



TOC Unit 3 MCQ QB - bddb

computer engineer (Savitribai Phule Pune University)

TOC

Unit III Context Free Grammar

MCQs Question Bank

1. A context free grammar G is in Chomsky normal form if every production is of the form
- A. $A \rightarrow BC$ or $A \rightarrow A$
 - B. $A \rightarrow BC$ or $A \rightarrow a$
 - C. $A \rightarrow BCa$ or $B \rightarrow b$
 - D. None of these

Ans: B

Explanation: In formal language theory, a context-free grammar, G , is said to be in Chomsky normal form if all of its production rules are of the form: $A \rightarrow BC$, or, $A \rightarrow a$

2. A context free language is called ambiguous if
- A. It has two or more leftmost derivations for some terminal string ϵL
 - B. It has two or more rightmost derivations for some terminal string ϵL
 - C. Both (a) and (b)
 - D. None of these

Ans: C

Explanation: A context free language is called ambiguous if there is no unambiguous grammar to define that language and it is also called inherently ambiguous Context Free Languages. A context free grammar is called ambiguous if there exists more than one LMD or more than one RMD for a string which is generated by grammar. There will also be more than one derivation tree for a string in ambiguous grammar.

3. The context free grammar $S \rightarrow SS \mid 0S1 \mid 1S0$ generates ϵ
- A. Equal number of 0's and 1's
 - B. Unequal number of 0's and 1's
 - C. Any number of 0's followed by any number of 1's
 - D. None of these

Ans: A

Explanation: $S \rightarrow SS$

$S \rightarrow 0S1S$

$S \rightarrow 0S11S0$

$S \rightarrow 0110.$

4. What is the highest type number which can be applied to the following grammar ? $S \rightarrow Aa, A \rightarrow Ba, B \rightarrow abc$

- A. Type 0
- B. Type 1
- C. Type 2
- D. Type 3

Ans: C

Explanation: Type-2 grammars generate context-free languages. The productions must be in the form $A \rightarrow \gamma$ where $A \in N$ (Non terminal) and $\gamma \in (T \cup N)^*$ (String of terminals and non-terminals).

5. Consider the CFG with $\{S, A, B\}$ as the non-terminal alphabet, $\{a, b\}$ as the terminal alphabet, S as the start symbol and the following set of production rules $S \rightarrow aB$ $S \rightarrow bA$ $B \rightarrow bA$ $A \rightarrow aB$ $A \rightarrow bS$ $A \rightarrow aS$ $B \rightarrow aBB$ $A \rightarrow bAA$. Which of the following strings is generated by the grammar?

- A. aaaabb
- B. aabbbb
- C. aabbab
- D. abbbba

Ans: C

Explanation: Given below production rules. $S \rightarrow aB$ $S \rightarrow bA$
 $B \rightarrow bA$ $A \rightarrow aB$

$B \rightarrow bS$ $A \rightarrow aS$

$B \rightarrow aBB$ $A \rightarrow bAA$

We can derive aabbab using below sequence $S \rightarrow aB$ [Using $S \rightarrow aB$]
 $\rightarrow aaBB$ [Using $B \rightarrow aBB$]

$\rightarrow aabB$ [Using $B \rightarrow b$] $\rightarrow aabbS$ [Using $B \rightarrow bS$]

$\rightarrow aabbaB$ [Using $S \rightarrow aB$]

$\rightarrow aabbab$ [Using $B \rightarrow b$]

6. Consider the following context-free grammars: Which one of the following pairs of languages is generated by G_1 and G_2 , respectively (GATE 2016)

$G_1: S \rightarrow aS \mid B, B \rightarrow b \mid bB$

$G_2: S \rightarrow aA \mid bB, A \rightarrow aA \mid B \mid \epsilon, B \rightarrow bB \mid \epsilon$

- (A) $\{a^m b^n | m > 0 \text{ or } n > 0\}$ and $\{a^m b^n | m > 0 \text{ and } n > 0\}$
 (B) $\{a^m b^n | m > 0 \text{ and } n > 0\}$ and $\{a^m b^n | m > 0 \text{ or } n \geq 0\}$
 (C) $\{a^m b^n | m \geq 0 \text{ or } n > 0\}$ and $\{a^m b^n | m > 0 \text{ and } n > 0\}$
 (D) $\{a^m b^n | m \geq 0 \text{ and } n > 0\}$ and $\{a^m b^n | m > 0 \text{ or } n > 0\}$

- A. A
 B. B
 C. C
 D. D

Ans: D

Explanation: In G1, there will be at least 1 b because of $S \rightarrow B$ and $B \rightarrow b$. But no of A's can be 0 as well and no of A and B are independent.

In G2, either we can take $S \rightarrow aA$ or $S \rightarrow bB$. So it must have at least 1 a or 1 b. So option D is correct.

7. The entity which generate Language is termed as:

- A. Automata
 B. Tokens
 C. Grammar
 D. Data

Ans: C

Explanation: The entity which accepts a language is termed as Automata while the one which generates it is called Grammar. Tokens are the smallest individual unit of a program.

