

Theory of Computation

Definition, Evolution and Application of Theory of Computation.

Three areas of the Theory of Computation

1. Complexity Theory
2. Computability Theory
3. Automata Theory

Finite Automata Basics (Set of states, alphabet, starting state, transition function, set of final states, string, language, transition table)

Draw state diagram of **Deterministic Finite Automata**

Some languages over alphabet $\Sigma = \{a, b\}$

1. All strings containing 'a'
2. All strings ending with 'a'
3. All strings starting with 'ab'
4. All strings containing 'ab'
5. All strings ending with 'ab'
6. Every 'a' should be followed by 'b'
7. 'a' must not be followed by 'b'
8. Starting with 'a' ending with 'b'
9. Ending with same character
10. String length is exactly 2
11. String length is at most 2
12. String length is at least 2
13. String length is multiple of 2
14. String length is multiple of 3
15. Number of 'a' is even
16. Number of 'a' and number of 'b' is even
17. String start with 'ab' **and** number of 'a' is even
18. $L = \{a^m b^n \text{ where } m, n \geq 1\}$
19. $L = \{a^m b^n \text{ where } m, n \geq 0\}$
20. $L = \{a^m b^n c^l \text{ where } m, n, l \geq 1\}$
21. $L = \{a^m b^n c^l \text{ where } m, n, l \geq 0\}$

Some languages over alphabet $\Sigma = \{0, 1\}$

1. $L = \{w : w \in \{0, 1\}^* \text{ is a binary number divisible by '2'}\}$
2. $L = \{w : w \in \{0, 1\}^* \text{ is a binary number divisible by '3'}\}$
3. $L = \{w : w \in \{0, 1\}^* \text{ is a binary number divisible by '4'}\}$

Non-Deterministic Finite Automata (alphabet $\Sigma = \{a, b\}$)

1. $L = \{a^m b^n \text{ where } m, n \geq 1\}$
2. String starts with 'a'
3. String starts and ends with different character
4. String ending with 'aab'
5. 3rd character is 'a' from right hand side

 ε - Non-Deterministic Finite Automata (alphabet $\Sigma = \{a, b\}$)

1. $L = \{a^m b^n \text{ where } m, n \geq 0\}$
2. $L = \{a^m b^n c^l \text{ where } m, n, l \geq 0\}$
3. $L = \{a^m (ab)^n (a+b)^l \text{ where } m, n, l \geq 0\}$

Difference between DFA, NFA and ε - NFA

DFA minimization

1. Partitioning method
2. Table filling

Minimize the DFA of

1. $L = \{w : w \text{ is even length string over } \Sigma = \{a, b\}\}$

Regular expression

Book: [Theory of Computation Anil Maheshwari](#)