

DFA VS NFA

1. DFA stands for Deterministic Finite Automata.
2. For each symbolic representation of the alphabet, there is only one state transition in DFA.
3. DFA cannot use Empty String transition.
4. DFA can be understood as one machine.

NFA

1. NFA stands for Nondeterministic Finite Automata
2. No need to specify how does the NFA react according to some symbol.
3. NFA can use Empty String transition.
4. NFA can be understood as multiple little machines computing at the same time.

In accessible state :

an inaccessible state, also known as an unreachable state, is a state that cannot be reached from the initial state of the automaton, regardless of the input string

Dead state :

Dead state is a state where the control can enter and confined till the input ends, but no way to come out from that state

Definition of DFA

A finite automata is defined by 5 tuple as

$$M = (Q, \Sigma, \delta, q_0, F)$$

Where Q is finit non- emty set of states

Finite non-empy set of input or alphabet

Is the transition mapping function.

q_0 is the initial or starting state

F is the set of finite or accepting State.

5. State and prove Arden's theorem.

Arden's theorem is particularly useful for converting FA into RE

Statement of Arden's theorem

Let p & Q be two RE , if p does not contain the f silent (null string) . Then the equation. $R = Q + RP$

Has a unique solution given by $R = QP^*$

When P^* represents the kleene start operation, indicating Zero or more concatenation of p.

Proof of arden's theorem:

To the prove arden,s theorem we start with the

equation: $R=Q+RP$

1. Substitute R in the equation recursively $R=Q+(q+RP)$

Expanding this gives : $R=Q+QP+RPP$

2. Continuing this substitution leads to

$$R=Q+QP+QP^2+QP^3+\dots$$

3. Recognising that the series can be expressed using

kleene star we can re write it. $R=Q(\epsilon+P+P^2+P^3+\dots)$

4. the expression in parenthesis is the equivalent to

P^* this yielding: $R=QP^*$

This shows that $R= QP^*$ in indeed a unique solution to the original equation under the condition that P does not contain

6. State and proof pumping lemma

Let L be a regular language. Then, there exists a constant p (called the pumping length) such that for any string s $\in L$ where $|s| \geq p$, the string s can be divided into three parts s = xyz, such that:

1. (Condition 1): $|xy| \leq p$ (the length of the first two parts is at most p).

2. (Condition 2): $|y| > 0$ (the length of y is at least 1, meaning y is not an empty string).

3. (Condition 3): For all $i \geq 0$, the string $xyz \in L$ (the string remains in the language even after "pumping" y, that is, repeating y any number of times, including 0).

7. Mealy Machine

output function z (t) depends on present state as will as presenct input also.

The value of output function z (t) Can be define as $z(t) = (X(t), x(t))$

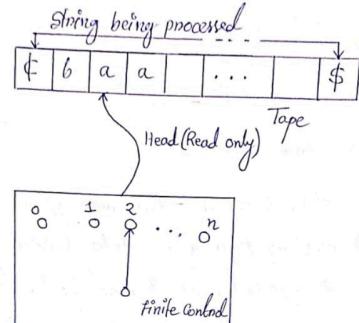
When (X) is called output function q(t) represent the present state X(r) represent the present input

8. Moore machine :

Output function Z(t) depends on the present state only and is independent of the current input . The value of the function Z(t) can be defined as $Z(t) = \lambda(q(t))$

9. Describe the block diagram of finite automaton

describe each the component:



1) Input Alphabet (Σ) - A finite set of symbols that can be input to the Automaton

2) States (Q) - A finite set of possible configuration or states the automaton can be in

3) start state (q_0)-the initial state of the automaton

4) transition function (δ) - a function that maps a state and an input symbol to a new state, representing the automaton behaviour.

5) accepting state (F) - A subset of of that indicates the automaton has reached a successful on final state

10. Recursive definition of regular expression:

A Regular Expression can be recursively defined as follows - ϵ is a Regular Expression indicates the language containing an empty string. $(L(\epsilon) = \{\epsilon\})$ φ is a Regular Expression denoting an empty language.

11. define clean closure with example:

Clean closure is the process of removing or remediating all hazardous waste from a regulated unit so that further regulatory control is not required

Example, : if $L = \{a, b\}$ then L^* includes string like a,b,aa,ab,ba,bbb,aaa and so on

12. Different positive closure with kleene,s closure:

Kleene,s closure (L^*)- allow for zero or more occurrences of a pattern

Positive closure (L^+)- allow for one or more occurrences of a pattern

Example, if $L = \{a\}$ then

- $L^*=\{a,aa,aaa,\dots\}$ Includes the empty string (ϵ)

- $L^+=\{a,aa,aaa,\dots\}$ Does not include ϵ

13. Different mealy and moore machine :

Mealy Machine

1.Output depends on present state as well as present input.

2.If input changes, output also changes.

3. Less number of states are required.

4.There is more hardware requirement for circuit implementation.

5. They react faster to inputs.

Moore Machine

1.Output depends only upon present state.

2.If input changes, output does change.

3.More number of states are required.

4.There is less hardware requirement for circuit implementation.

5.They react slower to inputs(One clock cycle later).

14. Short note Turing machine ?

A Turing machine is a computational model that performs computations by reading and writing to an infinite tape. Turing machines are used to solve problems in computer science and to test the limits of computation.

15. shirt note Epsilon nfa?

