# Exercise

1. Finite automata are used for pattern matching in text editors, for
   (a) compiler lexical analysis
   (b) programming in localized application
   (c) Both (a) and (b)
   (d) None of the above

2. A Deterministic Finite state Automaton (DFA) is a simple
   (a) function recognition device
   (b) language recognition device
   (c) routine recognition device
   (d) None of the above

3. Strings are fed into the device by means of an input tape, which is divided into squares, each one holding
   (a) one symbol          (b) one function
   (c) one data            (d) None of these

4. The automaton reads .............. one symbol ....................from the input tape and then enters a new state that depends only on the current state and the symbol just read.
   (a) at regular intervals      (b) at irregular intervals
   (c) Both (a) and (b)          (d) None of these

5. ......... means there is potentially more than one way a machine may process an input string.
   (a) Non-deterministic finite automata
   (b) Deterministic finite automata
   (c) Irregular finite automata
   (d) None of the above

6. ......... is a set of formation rules for strings in a formal language.
   (a) An informal grammar  (b) A formal grammar
   (c) Both (a) and (b)      (d) None of these

7. A grammar does not describe the ......... or what can be done with them in whatever context.
   (a) meaning of the strings
   (b) constructs of the strings
   (c) contents of the string
   (d) None of the above

8. A formal language theory is the discipline which studies
   (a) formal grammars and languages
   (b) unusual grammars and languages
   (c) Both (a) and (b)
   (d) None of the above

9. A formal grammar is a ......... for rewriting strings.
   (a) set of rules          (b) set of functions
   (c) Both (a) and (b)      (d) None of these

10. The classic formalization of generative grammars first proposed by
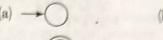
(a) Alexendar          (b) Bill Gates
(c) Noam Chomsky       (d) Charles Babbage

11. The operation of a grammar can be defined in terms of
    (a) relations of functions  (b) relations on strings
    (c) relations on behaviour  (d) None of these

12. Match List I with List II and select the correct answer using the codes given below in the lists.

| List I | | List II |
|---|---|---|
| P. AM | | 1. Frequency Modulation |
| Q. Java CUP | | 2. Amplitude Modulation |
| R. FM | | 3. Finite automaton |
| S. Simplest kind of automaton | | 4. Similar to YACC |

Codes

|     | P | Q | R | S |
|-----|---|---|---|---|
| (a) | 2 | 4 | 2 | 1 |
| (b) | 2 | 4 | 1 | 3 |
| (c) | 2 | 1 | 3 | 4 |
| (d) | 3 | 4 | 2 | 1 |

13. A ......... is a grammar in which the left hand side of each production rule consists of only a single non-terminal symbol.
    (a) deterministic grammar  (b) context grammar
    (c) context free grammar   (d) None of these

14. ......... or scanning is the process, where the stream of characters making up the source program is read from left to right and grouped into tokens.
    (a) Lexical analysis       (b) Diversion
    (c) Modeling               (d) None of these

15. ......... are sequences of characters with a collective meaning.
    (a) Flags                  (b) Tokens
    (c) Both (a) and (b)       (d) None of these

16. The lexical analyzer takes ......... as input and produces a stream of ......... as output.
    (a) source program , tokens
    (b) tokens, source program
    (c) Either (a) or (b)
    (d) None of the above

17. Loop and switch scanners are sometimes called
    (a) lexical scanners       (b) partial scanners
    (c) ad hoc scanners        (d) None of these

18. In Fortran I arrays are limited to
    (a) one-dimensions         (b) two-dimensions
    (c) three-dimensions       (d) None of these

42. There are two methods for implementing a scanner is a program that is hard coded to perform the scanning tasks and another uses regular expression and finite automata theory to model the scanning process.

43. Determinism may be seen as a kind of parallel computation wherein several processes can run concurrently.

44. The simplest kind of automaton is the finite automaton.

45. An infinite automaton has a finite memory that is fixed in advance.

46. Whether the input string is long or short, complex or simple, the finite automaton must reach its decision using the same fixed and finite memory.

47. The δ function gives 1 symbol moves.

48. For any DFA $M = (Q, \Sigma, \delta, q_0, F)$, $L(M)$ denotes the language accepted by $M$, which is $L(M) = \{x \in \Sigma^* \mid \delta^*(q_0, x) \in F\}$.

49. In Fortran I, variable declarations are required.

50. The scanner is tasked with determining that the input stream can be divided into valid symbols in the source language.

51. Sampling theory states if a signal is sampled at a rate twice the highest frequency then the samples contain all the information of the original signal

52. Some grammars allow more than one parse tree for the same token sequence. Such grammars are ambiguous.

53. Parse/derivation trees are not the structured derivations.

54. Java CUP is a parser generation tool, similar to YACC.

55. A Deterministic Finite state Automaton (DFA) is a simple language recognition device.

56. Deterministic means there is potentially more than one way a machine may process an input string.

57. A formal grammar is a set of formation rules for strings in a formal language.

58. Parsing is the process of recognizing an utterance (a string in natural languages) by breaking it down to a set of symbols and analyzing each one against the grammar of the language.

59. A program or function which performs lexical analysis is called a lexical analyzer.

60. The scanner cannot report about characters that are not valid tokens (*e.g.*, an illegal or unrecognized symbol).

61. Which one of the following is false for FA, $M = (\{q_0, q_1\}, \{a, b\}, \delta, q_0, \{q_1\})$?
    (a) $q_0 \in Q$
    (b) $q_0 \in F$
    (c) $abb \in \Sigma^*$
    (d) None of these
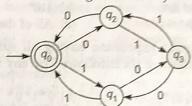
62. All notation in Mealy machine are equal to a Moore machine with only the difference of
    (a) output function
    (b) initial state
    (c) output alphabet
    (d) input alphabet

63. A final state as well as initial state in a transition diagram is denoted by

    (a) →◯
    (b) ◎
    (c) →◎
    (d) None of these

64. A transition system accepts a string $\omega \in \Sigma^*$ if
    (a) there exists a path which originates from some initial state
    (b) there exists a path which terminates at some final state
    (c) there exists a path which originates from some initial state, goes along the arrows and terminates at some final state
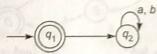    (d) None of the above

65. Consider the following transition system

    

    The string accepted by the transition system is
    (a) 1111110
    (b) 0000
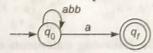    (c) 11000
    (d) 0010

66. The string accepted by following finite automata is

    

    (a) (a, aa, aaa ...)
    (b) (b, bb, bbb ...)
    (c) (a, b, ab, ba, aa, bb, ...)
    (d) φ

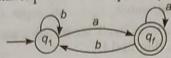67. Consider the transition diagram of a finite automaton given below.

    

    (a) All strings over {a, b}
    (b) All strings over {a, b} including ∧
    (c) Only ∧, meaning this automaton accepts $n_0$ string of length greater than zero
    (d) All strings over {a, b} excluding ∧

68. The FA given below accepts

    

    (a) all strings that contain the substring 'abb' and end with a
    (b) all strings that contain the substring 'abba' and end with a

(c) all strings over $\{a, b\}$

(d) Both (b) and (c)

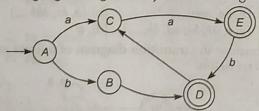**69.** The regular expression accepted by following FA is



(a) $(a + b)*b$      (b) $(a + b)*a$

(c) $a*b$      (d) $a*b*$

**70.** The set of all strings over $\{0, 1\}$ starting with $00$ and ending in $11$ is

(a) $0011$      (b) $00\,(0+1)*11$

(c) $(00)*(11)*$      (d) $0*1*$

**71.** The set of all strings over $\{0, 1\}$ in which occurrence of $b$'s is followed by $a$ or occurrence of $a$'s is followed by $b$ is
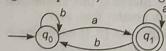
(a) $a*b*$      (b) $a*b + b*a$

(c) $a*b$      (d) $b*a$

**72.** The set of all strings over $\{0, 1\}$ which has exactly two $1$'s is

(a) $0*10*10*$      (b) $110*$

(c) $10*1$      (d) All of these

**73.** The regular expression having all strings in which any number of $0$'s is followed by any number of $2$'s is

(a) $(0|1|2)*$      (b) $0*1*2*$

(c) $0*+1+2$      (d) $(0+1)*2*$

**74.** The regular expression having all strings of $0$'s and $1$'s with two consecutve $0$'s is

(a) $(0|1)$      (b) $(0|1)*$

(c) $(0|\varepsilon)(1+10)*$      (d) $(0+1)*011$

**75.** The language recognized by the following FA



(a) $aabb* + bab*$      (b) $(aab\,(\varepsilon + bab)*)*$

(c) $(aab + ba) + (bab)*$      (d) $(aab)(bab)* + (bab)*$

**76.** The language accepted by following FA is



(a) $(a + b)*(a + b)$      (b) $(a + b)*a$

(c) $(a + b)*b$      (d) $a*b$

**77.** Which of the following statements is false?

(a) A regular language is also a context-free language

(b) A context-free language is also a regular language

(c) All context-free grammars are ambiguous

(d) Both (b) and (c)

**78.** A context-free grammar $G$ is said to be ambiguous if

(a) it has two or more left most derivations for terminal string $S \in L(G)$

(b) it has two or more right most derivations for terminal string $S \in L(G)$

(c) Neither (a) nor (b) is true

(d) Both (a) and (b) are true

**79.** If $L$ is a deterministic CFL and $R$ is a regular language, then

(a) $L \cap R$ is a deterministic CFL

(b) $L \cap R$ is a regular language

(c) Option (a) is true but (b) is not

(d) Option (b) is true but (a) is not

**80.** A context-free grammar $A \rightarrow BC \,|\, a$ is in

(a) Greibach normal form

(b) Chomsky normal form

(c) Both (a) and (b)

(d) Neither (a) nor (b)

**81.** The language generated by the grammar $S \rightarrow AB$, $A \rightarrow BC \,|\, a$, $B \rightarrow CC \,|\, b$, $C \rightarrow a$ is

(a) infinite      (b) empty

(c) Both (a) and (b)      (d) None of these

**82.** Which of the following statements is false?

(a) The intersection of two context-free languages may or may not be context-free

(b) The complement of a context-free language may or may not be context-free

(c) There is no such algorithm that could decide whether a CFL generates finite or infinite language

(d) None of the above

**83.** Which of the following is most powerful?

(a) DFA      (b) NDFA

(c) 2PDA      (d) DPDA

**84.** A 2-way Push-Down Automaton (2PDA) can

(a) be a PDA that is allowed to move in either direction (left or right) on its input

