undecidable problems
2. Decidability
3. Undecidability and Reducibility
4. NP-Completeness | Set 1 (Introduction)
5. Proof that Hamiltonian Path is NP-Complete
6. Proof that vertex cover is NP complete
7. Computable and non-computable problems

>> Quiz on Undecidability

Quick Links

- Last Minute Notes(LMNs)
- 'Quizzes' on Theory Of Computation !
- Recent Articles on Theory Of Computation

Next Article

Introduction to Theory of Computation

Similar Reads

Why Do We Study Theory of

Theory of Computation (ToC) is the study of how computers solve problems using mathematical model...

15+ min read

Introduction to Theory of Computation

Automata theory, also known as the Theory of Computation, is a field within computer science and...

15+ min read

Applications of various Automata

Automata is a machine that can accept the Strings of a Language L over an input alphabet Σ . So far we are...

15+ min read

Practice problems on finite automata

Que-1: Draw a deterministic and non-deterministic finite automate which accept 00 and 11 at the end of ...

10 min read

Regular Expressions, Regular Grammar and Regul...

To work with formal languages and string patterns, it is essential to understand regular expressions, regular...

15+ min read

Designing Deterministic Finite Automata (Set 5)

Prerequisite: Designing finite automata In this article, we will see some designing of Deterministic Finite...

13 min read

Designing Finite Automata from Regular Expressio...

In this article, we will see some popular regular expressions and how we can convert them to finite...

15+ min read

Introduction To Grammar in Theory of Computation

In Theory of Computation, grammar refers to a formal system that defines how strings in a language are...

15+ min read

Computer Organization and Architecture Tutorial

In this Computer Organization and Architecture Tutorial, you'll learn all the basic to advanced concepts like...

15+ min read

Skip to content

Arden's Theorem in Theory of Computation

Arden's Theorem is a fundamental result in the Theory of Computation used to solve regular expressions fro...

15+ min read