An epsilon nondeterministic finite automaton (ϵ -NFA) is a type of automaton that allows for instantaneous state transitions without reading an input symbol. This is called an ϵ -transition,

16. Define push down automata ?

Pushdown automata is a way to implement a CFG in the same way we design DFA for a regular grammar. A DFA can remember a finite amount of information, but a PDA can remember an infinite amount of information

17. MOORE MACHINE VS MEALY MACHINE

MOORE MACHINE

1- output depends only upon the present state

2- also please it's output in the state

3- More states are required

4- Moore machines requires more hardware requirements for circuit implementation

5- They react slower to inputs(one clock cycle later)

MEALY MACHINE

1- output depends on the present state as well as present input

2- places its output on the transition

3- Less number of States are required

4- Mealy machines requires less hardware requirements for circuit implementation

5- They react faster to inputs

18. What do you mean by null production ?

In automata, a unit production is a production in a Context-Free Grammar (CFG) where one non-terminal produces another non-terminal. Unit productions are of the form $A \rightarrow B$, where A and B are variables.

19. What is ambiguous grammar?

In automata theory, ambiguous grammar is a context-free grammar (CFG) that has a string that can be parsed in more than one way.

20. Rightmost Derivation?

The process of deriving a string by expanding the rightmost non-terminal at each step is called as rightmost derivation.

The geometrical representation of rightmost derivation is called as a rightmost derivation tree

21. Left most derivation ?

The process of deriving a string by expanding the leftmost non-terminal at each step is called as leftmost derivation.

The geometrical representation of leftmost derivation is called as a leftmost derivation tree.

22. Right linear grammar?

A right linear grammar (RLG) is a formal grammar where all production rules have at most one nonterminal in the right-hand side. The nonterminal can only appear as the rightmost symbol

23. Left linear grammar?

A left linear grammar is a type of linear grammar where all productions are in the form $A \rightarrow aw$, where a is either empty or a single nonterminal and w is a string of terminals.

24. Moam Chomsky classification?Noam Chomsky classified languages into four types based on their grammatical complexity:

1. Type 0: Recursively Enumerable Languages: These languages are recognized by Turing machines. They are the most general class of languages.

2. Type 1: Context-Sensitive Languages: These languages are recognized by linear bounded automata. They are more restricted than Type 0 languages.

3. Type 2: Context-Free Languages: These languages are recognized by pushdown automata. They are more restricted than Type 1 languages.

4. Type 3: Regular Languages: These languages are recognized by finite automata. They are the most restricted class of languages. This classification is also known as the Chomsky hierarchy.

25. State the Arden's Theorem. Prove it?

Arden's Theorem is a result in formal language theory and automata theory that provides a method for finding the solutions to certain types of linear equations over regular languages. It states that:

If P and Q are two regular expressions over Σ , and if P does not contain ϵ , then the following equation in R given by $R = Q + RP$ has a unique solution; $R = QP^*$

26. What is context free Grammer?

Context free grammar is a formal grammar which is used to generate all possible strings in a given formal language. Context free grammar G can be defined by four tuples as: $G = (V, T, P, S)$

27. What is automation?

Automation refers to the use of technology and machines to perform tasks without human intervention, often to improve efficiency, accuracy, and productivity in various processes

28. Mathematics definition of PDA ?

A Pushdown Automaton (PDA) is a 7-tuple $(Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$ where:

1. Q: A finite set of states

2. Σ : A finite set of input symbols (alphabet)

3. Γ : A finite set of stack symbols (including the empty symbol ϵ)

4. δ : A transition function that maps $(Q \times \Sigma \times \Gamma)$ to $(Q \times \Gamma^*)$

5. q_0 : The initial state ($q_0 \in Q$)

6. Z_0 : The initial stack symbol ($Z_0 \in \Gamma$)

7. F: A set of final states (FCQ)

29. Diagram of push down automata

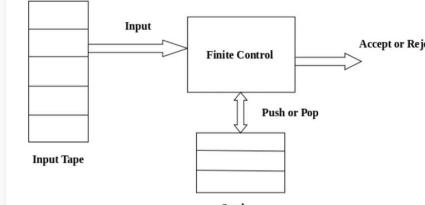


Fig: Pushdown Automata

30. Definition of regular expression?

An RE is a string made up of input alphabets (Σ) that defines a pattern for matching character combinations in strings

31. Null production?

In automata, a null production is a production of the form $X \rightarrow \lambda$, also known as an ϵ production. Null productions can only be removed from grammars that do not generate an empty string (ϵ)

32. What is cfg?

In automata, a context-free grammar (CFG) is a formal system that describes the structure of a language. CFGs are used to define context-free languages (CFLs) and are a central part of natural language processing and compilers.

33. Cnf Definition?

A CFG is in CNF if all of its production rules are of the form $A \rightarrow BC$, $A \rightarrow a$, or $S \rightarrow \epsilon$. In these rules, A, B, and C are nonterminal symbols, a is a terminal symbol, S is the start symbol, and ϵ denotes the empty string

34. Properties of regular expression?

- 1)Closure. If r_1 and r_2 are regular expressions(RE), then.
- 2)Closure Laws. $(r^*)^* = r^*$, closing an expression that is already closed does not change the language. ...
- 3)Associativity. If r_1, r_2, r_3 are RE, then. ...
- 4)Identity. ...
- 5)Annihilator. ...
- 6)Commutative Property. ...

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