(b) accept a language $L = \{0^n1^n2^n \,|\, n \geq 1\}$

(c) not be equivalent to PDA

(d) All of the above

**85.** All strings having equal number of $a$'s and $b$'s can be recognized by

(a) DFA      (b) NDFA

(c) PDA      (d) All of these

**86.** If $M = \{Q, \Sigma, \delta, \Gamma, q_0, z_0, F\}$ is a PDA, then

(a) $\delta$ : mapping from $Q \times \Sigma \times \Gamma$ to finite subset of $Q \times \Gamma$

(b) $\delta$ : mapping from $Q \times \Sigma \times \Gamma*$ to finite subset of $Q \times \Gamma*$

(c) $\delta$ : mapping from $Q \times \Sigma \times \Gamma$ to finite subset of $Q \times \Gamma*$

(d) $\delta$ : mapping from $Q \times (\Sigma \cup \{\lambda\}) \times \Gamma$ to finite subset of $Q \times \Gamma*$

87. A PDA $M$ simulates left most derivation of a context-free grammar $G$, if
    (a) the grammar is ambiguous
    (b) the grammar is unambiguous
    (c) the grammar is in Chomsky normal form
    (d) the grammar is in Greibach normal form

88. Which of the following are true?
    (a) All NFA are DFA
    (b) All DFA are NFA
    (c) Both (a) and (b)
    (d) NFA and DFA have different power

89. The behaviour of a NFA can be simulated by DFA
    (a) always      (b) sometimes
    (c) never      (d) depend on NFA

90. A FA (Finite Automaton) with null string accepting capability is known as
    (a) NFA      (b) DFA
    (c) NFA with ε-moves      (d) All (a), (b) and (c)

91. A FA having more than one input tape has
    (a) more power than one tape FA
    (b) equal power as one tape FA
    (c) more storage than one tape FA
    (d) Both (b) and (c) are true

92. If an input string ω has $n$ symbols and can be recognized by a Mealy machine $M_1$ and equivalent Moore machine $M_2$ then number of output symbols by $M_1$ and $M_2$ are respectively
    (a) $n, n$      (b) $n + 1, n$
    (c) $n, n + 1$      (d) $n + 1, n + 1$

93. For input null, the output produced by a Mealy machine is
    (a) null
    (b) dependent on present state

94. Pumping lemma is used for proving
    (a) a given grammar is regular
    (b) a given language is regular
    (c) a given language is not regular
    (d) All of the above

95. The logic of pumping lemma is a good example of
    (a) the pigeon-hole principle
    (b) divide and conquer method
    (c) iteration
    (d) recursion

96. The regular re-expression $(a \mid b)(a \mid b)$ denotes the
    (a) $\{a, b, ab, aa\}$      (b) $\{a, b, ba, bb\}$
    (c) $\{a, b\}$      (d) $\{aa, ab, ba, bb\}$

97. Context-free language can be recognized by
    (a) finite state automaton
    (b) linear bounded automaton
    (c) push-down automaton
    (d) Both (b) and (c)

98. Context-free languages are not closed under
    (a) union      (b) concatenation
    (c) closure      (d) iteration

99. Which of the following pairs of regular expression are not equivalent?
    (a) $(a * + b*) *$ and $(a + b) *$
    (b) $(a * + b) *$ and $(a + b) *$
    (c) $(ab) * a$ and $a(ba) *$
    (d) None of the above

100. Let $R_1$ and $R_2$ be regular sets defined over the alphabet $\Sigma$, then
    (a) $R_1 \cap R_2$ is not regular
    (b) $R_1 \cup R_2$ is regular
    (c) $\Sigma * - R_1$ is regular
    (d) $R_1^*$ is regular

(c) depends on given machine
(d) Cannot decide

# Answers

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. (a) | 2. (b) | 3. (a) | 4. (a) | 5. (a) | 6. (b) | 7. (a) | 8. (a) | 9. (a) | 10. (c) |
| 11. (b) | 12. (b) | 13. (c) | 14. (a) | 15. (b) | 16. (a) | 17. (c) | 18. (c) | 19. (a) | 20. (a) |
| 21. (a) | 22. (b) | 23. (a) | 24. (b) | 25. (b) | 26. (a) | 27. (b) | 28. (a) | 29. (b) | 30. (c) |
| 31. (a) | 32. (c) | 33. (a) | 34. (a) | 35. (b) | 36. (a) | 37. (a) | 38. (a) | 39. (a) | 40. (b) |
| 41. (a) | 42. (a) | 43. (b) | 44. (a) | 45. (b) | 46. (a) | 47. (a) | 48. (a) | 49. (b) | 50. (a) |
| 51. (a) | 52. (a) | 53. (b) | 54. (a) | 55. (a) | 56. (b) | 57. (a) | 58. (a) | 59. (a) | 60. (b) |
| 61. (a) | 62. (b) | 63. (b) | 64. (b) | 65. (d) | 66. (c) | 67. (b) | 68. (d) | 69. (c) | 70. (c) |
| 71. (b) | 72. (c) | 73. (b) | 74. (c) | 75. (c) | 76. (b) | 77. (d) | 78. (d) | 79. (c) | 80. (b) |
| 81. (a) | 82. (c) | 83. (c) | 84. (d) | 85. (c) | 86. (d) | 87. (d) | 88. (b) | 89. (a) | 90. (c) |
| 91. (d) | 92. (c) | 93. (a) | 94. (c) | 95. (a) | 96. (d) | 97. (d) | 98. (d) | 99. (d) | 100. (b) |

# Exercise

1. In theoretical computer science, the theory of computation is the branch that deals with
   (a) whether and how efficiently problems can be solved on a model of computation, using an algorithm
   (b) whether and how efficiently the given data can be analyzed on a model of computation, without using an algorithm
   (c) Both (a) and (b)
   (d) None of the above

2. The field is divided into three major branches; automata theory, computability theory and
   (a) robotics complexity theory
   (b) computational simplification theory
   (c) computational complexity theory
   (d) None of the above

3. Some examples of models of computation include .........., recursive functions, lambda calculus and production systems.
   (a) Turing machines
   (b) turning machines
   (c) trumbling machines
   (d) tracking machines

4. A formal language is often defined by means of
   (a) a formal grammar
   (b) an algorithm
   (c) an analysis
   (d) a syntactical rule

5. A formal language $L$ over an alphabet $\Sigma$ is a subset of $\Sigma^*$ i.e.,
   (a) a set of words over that alphabet
   (b) a set of alphabets over word
   (c) Both (a) and (b)
   (d) None of the above

6. Which of the following sorting algorithms has average-case and worst-case running time of $O(n \log n)$?
   (a) Bubble sort
   (b) Insertion sort
   (c) Merge sort
   (d) Quick sort

7. Let $P$ be a quick sort programme to sort numbers in ascending order. Let $t_1$ and $t_2$ be the time taken by the program for the inputs [1 2 3 4 5] and [5 4 3 2 1] respectively. Which of the following holds?
   (a) $t_1 = t_2$
   (b) $t_1 > t_2$
   (c) $t_1 < t_2$
   (d) $t_1 = t_2 + 5 \log 5$

8. A utility programme that takes a procedure and searches a library to locate copies of any procedures called but not defined in the first procedure, is called
   (a) linker
   (b) relocator
   (c) loader
   (d) text editor

9. If $c > 0$ and $f(x) = ex - cx$ for all real numbers $x$, then the minimum value of $f$ is
   (a) $f(c)$
   (b) $f(ec)$
   (c) $f(1/c)$
   (d) $f(\log a)$

10. If the finite group $G$ contains a subgroup of order seven but no element (other than the identity) is its own inverse, the order of $G$ could be
    (a) 26
    (b) 28
    (c) 35
    (d) 42

11. In a game, two players take turns tossing a fair coin; the winner is the first one to toss a head. The probability that the player who makes the first toss wins the game is
    (a) 1/4
    (b) 1/3
    (c) 1/2
    (d) 2/3

12. Events $A$ and $B$ are mutually exclusive and have non-zero probabilities. Which of the following statement(s) are true?
    (a) $P(A \cup B) = P(A) + P(B)$
    (b) $P(BC) \geq \left( \dfrac{P}{A} \right)$
    (c) $P(A \cap B) = P(A) \cdot P(B)$
    (d) $P(B) C < P(A)$

13. A square matrix is singular whenever
    (a) the rows are linearly independent
    (b) the columns are linearly independent
    (c) the rows are linearly independent
    (d) None of the above

14. The simplex method is so named because
    (a) it is simple
    (b) it is based on the theory of algebraic complexes
    (c) the simple pendulum works on this method
    (d) None of the above

15. Which of the following statements is true in respect of the convergence of the Newton-Raphson procedure?
    (a) It converges always under all circumstances
    (b) It does not converge to a root, where the second differential coefficient changes sign
    (c) It does not converge to a root, where the second differential coefficient vanishes
    (d) None of the above

16. If $f(x_i) f(x_{i+1}) < 0$, then
    (a) there must be a root of $f(x)$ between $x_i$ and $x_{i+1}$
    (b) there need not be a root if $f(x)$ between $x_i$ and $x_{i+1}$
    (c) the fourth derivative of $f(x)$ with respect to $x$ vanishes at $x_i$
    (d) the fourth derivative of $f(x)$ with respect to $x$ vanishes at $x_{i+1}$

17. A fair die is tossed 360 times. The probability that a six comes up on 70 or more of the tosses is
    (a) greater than 0.50
    (b) between 0.16 and 0.50
    (c) between 0.02 and 0.16
    (d) between 0.01 and 0.02

18. $\lim_{n \to \infty} \sum_{n=1}^{n} \dfrac{1}{n!}$ is

   (a) zero                (b) $e - 2$
   (c) $e$                  (d) $e - 1$

19. The number of 1's in the binary representation of $13 * 16^3 + 11 * 16^2 + 9 * 16 + 3$ in which of the following?

   (a) 7                  (b) 8
   (c) 9                  (d) 10

20. In computability theory and computational complexity theory, a model of computation is

   (a) the definition of the set of allowable operations used in computation and their respective costs
   (b) the definition of the set of allowable operations used in analysis
   (c) respective costs only
   (d) None of the above

21. ......... a string rewriting system that uses grammar-like rules to operate on strings of symbols.

   (a) Mu-recursive functions  (b) Register machine
   (c) Markov algorithm    (d) None of these

22. Let $A$ be an $n \times n$ matrix and let $P$ be an $n \times n$ permutation matrix which of the following must be true?

   (a) $A = P^{-1}AP$
   (b) $PA = (PP^{-1}AP)$
   (c) $PAP^{-1} = P(P^{-1}AP)P^{-1}$
   (d) $\det(A) = \det(P^{-1}AP)$

23. Consider the representation of six-bit numbers by two's complement, one's complement or by sign and magnitude. In which representation is there overflow from the addition of the integers 011000 and 01100?

   (a) Two's complement only
   (b) Sign and magnitude and one's complement
   (c) Two's complement and sign and magnitude
   (d) All of the above

24. In computer science, formal languages are often used

   (a) as the basis for defining network layout and other systems
   (b) as the basis for defining programming languages and other systems in which the words of the language are associated with particular meanings or semantics
   (c) as the basis for defining the data to be used with a program
   (d) None of the above

25. As $n \to \infty$, the function $2^{\sqrt{n}}$ grows faster than

   (a) $\log n$ but slower than $\sqrt{n}$
   (b) $\sqrt{n}$ but slower than $n$
   (c) $n$ but slower than $n^2$
   (d) $n^2$ but slower than $\sqrt{2n}$

26. Which of the following assertions has the property that if the assertion is true before executing the program fragment

$$Z := Z * a;$$
$$y := y - 1$$

then it will also be true afterward?

   (a) $a * Y = Z$         (b) $Z = ay$
   (c) $ab = Z * ay$      (d) None of these

27. Which of the following regular expressions is equivalent to (describe the same set of strings as) $(a * + b*)(c + d)$?

   (a) $a * (c + d) + b(c + d)$
   (b) $(a + b) * c + (a + b) * c$
   (c) $(a * + b)c + (a * + b)d$
   (d) None of the above

28. A formal language $L$ over an alphabet $\Sigma$

   (a) is a subset of $\Sigma^*$ i.e., a set of words over that alphabet
   (b) is a superset of $\Sigma^*$ i.e., a set of alphabet over the words
   (c) is a different set from $\Sigma^*$ i.e., distinct set of words and alphabet
   (d) None of the above

29. Let $b_q, b_{q-1}, \ldots, b_0$, per the binary representation of integer $b$. The integer 3 is a divisor of $b$ if and only if

   (a) $b_1 = b_0 = 1$
   (b) the sum of the binary digits is divisible by 9
   (c) the alternating sum $b_0 - b_i + b_x - \ldots$ is zero
   (d) the alternating sum $b_0 - b_i + b_x - \ldots$ is divisible by 3

30. All functions $f$ defined on the $XY$- plane such that $\dfrac{\partial f}{\partial y} = 2xy + y$ and $\dfrac{\partial f}{\partial y} = x + 2y$ are given by $f(x, y) = 0$

   (a) $x^2 + xy + y^2 + c$     (b) $x^2 - xy + y^2 + c$
   (c) $x^2 - xy - y^2 + c$     (d) $x^2 - 2xy + y^2 + c$

31. A generalized form of the diagonal argument was used by Cantor to prove Cantor's theorem i.e.,

   (a) for every set $S$ the power set of $S$ i.e., the set of all supersets of $S$ (here written as $P(S)$), is larger than $S$ itself
   (b) for every set $S$ the power set of $S$ i.e., the set of all subsets of $S$ (here written as $P(S)$), is larger than $S$ itself
   (c) Both (a) and (b)
   (d) None of the above

32. ......... are widely used in mathematics to prove the existence or non-existence of certain objects.

   (a) Analogues of the diagonal argument
   (b) Digital of the diagonal argument
   (c) Binary of the diagonal argument
   (d) None of the above

33. $k$ digits are to be chosen at random (with repetitions allowed) from $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$. What is the probability that 0 will not be chosen?
   (a) $1/k$
   (b) $1/10$
   (c) $(k-1)/k$
   (d) $(9/10)k$

34. Which of the following is true of the behavior of
   $$f(x) = (x^3 + 8)/(x^2 - 4) \text{ as } x \text{--} > 2 ?$$
   (a) The limit is 0
   (b) The limit is 1
   (c) The limit is 4
   (d) The graph of the function has a vertical asymptote at 2

35. In the automata theory, a branch of theoretical computer science, a Deterministic Finite Automaton (DFA)
   (a) is a finite state machine that accepts/rejects finite strings of symbols and only produces a unique computation (or run) of the automaton for each input string
   (b) is a infinite state machine that accepts/rejects finite strings of symbols and only produces a unique computation (or run) of the automaton for each input string
   (c) is a finite state machine that accepts/rejects finite strings of symbols and only produces all possible computations (or run) of the automaton for selected input string
   (d) None of the above

36. If $f$ is a linear transformation from the plane to the real numbers and if $f(I, 1) = 1$ and $f(-I, 0)$, then $f(3, 5)$
   (a) $-6$
   (b) $-5$
   (c) zero
   (d) 9

37. Deterministic refers to
   (a) the uniqueness of the computation
   (b) the duplicity of the computation
   (c) the layout of the computation
   (d) None of the above

38. 100 is to be divided into two parts such that their product is maximum. The parts will be
   (a) (40, 60)
   (b) (50, 50)
   (c) (47, 53)
   (d) (48.3, 51.7)

39. The series $\Sigma 1/(\log n)^{1/n}$ is
   (a) divergent to infinity
   (b) convergent
   (c) conditionally convergent
   (d) divergent to $-\infty$

40. Recursively enumerable languages are known as
   (a) type 2 languages in the Chomsky hierarchy of formal languages
   (b) type 1 languages in the Chomsky hierarchy of formal languages
   (c) type 0 languages in the Chomsky hierarchy of formal languages
   (d) None of the above

41. A recursively enumerable language is a
   (a) ocassionaly enumerable subset in the set of all possible words over the alphabet of the language
   (b) infinitely enumerable subset in the set of all possible words over the alphabet of the language
   (c) recursively enumerable subset in the set of all possible words over the alphabet of the language
   (d) None of the above

42. All regular, context-free, context-sensitive and recursive languages are
   (a) occasionally enumerable
   (b) non-recursively enumerable
   (c) recursively enumerable
   (d) None of the above

43. Context-sensitive languages (context-sensitive grammars) are known as
   (a) type 1
   (b) type 2
   (c) type 3
   (d) type 0

44. Context-free languages (context-free grammars) is known as
   (a) type 1
   (b) type 2
   (c) type 3
   (d) type 0

45. Regular languages (right-linear and left-linear grammars) is known as
   (a) type 1
   (b) type 2
   (c) type 3
   (d) type 0

46. A DFA is defined as an abstract mathematical concept but due to the deterministic nature of a DFA
   (a) it is implementable only in software for solving various specific problems
   (b) it is implementable only in hardware for solving various specific problems
   (c) it is implementable in hardware and software for solving various specific problems
   (d) None of the above

47. The following grammar is
   $$G = (N, T, P, S)$$
   $$N = \{S, A, B\}$$
   $$T = \{a, b, c\}$$
   $$P: S \to aSa$$
   $$S \to aAa$$
   $$A \to bB$$
   $$B \to bB$$
   $$B \to c$$
   (a) type 3
   (b) type 2 but not type 3
   (c) type 1 but not type 2
   (d) type 0 but not type 1

48. The following grammar is
   $$G = (N, T, P, S)$$
   $$N = \{S, A, B, C, D, E\}$$
   $$T = \{a, b, c\}$$
   $$P: S \to aAB$$

$$AB \rightarrow CD$$
$$CD \rightarrow CE$$
$$C \rightarrow aC$$
$$C \rightarrow b$$
$$bE \rightarrow bc$$

(a) type 3
(b) type 2 but not type 3
(c) type 1 but not type 2
(d) type 0 but not type 1

49. The following grammar is

$$G = (N, T, P, S)$$
$$N = \{S, A, B, C\}$$
$$T = \{a, b, c\}$$
$$P : S \rightarrow aS$$
$$A \rightarrow bB$$
$$B \rightarrow cC$$
$$C \rightarrow a$$

(a) type 3
(b) type 2 but not type 3
(c) type 1 but not type 2
(d) type 0 but not type 1

50. The following grammar is

$$G = (N, T, P, S)$$
$$N = \{S, A, B, C, D, E\}$$
$$T = \{a, b, c\}$$
$$P : S \rightarrow ABCD$$
$$BCD \rightarrow DE$$
$$D \rightarrow aD$$
$$D \rightarrow a$$
$$E \rightarrow bE$$
$$E \rightarrow c$$

(a) type 3
(b) type 2 but not type 3
(c) type 1 but not type 2
(d) type 0 but not type 1

51. Consider the following CFG :

$$S \rightarrow aB \quad S \rightarrow bA$$
$$B \rightarrow b \quad A \rightarrow a$$
$$B \rightarrow bS \quad A \rightarrow aS$$
$$B \rightarrow aBB \quad A \rightarrow bAA$$

Consider the following derivation :

$$S \Rightarrow aB$$
$$\Rightarrow aaBB$$
$$\Rightarrow aaBb$$
$$\Rightarrow aabSb$$
$$\Rightarrow aabbAb$$
$$\Rightarrow aabbab$$

This derivation is

(a) a leftmost derivation
(b) a rightmost derivation
(c) both leftmost and rightmost derivation
(d) neither leftmost nor rightmost derivation

52. Consider the following language :

$$L = \{a^n b^n c^n \mid n \geq 1\}$$

$L$ is

(a) CFL but not regular
(b) CSL but not CFL
(c) regular
(d) type 0 language but not type 1

53. Consider the following language :

$$L = \{a^n b^n \mid n \geq 1\}$$

$L$ is

(a) CFL but not regular
(b) CSL but not CFL
(c) regular
(d) type 0 language but not type 1

54. Consider the following language :

$$L = \{a^n b^m c^p d^q \mid n, m, p, q \geq 1\}$$

$L$ is

(a) CFL but not regular
(b) CSL but not CFL
(c) regular
(d) type 0 language but not type 1

55. The following CFG is in

$$S \rightarrow AB$$
$$B \rightarrow CD$$
$$B \rightarrow AD$$
$$B \rightarrow b$$
$$D \rightarrow AD$$
$$D \rightarrow d$$
$$A \rightarrow a$$
$$C \rightarrow a$$

(a) Chomsky normal form but not strong Chomsky normal form
(b) Weak Chomsky normal form but not Chomsky normal form
(c) Strong Chomsky normal form
(d) Greibach normal form

56. The following CFG is in

$$S \rightarrow aBB$$
$$B \rightarrow bAA$$
$$A \rightarrow a$$
$$B \rightarrow b$$

(a) Chomsky normal form but not strong Chomsky normal form
(b) Weak Chomsky normal form but not Chomsky normal form
(c) Strong Chomsky normal form
(d) Greibach normal form

57. Which of the following CF language is inherently ambiguous?
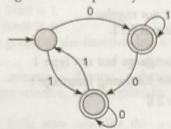(a) $\{a^n b^n c^m d^m \mid n, m \geq 1\}$
(b) $\{a^n b^m c^p d^q \mid n = p \text{ or } m = q, n, m, p, q \geq 1\}$
(c) $\{a^n b^m c^p d^q \mid n \neq m \land p \neq q\}$
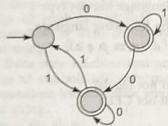(d) $\{a^n b^m c^p d^q \mid n \neq m \lor p \neq q\}$

58. Which string is not accepted by the following FSA?



(a) 00111     (b) 01010     (c) 00110     (d) 11010

59. Which string is accepted by the following FSA?



(a) 00111     (b) 11011     (c) 01101     (d) 0101

60. Can a DFSA simulate a NFSA?
(a) No                        (b) Yes
(c) Sometimes             (d) Depends on NFA

61. Which of the following is true for an arbitrary language $L$?
(a) $L^* = L + \cup \{\lambda\}$
(b) $L^* = L+$
(c) $L^* = L + - \{\lambda\}$
(d) None of these

62. The concept of FSA is much used in this part of the compiler
(a) lexical analysis       (b) parser
(c) code generation     (d) code optimization

63. The concept of grammar is much used in this part of the compiler
(a) lexical analysis       (b) parser
(c) code generation     (d) code optimization

64. $(a + b)(cd)^*(a + b)$ denotes the following set :
(a) $\{a(cd)nb \mid n \geq 1\}$
(b) $\{a(cd)na \mid n \geq 1\} \cup \{b(cd)nb / n \geq 1\}$
(c) $\{a(cd)na \mid n \geq 0\} \cup \{a(cd)nb / n \geq 0\} \cup \{b(cd)na / n \geq 0\} \cup \{b(cd)nb / n \geq 0\}$
(d) $\{acndnb \mid n \geq 1\}$

65. $baa^*c$ denotes the set
(a) $\{bnamcp \mid n, m, p \geq 1\}$
(b) $\{banc \mid n \geq 0\}$
(c) $\{banc \mid n \geq 1\}$
(d) $\{w \mid w \text{ is a string of } a, b, c\}$

66. The set of all strings over the alphabet $\Sigma = \{a, b\}$ (including $\varepsilon$) is denoted by
(a) $(a + b)^*$             (b) $(a + b)^+$
(c) $a^* b^*$               (d) $a^* b^*$

67. Palindromes can't be recognized by any FSA because
(a) FSA cannot remember arbitrarily large amount of information
(b) FSA cannot deterministically fix the mid-point
(c) even if the mid-point is known an FSA cannot find whether the second half of the string matches the first half
(d) All of the above

68. Let $\Sigma = \{a, b, c, d, e\}$, the number of strings in $\Sigma^*$ of length 4 such that no symbol is used more than once in a string is
(a) 360                     (b) 120
(c) 35                      (d) 36

69. Which of the following denotes Chomsky hierarchy?
(a) $REG \subset CFL \subset CSL \subset type0$
(b) $CFL \subset REG \subset type0 \subset CSL$
(c) $CSL \subset type0 \subset REG \subset CFL$
(d) $CSL \subset CFL \subset REG \subset type0$

70. A language $L$ is accepted by a FSA iff it is
(a) CFL                     (b) CSL
(c) recursive              (d) regular

71. Which of the following regular expressions denotes a language comprising of all possible strings over $\Sigma = \{a, b\}$ of length $n$, where $n$ is a multiple of 3.
(a) $(a + b + aa + bb + aba + bba)^*$
(b) $(aaa + bbb)^*$
(c) $((a + b)(a + b)(a + b))^*$
(d) $(aaa + ab + a) + (bbb + bb + a)$

72. A language is represented by a regular expression $(a)^* (a + ba)$. Which of the following string does not belong to the regular set represented by the above expression?
(a) $aaa$                   (b) $aba$
(c) $ababa$                 (d) $aa$

73. Which of the following is not primitive recursive but partially recursive?
(a) McCarthy's function    (b) Riemann function
(c) Ackermann's function   (d) Bounded function

74. Consider the following right-linear grammar $G = (N, T, P, S) N = \{S\}$

| $P : S \to aS \mid aA$ | $T = \{a, b\}$ |
|---|---|
| $A \to bA \mid b$ | |

Which of the following regular expression denotes $L(G)$?
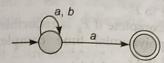(a) $(a + b)^*$
(b) $a(ab)^* b$

(c) $aa*bb*$      (d) $a*b*$

**75.** Which of the following strings is not generated by the following grammar? $S \to SaSbS \mid \varepsilon$
(a) aabb      (b) abab
(c) aababb      (d) aaabb

**76.** Consider the following NFSA :



The automaton accepts
(a) all words of the form $\{(ab)na \mid n \geq 1\}$
(b) all words that end with $a$ and $\varepsilon$
(c) all words that end with $a$ and not $\varepsilon$
(d) all words containing substring $ba$

**77.** Consider a language $L$ for which there exists a Turing Machine (TM) $T$ that accepts every word in $L$ and either rejects or loops for every word that is not in $L$. The language $L$ is
(a) NP hard      (b) NP-complete
(c) recursive      (d) recursively enumerable

**78.** Consider the following statements :
I. Recursive languages are closed under complementation.
II. Recursively enumerable languages are closed under union.
III. Recursively enumerable languages are closed under complementation.
Which of the above statement are true?
(a) Only I      (b) I and II
(c) I and III      (d) II and III

**79.** Which of the following statement is wrong?
(a) Any regular language can be generated by a context-free grammar
(b) Some non-regular languages cannot be generated by any CFG
(c) The intersection of a CFL and regular set is a CFL
(d) All non-regular languages can be generated by CFGs

**80.** Recursively enumerable languages are not closed under
(a) union      (b) homomorphism
(c) complementation      (d) concatenation

**81.** Which of the following problem is undecidable?
(a) Membership problem for CFL
(b) Membership problem for regular sets
(c) Membership problem for CSL
(d) Membership problem for type 0 languages

**82.** Recursive languages are
(a) a proper superset of CFL
(b) always recognized by PDA
(c) are also called type 0 languages
(d) always recognized by FSA

**83.** $R_1$ and $R_2$ are regular sets. Which of the following is not true?
(a) $R_1 \cap R_2$ neet not be regular
(b) $\Sigma^* - R_1$ is regular
(c) $R_1 \cup R_2$ is regular
(d) is regular

**84.** Which of the following regular expression identity is true?
(a) $r(*) = r*$      (b) $(r*s*)* = (r+s)*$
(c) $(r+s)* = r*+s*$      (d) $r*s* = r*+s*$

**85.** Which one of the following statement is false?
(a) Context-free languages are closed under union
(b) Context-free languages are closed under concatenation
(c) Context-free languages are closed under intersection
(d) Context-free languages are closed under Kleene closure

**86.** Which of the following conversion is not possible (algorithmically)?
(a) Regular grammar to context-free grammar
(b) Non-deterministic FSA to deterministic FSA
(c) Non-deterministic PDA to deterministic PDA
(d) Non-deterministic TM to deterministic TM

**87.** Match List I with List II and select the correct answer using the codes given below the lists.

| List I | List II |
| --- | --- |
| P. One of the earliest expert system | 1. for each state and alphabet, the transition relation has exactly one state. |
| Q. In deterministic finite automaton | 2. MYCIN |
| R. The union of two regular languages | 3. is a regular (type 3) language. |
| S. Every regular set | 4. is regular. |

**Codes**

| | P | Q | R | S |
| --- | --- | --- | --- | --- |
| (a) | 2 | 4 | 2 | 1 |
| (b) | 2 | 1 | 4 | 3 |
| (c) | 2 | 1 | 3 | 4 |
| (d) | 3 | 4 | 2 | 1 |

**88.** A deterministic context-free language is a language recognized by
(a) some deterministic pushdown automaton
(b) some non-deterministic pushdown automaton
(c) Both (a) and (b)
(d) None of the above

**89.** Every ......... can be transformed into an equivalent pushdown automaton.
(a) context-free grammar      (b) automaton theory
(c) Both (a) and (b)      (d) None of these

90. In automata theory, a Pushdown Automaton (PDA) is a variation of
    (a) finite automaton that can make use of a stack containing data
    (b) infinite automaton that can make use of a stack containing data
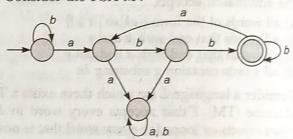    (c) Both (a) and (b)
    (d) None of the above

91. The worst case of Hopcroft's algorithm running time of this algorithm is
    (a) $n(Os \log n)$, where $n$ is the number of states and $s$ is the size of the alphabet
    (b) $O(ns \log n)$, where $n$ is the number of states and $s$ is the size of the alphabet
    (c) $n(Sn \log n)$, where $n$ is the number of states and $s$ is the size of the alphabet
    (d) None of the above

92. Unreachable states can be removed from the DFA
    (a) without affecting the language that it accepts
    (b) affecting the language that it accepts
    (c) rarely without affecting the language that it accepts
    (d) None of the above

93. DFA minimization is usually done in ......... steps, corresponding to the removal/merger of the relevant states.
    (a) one　　　　　　(b) two
    (c) three　　　　　(d) four

94. ......... are those states that are not reachable from the initial state of the DFA, for any input string.
    (a) Reachable states　　(b) Unreachable states
    (c) Both (a) and (b)　　(d) None of these

95. DFAs recognize exactly the set of regular languages which are among other things, useful
    (a) for doing lexical analysis and pattern matching
    (b) for determining the data pattern
    (c) for determining the output layout
    (d) None of the above

96. A deterministic finite automaton without accept states and without a starting state
    (a) is known as a lexical analysis system or automaton
    (b) is known as a transition system or semi-automaton
    (c) Both (a) and (b)
    (d) None of the above

97. DFAs were invented
    (a) to model real world finite state machines
    (b) to model the logical states of a machine
    (c) Both (a) and (b)
    (d) None of the above

98. Consider three decision problems $P_1, P_2$ and $P_3$. It is known that $P_1$ is decidable and $P_2$ is undecidable. Which one of the following is true?
    (a) $P_3$ is decidable if $P_1$ is reducible to $P_3$
    (b) $P_3$ is undecidable if $P_3$ is reducible to $P_2$
    (c) $P_3$ is undecidable if $P_2$ is reducible to $P_3$
    (d) $P_3$ is decidable if $P_3$ is reducible to $P_2$'s complement

99. Consider three problems $P_1, P_2$ and $P_3$. It is known that $P_1$ has polynomial time solution and $P_2$ is NP-complete and $P_3$ is in NP. Which one of the following is true?
    (a) $P_3$ has polynomial time solution if $P_1$ is polynomial time reducible to $P_3$
    (b) $P_3$ is NP-complete if $P_3$ is polynomial time reducible to $P_2$
    (c) $P_3$ is NP-complete if $P_2$ is reducible to $P_3$
    (d) $P_3$ has polynomial time complexity and $P_3$ is reducible to $P_2$

100. Consider the FSA $M$:



The language recognized by $M$ is
    (a) $\{w \in \{a, b\}^* \mid$ every $a$ in $w$ is followed by exactly two $b$'s$\}$
    (b) $\{w \in \{a, b\}^* \mid$ every $a$ in $w$ is followed by atleast two $b$'s$\}$
    (c) $\{w \in \{a, b\}^* \mid w$ contains the substring $abb\}$
    (d) $\{w \in \{a, b\}^* \mid w$ does not contain $aa$ as substring$\}$

101. Let $N_f$ and $Np$-denote the classes of languages accepted by non-deterministic FSA and non-deterministic PDA respectively. Let $D_f$ and $D_p$ denote the classes of languages accepted by deterministic FSA and PDA respectively. Which of the following is true?
    (a) $D_f \subset N_f$　　　　$D_p \subset N_p$
    (b) $D_f \subset N_f$　　　　$D_p = N_p$
    (c) $D_f = N_f$　　　　　$D_p \subset N_p$
    (d) $D_f = N_f$　　　　　$D_p = N_p$

102. Consider the languages :
    $L_1 = \{a^n b^n c^m \mid n, m > 0\}$ and $L_2 = \{a^n b^m c^m \mid n, m > 0\}$
    Which one of the following statements is false?
    (a) $L_1 \cap L_2$ is a CFL
    (b) $L_1 \cup L_2$ is a CFL
    (c) $L_1 \cup L_2$ is inherently ambiguous
    (d) $L_1 \cap L_2$ is a CSL

103. Consider the languages :
    $L_1 = \{a^n b^m c^n d^p \mid m, p > 0\}$ and $L_2 = \{a^n b^m c^p d^m \mid m, p > 0\}$
    Which one of the following statements is false?
    (a) $L_1 \cap L_2$ is a CFL
    (b) $L_1 \cup L_2$ is a CFL
    (c) $L_1 \cup L_2$ is inherently ambiguous
    (d) $L_1 \cap L_2$ is a CSL

104. Consider the languages :

$L_1 = \{a^n b^m c^m d^n | n, m \geq 0\}$ and $L_2 = \{a^n b^n c^m d^m | n, m > 0\}$

Which one of the following statements is false?

(a) $L_1 \cup L_2$ is a CFL
(b) $L_1 \cap L_2$ is a CFL
(c) $L_1$ and $L_2$ are CFL
(d) $L_1 \cap L_2$ is a CSL

105. Let $L$ and $\bar{L}$ be a language and its complement. Which one of the following possibilities will not hold?

(a) $L$ and $\bar{L}$ are recursive
(b) $L$ is recursively enumerable but $\bar{L}$ not recursively enumerable
(c) $L$ and $\bar{L}$ are not recursively enumerable
(d) $L$ and $\bar{L}$ are recursively enumerable but not recursive

106. Let $L_1$ be a recursive language and $L_2$ be a recursively enumerable language which is not recursive. Which one of the following is true?

(a) $L_1$ is recursive and $L_2$ is recursively enumerable
(b) $L_1$ is recursive and $L_2$ is not recursively enumerable
(c) $L_1$ and $L_2$ are recursively enumerable
(d) $L_1$ is recursively enumerable and $L_2$ is recursive

107. Consider the languages :

$$L_1 = \{ww^R | w \in \{0, 1\}^*\}$$
$$L_2 = \{wcw^R | w \in \{0, 1\}^*\}$$
$$L_3 = \{ww | w \in \{0, 1\}^*\}$$

Which one of the following is true?

(a) $L_1$ is deterministic CFL
(b) $L_2$ is deterministic CFL
(c) $L_3$ is a CFL but not a deterministic CFL
(d) $L_3$ is deterministic CFL

108. Let $S$ be a NP-complete problem and $Q$ and $R$ be two other problems not known to be in NP. $Q$ is polynomial time reducible to $S$ and $S$ is polynomial time reducible to $R$. Which one of the following statements is true?

(a) $R$ is NP-complete
(b) $R$ is NP hard
(c) $Q$ is NP-complete
(d) $Q$ is NP hard

109. $L_1 = \{a^{n+m} b^n c^m | n, m \geq 0\}$
$L_2 = \{a^{n+m} b^{n+m} c^m | n, m \geq 0\}$
$L_3 = \{a^{n+m} b^{n+m} c^{m+n} | n, m \geq 0\}$

Which of these languages are not CF?

(a) Only $L_1$
(b) Only $L_3$
(c) $L_1$ and $L_2$
(d) $L_2$ and $L_3$

110. If $s$ is a string over $(0 + 1)^*$, then let $m_0(s)$ denote the number of 1's in number of 0's in $s$ and $n_1(s)$ the number of $s$. Which one of the following languages is not regular?

(a) $L = \{s \in (0 + 1)^* | n_0(s)$ is a 3-digit prime\}
(b) $L = \{s \in (0 + 1)^* |$ for every prefix $s'$ of $s, |n_0(s') - n_1(s')| \leq 2\}$

(c) $L = \{s \in (0 + 1)^* | sn_0(s) - n_1(s)| \leq 4\}$
(d) $L = \{s \in (0 + 1)^* | n_0(s) \bmod 7 = n_1(s) \bmod 5 = 0\}$

111. For $s \in (0 + 1)^*$ let $d(s)$ denote the decimal value of $s (e.g., D(|0|) = 5)$.
Let $L = \{s \in (0 + 1)^* | d(s) \bmod 5 = 2$ and $d(s) \bmod 7 \neq 4\}$
Which one of the following statements is true?

(a) $L$ is recursively enumerable but not recursive
(b) $L$ is recursive but not context-free
(c) $L$ is context-free but not regular
(d) $L$ is regular

112. Let FHAM be the problem of finding a Hamiltonian cycle in a graph $G$ and DHAM be the problem of determining if a Hamiltonial cycle exists in a graph. Which one of the following is true?

(a) Both FHAM and DHAM are NP-hard
(b) FHAM is NP hard but DHAM is not
(c) DHAM is NP hard but FHAM is not
(d) Neither FHAM nor DHAM is NP-hard

113. Consider the following statements about the context-free grammar $G = \{S \rightarrow SS, S \rightarrow ab, S \rightarrow ba, S \rightarrow c\}$

I. $G$ is ambiguous.
II. $G$ produces all strings with equal number of $a$'s and $b$'s.
III. $G$ can be accepted by a deterministic PDA.

Which combination below expresses all the true statements about $G$?

(a) Only I
(b) I and III
(c) II and III
(d) I, II and III

114. Let $L_1$ be a regular language and $L_2$ be a deterministic CFL. $L_3$ is recursively enumerable but not recursive. Which one of the following statement is false?

(a) $L_1 \cap L_2$ is a DCFL
(b) $L_3 \cap L_1$ is recursive
(c) $L_1 \cup L_2$ is context-free
(d) $L_1 \cap L_2 \cap L_3$ is recursively enumerable

115. Consider the regular language $L = (111 + 11111)^*$. The minimum number of states in any DFA accepting the language is

(a) 3
(b) 5
(c) 8
(d) 9

116. Which one of the following grammars generates the language $L = \{a^i b^j | i \neq j\}$

(a) $S \rightarrow AC | CB$
$C \rightarrow aCb | a | b$
$A \rightarrow aA | \varepsilon$
$B \rightarrow Bb | \varepsilon$

(b) $S \rightarrow aS | Sb | a | b$

(c) $S \rightarrow AC | CB$
$C \rightarrow aCb | \varepsilon$
$A \rightarrow aA | \varepsilon$
$B \rightarrow bB | b$

(d) $S \rightarrow AC | CB$
$C \rightarrow aCb | \varepsilon$
$A \rightarrow aA | a$
$B \rightarrow bB | b$

117. In the above correct grammar what is the minimum length of the derivation (number of steps starting from $S$) to generate the string $a_l b_m$ with $l \neq m$?
   (a) $\max(l, m) + 2$
   (b) $l + m + 2$
   (c) $l + m + 3$
   (d) $\max(l, m) + 3$

118. Consider $S \rightarrow SS | a$ :
   What is the number of different derivation trees for $aaaaa$
   (a) 3
   (b) 5
   (c) 7
   (d) 14

119. Which one of the following grammar generates $L = \{a_i\, b_j\, c_k | i \neq k, i, j, k \geq 1\}$
   (a) $S \rightarrow AC | CB$
   $A \rightarrow aA | a$
   $B \rightarrow Bc | c$
   $C \rightarrow aCc | bD | b$
   $D \rightarrow bD | b$
   (b) $S \rightarrow aS | aA$
   $A \rightarrow bA | bB$
   $B \rightarrow cB | c$
   (c) $S \rightarrow AB$
   $A \rightarrow aAb | ab$
   $B \rightarrow bBc | bc$
   (d) $S \rightarrow AC | CB$
   $A \rightarrow aA | \varepsilon$
   $B \rightarrow Bc | \varepsilon$
   $C \rightarrow aCc | \varepsilon | bD$
   $D \rightarrow bD | b | \varepsilon$

120. A minimum state deterministic automaton accepting the language $L = \{w | w \in \{0, 1\}^*$, the number of 0's and 1's in $w$ are divisible by 3 and 5 respectively$\}$ has
   (a) 15 states
   (b) 11 states
   (c) 10 states
   (d) 9 states

121. The language $L = \{0^{i^2} | i \geq 0\}$ over the alphabet $\{0, 1, 2\}$ is
   (a) not recursive
   (b) is recursive and a deterministic CFL
   (c) is a regular language
   (d) is not a deterministic CFL but a CFL

122. Which of the following languages is regular?
   (a) $\{wwR | w \in \{0, 1\}^+\}$
   (b) $\{wwRx | w, x \in \{0, 1\}^+\}$
   (c) $\{wxwR | w, x \in \{0,1\}^+\}$
   (d) $\{xwwR | w, x \in \{0, 1\}^+\}$

123. Let $\Sigma = \{0, 1\}$, $L_1 = \Sigma^*$ and $L_2 = \{0^n\,1^n | n \geq 1\}$, then the languages $L_1 \cup L_2$ and $L_2$ are respectively
   (a) regular, regular
   (b) regular, not regular
   (c) not regular, regular
   (d) not regular, not regular

124. Which of the following statements is false?
   (a) The halting problem for Turing machines is undecidable
   (b) Determining whether a context-free grammar is ambiguous is undecidable
   (c) Given two arbitrary context-free grammar $G_1$ and $G_2$, it is undecidable with $L(G_1) = L(G_2)$
   (d) Given two regular grammars $G_1$ and $G_2$, it is undecidable whether $L(G_1) = L(G_2)$

125. Two of the following four regular expressions are equivalent which are
   I. $(00)^* (0 + \varepsilon)$
   II. $(00)^*$
   III. $0^*$
   IV. $0(00)^*$
   (a) I and II
   (b) II and III
   (c) I and III
   (d) III and IV

126. Let $L \subseteq \Sigma^*$, where $\Sigma = \{a, b\}$. Which of the following is true?
   (a) $L = \{x | x$ has an equal number of $a$'s and $b$'s $\}$ is regular
   (b) $L = \{a^n\, b^n | n \geq 1\}$ is regular
   (c) $L = \{a^m\, b^n | m, n \geq 1\}$ is regular
   (d) $L = \{x | x$ has more $a$'s than $b$'s$\}$ is regular

127. Define for a CFL $L$, init $(L) = \{u | uv \in L$ for some $v \in \{0, 1\}^*\}$. In other words, init $(L)$ is the set of prefixes of $L$. Let $L = \{w | w \in \{0, 1\}^+$, $w$ has equal number of 0's and 1's$\}$. Then init $(L)$ is
   (a) the set of all binary strings with unequal number of 0's and 1's
   (b) the set of all binary stings including $\varepsilon$
   (c) the set of all binary strings with exactly one more 0 than the number of 1's or one more 1 than the number of 0's
   (d) None of the above

128. If $L_1$ and $L_2$ are CFL and $R_a$ regular set, one of the languages below is not necessarily a CFL, which is
   (a) $L_1 L_2$
   (b) $L_1 \cup L_2$
   (c) $L_1 \cap L_2$
   (d) $L_1 \cap R$

129. The grammar whose productions are
   $\langle stmt \rangle \rightarrow$ if $\langle id \rangle$ then $\langle stmt \rangle$
   $\langle stmt \rangle \rightarrow$ if $\langle id \rangle$ then $\langle stmt \rangle$ else $\langle stmt \rangle$
   $\langle stmt \rangle \rightarrow \langle id \rangle := \langle id \rangle$
   $\langle stmt \rangle \rightarrow a | b | c | d | f$
   is ambiguous because
   (a) the sentence if $a$ then if $b$ then $c := d$ has more than one derivation trees
   (b) the leftmost and rightmost derivation of the sentence if $a$ then if $b$ then c:= $d$ give rise to different parse trees
   (c) the sentence if $a$ then if $b$ then $c := d$ else $c := f$ has more than two parse trees
   (d) the sentence if $a$ then if $b$ then $c := d$ else $c := f$ has two parse trees

130. Which one of the following regular expressions over $\{0, 1\}$ denotes the set of all strings not containing 100 as a substring?
   (a) $0^*(11^*0)^*$
   (b) $0^*1010^*$
   (c) $0^*1^*01$
   (d) $0^*(10 + 1)^*$

131. Which one of the following is not decidable?
(a) Given a Turing machine $M$, a string $s$ and an integer $k$, $M$ accepts $s$ with $k$ steps
(b) Equivalence of two given Turing machines
(c) Language accepted by a given DFSA is non-empty
(d) Language generated by a CFG is non-empty

132. Which of the following languages over $\{a, b, c\}$ is accepted by a deterministic PDA?
(a) $\{wbw R| w \in \{a, c\}^*\}$
(b) $\{wwR| w \in \{a, b, c\}^*\}$
(c) $\{a^n b^n c^n| n \geq 1\}$
(d) $\{w| w$ is a palindrome over $\{a, b, c\}\}$

133. Which of the following instances of the post correspondence problem has a viable sequence (a solution)?
(a) $\{(b, bb), (bb, bab), (bab, abb), (abb, babb)\}$
(b) $\{(ab, aba), (baa, aa), (aba, baa)\}$
(c) $\{(ab, abb), (ba, aaa), (aa, a)\}$
(d) None of the above

134. It is undecidable, whether
(a) an arbitrary TM has 15 states
(b) an arbitrary TM halts after 10 steps
(c) an arbitrary TM ever prints a specific letter
(d) an arbitrary TM accepts a string $w$ in 5 steps

135. Let $r = 1(1+0)^*$, $s = 11*0$ and $t = 1*0$ be three regular expressions and $R$, $S$, $T$, the regular sets corresponding to them. Which of the following is true?
(a) $S \subset R$
(b) $R \subset S$
(c) $T \subset S$
(d) $R \subset T$

136. Which one of the following is the strongest correct statement about a finite language $L$ over a finite alphabet $\Sigma$?
(a) $L$ is undecidable
(b) $L$ is recursive
(c) $L$ is a CSL
(d) $L$ is a regular set

137. Match List I with List II and select the correct answer using the codes given below the lists.

| List I | | List II |
|--------|--|---------|
| P. | Unreachable states | 1. are those non-accepting states whose transitions for every input character terminate on themselves. |
| Q. | Non-distinguishable states | 2. is the task of transforming a given deterministic finite automaton. |
| R. | DFA minimization | 3. cannot be distinguished from one another for any input string. |
| S. | Dead states | 4. are not reachable from the initial state of the DFA, for any input string. |

Codes

| | P | Q | R | S |
|--|--|--|--|--|
| (a) | 2 | 4 | 2 | 1 |
| (b) | 4 | 3 | 2 | 1 |
| (c) | 2 | 1 | 3 | 4 |
| (d) | 3 | 4 | 2 | 1 |

138. Which of the following statements is ture?
(a) Infinite union of regular sets is regular
(b) Infinite union of finite sets is regular
(c) Finite union of finite sets is regular
(d) Complement of a finite set need not be regular

139. Dead states are the non-accepting states
(a) whose transitions for every input character do not terminate on themselves
(b) whose transitions for every input character terminate on themselves
(c) whose transitions for every input character remains uneffective
(d) None of the above

140. Dead states are also called .......... because once entered there is no escape.
(a) trap states
(b) deterministic states
(c) indeterministic states
(d) None of these

141. ......... are those that cannot be distinguished from one another for any input string.
(a) Non-distinguishable states
(b) Distinguishable states
(c) Determinstic states
(d) None of the above

142. Associative network is a direct graph consisting of
(a) nodes and arcs
(b) hill climbing and best-first
(c) raw and refined
(d) None of the above

143. The important search strategies used in informed search are
(a) nodes and arcs
(b) hill climbing and best-first
(c) raw and refined
(d) None of the above

144. Intelligence includes both ......... and ......... knowledge.
(a) nodes, arcs
(b) hill climbing, best-first
(c) raw, refined
(d) None of the above

145. One of the earliest expert system developed for blood diseases was
(a) MYCIN
(b) intelligent
(c) representation
(d) None of these

146. Knowledge plays an important role in building ......... systems.
(a) MYCIN
(b) intelligent
(c) representation
(d) None of these

# Answers

| | | | | |
|---|---|---|---|---|
| 1. (a) | 2. (c) | 3. (a) | 4. (a) | 5. (a) |
| 11. (d) | 12. (a) | 13. (c) | 14. (b) | 15. (b) |
| 21. (c) | 22. (d) | 23. (d) | 24. (b) | 25. (d) |
| 31. (b) | 32. (a) | 33. (d) | 34. (d) | 35. (a) |
| 41. (c) | 42. (c) | 43. (a) | 44. (b) | 45. (c) |
| 51. (d) | 52. (b) | 53. (a) | 54. (c) | 55. (c) |
| 61. (b) | 62. (a) | 63. (b) | 64. (c) | 65. (c) |
| 71. (d) | 72. (c) | 73. (c) | 74. (c) | 75. (c) |
| 81. (d) | 82. (a) | 83. (b) | 84. (b) | 85. (c) |
| 91. (b) | 92. (a) | 93. (c) | 94. (b) | 95. (a) |
| 101. (c) | 102. (a) | 103. (a) | 104. (b) | 105. (d) |
| 111. (d) | 112. (a) | 113. (b) | 114. (b) | 115. (d) |
| 121. (b) | 122. (c) | 123. (b) | 124. (d) | 125. (c) |
| 131. (b) | 132. (a) | 133. (c) | 134. (c) | 135. (a) |
| 141. (a) | 142. (a) | 143. (b) | 144. (c) | 145. (a) |
| 151. (b) | 152. (a) | 153. (b) | 154. (d) | 155. (c) |
| 161. (b) | 162. (b) | 163. (a) | 164. (b) | 165. (a) |
| 171. (a) | 172. (a) | 173. (a) | 174. (b) | 175. (a) |
| 181. (b) | 182. (b) | 183. (a) | 184. (a) | 185. (a) |
| 191. (b) | 192. (a) | 193. (a) | 194. (a) | 195. (b) |
| 201. (a) | | | | |

| | | | | |
|---|---|---|---|---|
| 6. (c) | 7. (c) | 8. (a) | 9. (d) | 10. (c) |
| 16. (a) | 17. (c) | 18. (d) | 19. (d) | 20. (a) |
| 26. (c) | 27. (a) | 28. (a) | 29. (d) | 30. (a) |
| 36. (d) | 37. (a) | 38. (b) | 39. (b) | 40. (d) |
| 46. (c) | 47. (b) | 48. (c) | 49. (a) | 50. (d) |
| 56. (d) | 57. (b) | 58. (a) | 59. (b) | 60. (b) |
| 66. (a) | 67. (b) | 68. (d) | 69. (b) | 70. (a) |
| 76. (b) | 77. (c) | 78. (b) | 79. (d) | 80. (c) |
| 86. (c) | 87. (b) | 88. (a) | 89. (a) | 90. (a) |
| 96. (b) | 97. (a) | 98. (c) | 99. (c) | 100. (b) |
| 106. (b) | 107. (b) | 108. (b) | 109. (d) | 110. (c) |
| 116. (a) | 117. (a) | 118. (d) | 119. (a) | 120. (a) |
| 126. (c) | 127. (b) | 128. (c) | 129. (d) | 130. (d) |
| 136. (d) | 137. (b) | 138. (c) | 139. (b) | 140. (a) |
| 146. (b) | 147. (c) | 148. (a) | 149. (c) | 150. (a) |
| 156. (d) | 157. (d) | 158. (a) | 159. (d) | 160. (a) |
| 166. (a) | 167. (b) | 168. (b) | 169. (a) | 170. (b) |
| 176. (b) | 177. (a) | 178. (b) | 179. (a) | 180. (a) |
| 186. (b) | 187. (a) | 188. (a) | 189. (a) | 190. (a) |
| 196. (a) | 197. (a) | 198. (b) | 199. (a) | 200. (a) |

# Exercise

1. The language accepted by finite automata is
   (a) context-tree
   (b) regular
   (c) non-regular
   (d) None of these

2. Which of the following is true?
   (a) All NFA are DFA
   (b) All DFA are NFA
   (c) Both (a) and (b)
   (d) NFA and DFA have different power

3. Two-way finite automata has
   (a) two tapes
   (b) two heads
   (c) bi-directional head movement
   (d) All of the above

4. The major difference between a Moore and a Mealy machine is that
   (a) the output of Moore machine depends upon present state and input
   (b) the output of Moore machine depends upon present state only
   (c) Both (a) and (b)
   (d) None of the above

5. If an input string $w$ has $n$ symbols and can be recognized by a Mealy machine $M_1$ and equivalent Moore machine $M_2$, then number of output symbols by $M_1$ and $M_2$ are respectively
   (a) $n, n$
   (b) $n + 1, n$
   (c) $n, n + 1$
   (d) $n + 1, n + 1$

6. Regular languages are recognized by
   (a) finite automaton
   (b) pushdown automaton
   (c) Turing machines
   (d) All of these

7. Which of the following regular expressions denotes a language comprising all possible strings over the alphabet $\{a, b\}$?
   (a) $a * b *$
   (b) $(a | b) *$
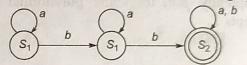   (c) $(ab) *$
   (d) $(a | b*)$

8. Which of the following is not true? [UGC NET, June 2005]
   (a) Power of deterministic automata is equivalent to power of non-deterministic automata
   (b) Power of deterministic pushdown automata is equivalent to power of non-deterministic pushdown automata
   (c) Power of deterministic turing machine is equivalent to power of non-deterministic turing machine
   (d) All of the above

9. Identify the language which is not context-free. [UGC NET, June 2005]
   (a) $L = \{W W^R | W \in \{0, 1\}^*\}$
   (b) $L = \{a^n b^n | n \geq 0\}$
   (c) $L = \{WW | W \in \{0, 1)^*\}$
   (d) $L = \{a^n b^m c^m d^n | n, m \geq 0\}$

10. Top down parsers use
    (a) leftmost derivation
    (b) rightmost derivation
    (c) rightmost derivation in reverse order
    (d) None of the above

11. Bottom up parsers use
    (a) leftmost derivation
    (b) rightmost derivation
    (c) right most derivation in reverse order
    (d) None of the above

12. A context-free grammar is
    (a) type 0
    (b) type 1
    (c) type 2
    (d) type 3

13. Consider a Moore machine $M$ whose digraph is



Then, $L(M)$ the language accepted by the machine $M$ is the set of all string having [UGC NET, Dec 2007]
    (a) two or more $b$'s
    (b) three or more $b$'s
    (c) two or more $a$'s
    (d) three or more $a$'s

14. DPDA accepts any language which is
    (a) DCFL
    (b) CFL
    (c) regular language
    (d) Both (a) and (c)

15. Which one of the following is the most powerful parsing method?
    (a) LL(1)
    (b) Canonical LR
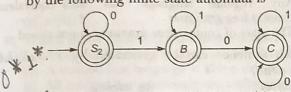    (c) SLR
    (d) LALR

16. The grammar $G$ having productions $S \rightarrow aSb \,|\, ab$ is
    (a) LL (1) grammar
    (b) LL (2) grammar
    (c) LL (0)
    (d) None of these

17. Which of the following regular expressions corresponds to the language of all strings over the alphabet $\{a, b\}$ that contains exactly two $a$'s?
    (i) $aa$  (ii) $ab * a$  (iii) $b * aba *$
    (a) (i) and (ii)
    (b) (ii) and (iii)
    (c) (i) and (iii)
    (d) None of these

18. The result of pumping lemma is
    (a) negative always
    (b) sometime negative
    (c) positive sometime
    (d) positive always

19. Match List I with List II and select the correct answer using the codes given below the lists.

| List I | | List II |
|--------|--|---------|
| P. Finite automaton | 1. | Type 0 language |
| Q. Turing machine | 2. | Type 1 language |
| R. Pushdown automaton | 3. | Type 3 language |
| S. Linear bounded automaton | 4. | Type 2 language |

P-3, R-4, B-1, S-2

**Codes**

| | P | Q | R | S |
|---|---|---|---|---|
| (a) | 3 | 1 | 4 | 2 |
| (b) | 4 | 1 | 3 | 2 |
| (c) | 3 | 4 | 1 | 2 |
| (d) | 3 | 1 | 2 | 4 |

**20.** Choose the correct statement.
(a) All regular grammars are CFG
(b) All CFGs are CSG
(c) Regular grammars are most restricted grammars
(d) All of the above

**21.** The regular expression for the language recognized by the following finite state automata is

0*1*.



(a) $0*|0*1^+$
(b) $0*|0*1^+|0*1^+(0+1)*$
(c) $0*|11*$
(d) None of these

**22.** Which of the following regular expressions corresponds to this grammar?

$$S \to AB/AS, \ A \to a/aA, \ B \to b$$

**[UGC NET, Dec 2006]**

(a) $aa*b^+$
(b) $aa*b$
(c) $(ab)*$
(d) $a(ab)*$

**23.** The language $L = \{a^n b^n a^n, n \to 1\}$ is recognized by
(a) Turing machine
(b) 2PDA
(c) post machine
(d) All of these

**24.** A universal Turing machine is a
(a) reprogrammable Turing machine
(b) two tape TM
(c) single tape TM
(d) None of the above

**25.** Match List I with List II and select the correct answer using the codes given below the lists.

| List I | List II |
|---|---|
| P. Lexical analyser | 1. Pushdown automata |
| Q. Parsing | 2. Turing machine |
| R. Computing | 3. Finite state automata |
| S. Non-deterministic but finite machine | 4. Non-deterministic FA |

**Codes**

P-3, Q-1, R-2, S-4

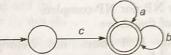| | P | Q | R | S |
|---|---|---|---|---|
| (a) | 3 | 4 | 2 | 1 |
| (b) | 3 | 1 | 2 | 4 |
| (c) | 3 | 1 | 4 | 2 |
| (d) | 3 | 2 | 1 | 4 |

**26.** A recursive enumerable language is
(a) accepted by TM
(b) not accepted by TM
(c) sometimes accepted and sometimes not accepted
(d) None of the above

**27.** Which sentence can be generated by **[UGC NET, Dec 2005]**

{d, bd, bccd, bccccd, —

$S \to d|bA$
$A \to d|ccA$

(a) bccddd
(b) aabccd
(c) ababccd
(d) None of these

**28.** Regular expression $a + b$ denotes the set **[UGC NET, Dec 2005]**

(a) $\{a\}$
(b) $\{\wedge a, b\}$
(c) $\{a, b\}$
(d) None of these

**29.** Suppose $L$ is a recursive enumerable language and TM, $M$ accepts $L$, then for $W \notin L$, the machine $M$
(a) halts always
(b) does not halt
(c) may or may not halt
(d) rejects

**30.** Which of the following strings is accepted by given NDFA?



(a) $c \cdot (a \cup b)*$
(b) $c \cdot a * \cdot b *$
(c) $c \cdot (ab)*$
(d) None of these

**31.** The regular expression $(a \mid b)(a \mid b)$ denotes the set

$(a+b)(a+b)$

(a) $\{a, b, ab, aa\}$
(b) $\{a, b, ba, bb\}$
(c) $\{a, b\}$
(d) $\{aa, ab, ba, bb\}$

**32.** Which of the following regular expressions denotes a language comprising all possible strings of even length over the alphabet $\{0, 1\}$?
(a) $(0 \mid 1)*$
(b) $(0 \mid 1)*(0 \mid 1)*$
(c) $(00 \mid 01 \mid 11 \mid 10)*$
(d) $(0 \mid 1)(0 \mid 1)(0 \mid 1)*$

**33.** The context-free languages are closed for— **[UGC NET, Dec 2006]**

(i) Intersection
(ii) Union
(iii) Complementation
(iv) Kleene star

(a) (i) and (iv)
(b) (i) and (iii)
(c) (ii) and (iv)
(d) (ii) and (iii)

**34.** Which of the following strings is in the language defined by grammar? **[UGC NET, June 2006]**

$$S \to 0A, \ A \to 1A \mid 0A \mid 1$$

(a) 01100
(b) 00101
(c) 10011
(d) 11111

**35.** The logic of pumping lemma is a good example of **[UGC NET, June 2006]**
(a) pigeon hole principle
(b) recursion
(c) divide and conquer technique
(d) iteration

**36.** Consider the language :

$$L_1 = \{a^n b^m c^n d^m \mid n \geq 1, m \geq 1\}$$
and $\quad L_2 = \{a^n b^m c^m d^n \mid n \geq 1, m \geq 1\}$

(a) both $L_1$ and $L_2$ are context-free
(b) $L_1$ is not context-free but $L_2$ is context-free
(c) both are not context-free
(d) $L_1$ is context-free but $L_2$ is not context-free

**37.** The FSM shown in the figure accepts



(a) all strings  
(b) no strings  
(c) ∈-alone  
(d) None of these

**38.** The FSM shown in the figure accepts



(a) all strings  
(b) no strings  
(C) ∈-alone  
(d) None of these

**39.** The Travelling Salesman Problem (TSP) is  
(a) NP but not NP-complete  
(b) NP-complete  
(c) neither NP nor NP-complete  
(d) None of the above

**40.** The string 1101 does not belong to the set represented by  
(a) $110*(0+1)$  
(b) $1(0+1)*101$  
(c) $(00+(11)*0)*1$  
(d) $(10)*(01)*(00+11)*$

**41.** Chomsky's hierarchy states that  
(a) type 0 ⊂ type 1 ⊂ type 2 ⊂ type 3  
(b) type 0 ⊆ type 1 ⊆ type 2 ⊆ type 3  
(c) type 0 ⊃ type 1 ⊃ type 2 ⊃ type 3  
(d) type 0 ⊇ type 1 ⊇ type 2 ⊇ type 3

**42.** An FSM with  
(a) 1 stack is more powerful than an FSM with no stack  
(b) 2 stack is more powerful than a FSM with 1 stack  
(c) Both (a) and (b)  
(d) None of the above

**43.** Consider the following two FSMs shown in the figure :



Which of the following statements is correct?  
(a) Both are equivalent  
(b) Second FSM accepts ∧ only  
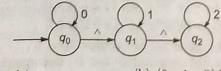(c) First FSM accepts nothing  
(d) None of the above

**44.** A PDM behaves like a TM when the number of auxiliary memory it has, is  
(a) zero  
(b) 1 or more  
(c) 2 or more  
(d) None of these

**45.** Give the regular expression described by the following NFA.



(a) $(012)*$  
(b) $(0+1+2)*$  
(c) $0*1*2*$  
(d) None of these

**46.** Which of the following statements is wrong?  
(a) Every recursive language is recursively enumerable  
(b) A language is accepted by a finite automaton if and only if it is context-free  
(c) Recursive languages are closed under intersection  
(d) A language is accepted by a finite automaton if and only if it is right-linear

**47.** Which of the following statements is true?  
(a) All languages can be generated by context-free grammar  
(b) The number of symbols necessary to stimulate a Turing Machine (TM) with $m$ symbols and $n$ states is $mn$  
(c) Any regular language has an equivalent context-free grammar  
(d) The class of context-free grammar is not closed

**48.** Which sentence can be generated by $S \to aS/bA$, $A \to d/aA$?  
(a) aabccd  
(b) adabcca  
(c) abcca  
(d) ababbd

**49.** Which of the following statements is wrong?  
(a) A Turing machine cannot solve halting problems  
(b) Set of recursively enumerable languages is closed under union  
(c) A finite state machine with 2 stacks is more powerful than a finite state machine with 3 stacks  
(d) Context sensitive grammar can be recognized by a linearly bounded memory machine

**50.** Which of the following statements is wrong?  
(a) Recursive languages are closed under union  
(b) Recursive languages are closed under complementation  
(c) If a language and its complement are both regular then the language must be recursive  
(d) A language is accepted by a finite automaton if and only if it is recursive

**51.** Recursively enumerable languages are not closed under  
(a) complementation  
(b) union  
(c) intersection  
(d) None of these

**52.** Which of the following statements is false?  
(a) Regular language is subset of context-free language  
(b) Context sensitive language is subset of context-free language  
(c) Context-free language is subset of context sensitive language  
(d) Context sensitive language is subset of types-0 language

**53.** Which of the following statements is false?  
(a) Pushdown automaton also performs the operation of finite automation  
(b) Turing machine can also perform the operation of finite automaton  
(c) Linear bounded automaton can also perform the operation of finite automaton  
(d) None of the above

54. Which of the following regular expressions denotes a language comprising all possible strings of even length over the alphabet (0, 1)?
    (a) 1/0 (1/0) *
    (b) (0/1) (1/0)*
    (c) (1/0)
    (d) (00/01/11/10)*

55. The regular expression which denotes zero or more instances of an x or y, is
    (a) (x/y)
    (b) (x/y) *
    (c) x */y
    (d) (xy) *

56. (ab*) is regular expression defining a language over {a, b}. Another regular expression that defines the same language over {a, b} is
    (a) a * ba
    (b) a *(ba) *
    (c) a (ba)*
    (d) None of these

57. Which of the following statements is false?
    (a) A regular language is also a context-free language
    (b) A context-free language is also a regular language
    (c) All context-free grammars are ambiguous
    (d) Both (b) and (c)

58. For a derivation tree, which of the following statements is false?
    (a) The label of each leaf node is x, where x is a terminal
    (b) The label of all nodes except leaf nodes (or leaves) is a non-terminal .
    (c) If the root of a subtree is A, then it is called an A-tree
    (d) None of the above

59. A context-free grammar G is said to be ambiguous if
    (a) it has two or more leftmost derivations for terminal string s ∈ L (G)
    (b) it has two or more rightmost derivations for terminal string s ∈ L (G)
    (c) Neither (a) nor (b) is true
    (d) Both (a) and (b) are true

60. If L is a deterministic CFL and R is regular language, then
    (a) L ∩ R is a deterministic CFL .
    (b) L ∩ R is a regular language
    (c) (a) is true but (b) is not
    (d) (b) is true but (a) is not

61. If $L_1$ and $L_2$ are two context-free languages, then which of the following is false?
    (a) $L_1 L_2$ is a context-free language
    (b) $L_1 \cap L_2$ may be or may not be context-free language
    (c) $L_1 * L_2 *$ is not a context-free language
    (d) None of the above

62. Which of the following statements is true?
    (a) Any regular language has an equivalent CFG
    (b) Some non-regular languages cannot be generated by any CFG
    (c) Some regular languages cannot be generated by any CFG
    (d) Both (a) and (b)

63. Which of the following is most powerful?
    (a) DFA
    (b) NDFA
    (c) 2PDA
    (d) DPDA

64. A pushdown automaton is different than a finite automaton by
    (a) a read head
    (b) a memory in the form of stack
    (c) a set of states
    (d) All of the above

65. Which of the following statements is false?
    (a) For a finite automaton, the working can be desribed in terms of change of states
    (b) For a pushdown automaton, the working can be described in terms of change of instantaneous descriptions
    (c) Both (a) and (b)
    (d) Neither (a) nor (b)

66. Which of the following statements is false?
    (a) LR(k) grammars are used in design of compilers
    (b) LR(k) grammars are subclasses of CFGs
    (c) If a grammar is an LR(k) grammar, then it is also an LR(k') grammar for all k' < k
    (d) LR(k) grammars play an important role in the study of programming languages

67. The LR(0) grammars
    (a) define exactly the deterministic CFLs having the prefix property
    (b) may be those grammars which do not allow start symbol in right side of any production
    (c) do not allow leftmost derivation
    (d) All of the above

68. If a grammar is in LL(1), then it can be compiled by
    (a) a recursive decent parser
    (b) any parser
    (c) cannot be compiled
    (d) None of the above

69. Which of the following is a false statement?
    (a) An LL(k) grammar has to be CFG
    (b) There are some LL(k) grammars which are not CFG
    (c) An LL(k) grammar has to be unambiguous
    (d) None of the above

70. A Turing machine
    (a) is a simple mathematical mode of general purpose computer
    (b) models the computing power of any computer
    (c) is capable of performing any calculation which can be performed by any computing machine
    (d) All of the above

71. A Turing machine is similar to a finite automaton with only the difference of
    (a) read/write head
    (b) input tape
    (c) finite state control
    (d) All of these

**72.** Universal Turing machine influences the concept of
(a) computability
(b) stored-program computer
(c) Both (a) and (b)
(d) None of the above

**73.** A finite state machine having finite tape length without rewinding capability and unidirectional tape movement is called
(a) Turing machine (b) PDA
(c) DFA (d) All of these

**74.** Which of the following statements is false?
(a) A turing machine is more powerful than finite state machine because it has no finite state
(b) A finite state machine can be assumed to be a turing machine of finite tape length without rewinding capability and undirectional tape movement
(c) Both (a) and (b)
(d) None of the above

**75.** Which of the following statements is false?
(a) The recursiveness problem of type-0 grammar is unsolvable
(b) There is no algorithm that can determine whether or not a given Turing machine halts with complete blank tape when it starts with a given tape configuration
(c) The problem of determining whether or not a given context-sensitive language is context-free is solvable
(d) None of the above

**76.** Which of the follownig statements is false?
(a) If a langauge is not recursively enumerable, then its complement cannot be recursive

(b) The family of recursive languages is closed under union
(c) The family of recursive languages is closed under intersection
(d) None of the above

**77.** Which of the following statements is false?
(a) Every context-sensitive language is recursive
(b) Every recursive language is context-sensitive
(c) Both (a) and (b)
(d) None of the above

**78.** A problem is NP-complete if
(a) answer can be verified quickly
(b) a quick algorithm to solve this problem can be used to solve all other NP problems quickly
(c) it can be solved in polynomial time
(d) All of the above

**79.** Which of the following problems is not NP-complete?
(a) Satifiability problem
(b) Vertex cover problem
(c) Integer linear programming problem
(d) None of the above

**80.** Which of the following is incorrect?
(a) The class of decision problem that can be solved by a deterministic sequential machine in polynomial time is known as $P$
(b) The class of decision problem that can be verified in polynomial time is known as NP
(c) The class of problems that can be understood as the class NP-hard consequently is NP-complete or harder
(d) None of the above

# Answers

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. (b) | 2. (b) | 3. (c) | 4. (b) | 5. (c) | 6. (d) | 7. (b) | 8. (b) | 9. (c) | 10. (a) |
| 11. (b) | 12. (c) | 13. (a) | 14. (d) | 15. (b) | 16. (b) | 17. (d) | 18. (a) | 19. (a) | 20. (d) |
| 21. (a) | 22. (b) | 23. (d) | 24. (a) | 25. (b) | 26. (a) | 27. (d) | 28. (c) | 29. (c) | 30. (a) |
| 31. (d) | 32. (c) | 33. (b) | 34. (b) | 35. (a) | 36. (b) | 37. (c) | 38. (b) | 39. (b) | 40. (d) |
| 41. (c) | 42. (c) | 43. (d) | 44. (c) | 45. (c) | 46. (b) | 47. (c) | 48. (a) | 49. (c) | 50. (d) |
| 51. (a) | 52. (b) | 53. (d) | 54. (c) | 55. (b) | 56. (c) | 57. (d) | 58. (d) | 59. (d) | 60. (c) |
| 61. (c) | 62. (d) | 63. (c) | 64. (b) | 65. (c) | 66. (c) | 67. (d) | 68. (a) | 69. (b) | 70. (d) |
| 71. (a) | 72. (c) | 73. (a) | 74. (a) | 75. (d) | 76. (d) | 77. (b) | 78. (d) | 79. (d) | 80. (d) |