8. In context to the process of removing useless symbols, which of the following is correct? A. We remove the Nullable variables

- B. We eliminate the unit productions
 C. We eliminate products which yield no terminals
 D. All of the mentioned

Ans: C

Explanation: In the process of removal of useless symbols, we want to remove productions that can never take part in any derivation. Useless symbols are symbols which don't generate string of terminals from start symbol. or they don't take part in derivation process

9. Recognize the CFL for the given CFG. $S \rightarrow aB \mid bA$, $A \rightarrow a \mid aS \mid bAA$ $B \rightarrow b \mid bS \mid aBB$
 A. strings contain equal number of a's and equal number of b's.
 B. strings contain odd number of a's and odd number of b's.

- C. strings contain odd number of a's and even number of b's.
- D. strings contain even number of a's and even number of b's.

Ans: A

Explanation: $S \rightarrow aB \rightarrow ab$

$S \rightarrow bA \rightarrow bbAA \rightarrow bbaA \rightarrow bbaa$

10. The minimum number of productions required to produce a language consisting of palindrome strings over $\Sigma=\{a,b\}$ is

- A. 3
- B. 7
- C. 5
- D. 6

Ans: C

Explanation: The grammar which produces a palindrome set can be written as: $S \rightarrow aSa \mid bSb \mid \epsilon \mid a \mid b$

$L=\{\epsilon, a, b, aba, abbbaabbba, \dots\}$

11. Which of the following statement is false?

- A. Context free language is the subset of context sensitive language
- B. Regular language is the subset of context sensitive language
- C. Recursively enumerable language is the super set of regular language
- D. Context sensitive language is a subset of context free language

Answer: D

Explanation: Every regular language can be produced by context free grammar and context free language can be produced by context sensitive grammar and so on.

12. The Grammar can be defined as: $G=(V, \Sigma, p, S)$

In the given definition, what does S represents?

- A. Accepting State
- B. Starting Variable
- C. Sensitive Grammar
- D. None of these

Answer: B

Explanation: $G=(V, \Sigma, p, S)$, here V =Finite set of variables, Σ = set of terminals, p = finite productions, S = Starting Variable.

13. Which among the following cannot be accepted by a regular grammar?

- A. L is a set of numbers divisible by 2
- B. L is a set of binary complement
- C. L is a set of string with odd number of 0
- D. L is a set of 0^n1^n

Answer: D

Explanation: There exists no finite automata to accept the given language i.e. 0^n1^n . For other options, it is possible to make a dfa or nfa representing the language set.

14. Which of the expression is appropriate?

For production $p: a \rightarrow b$ where $a \in V$ and $b \in \Sigma^*$

- a) V
- b) S
- c) $(V + \Sigma)^*$
- d) $V + \Sigma$

Answer: C

Explanation: According to the definition, the starting variable can produce another variable or any terminal or a variable which leads to terminal.

15. For $S \rightarrow 0S1 | \epsilon$ for $\Sigma = \{0, 1\}^*$, which of the following is wrong for the language produced? a) Non regular language

- b) $0^n 1^n \mid n \geq 0$
- c) $0^n 1^n \mid n \geq 1$
- d) None of the mentioned

Answer: D

Explanation: $L = \{\epsilon, 01, 0011, 000111, \dots, 0^n 1^n\}$. As epsilon is a part of the set, thus all the options are correct implying none of them to be wrong.

16. Which of the following statement is correct?

- a) All Regular grammar are context free but not vice versa
- b) All context free grammar are regular grammar but not vice versa
- c) Regular grammar and context free grammar are the same entity
- d) None of the mentioned

Answer: A

Explanation: Regular grammar is a subset of context free grammar and thus all regular grammars are context free.

17. Are ambiguous grammar context free?

- a) Yes
- b) No

Answer: A

Explanation: A context free grammar G is ambiguous if there is atleast one string in $L(G)$ which has two or more distinct leftmost derivations.

18. Unrestricted grammar is also called _____ Grammar

- A. Type 3
- B. Type 2
- C. Type 1
- D. Type 0

Answer: D

Explanation: Type 0 grammar does not have any restriction about productions.

19. Which of the following CFG's can't be simulated by an FSM ?

- A. $S \rightarrow Sa \mid b$
- B. $S \rightarrow aSb \mid ab$
- C. $S \rightarrow abX, X \rightarrow cY, Y \rightarrow d \mid aX$
- D. None of these

Answer: B

Explanation: Option (b) generates the set $\{a^n b^n, n=1,2,3, \dots\}$ which is not regular, Option (a) is left linear whereas option (C) is right linear.

20. A CFG consists of :

- A. Set of Nonterminals
- B. Start symbol
- C. Set of terminals
- D. All of these

Answer: D

Explanation: $G = \{V, T, P, S\}$ variables, Terminals, Productions, start symbol

21. A grammar

in which V represents

- A. Set of Nonterminal
- B. Start symbol
- C. Set of terminals
- D. Production

Answer: A

Explanation: V is set of nonterminals or variables

22. Context free grammar is called Type 2 grammar because of _____ hierarchy.

- A. Greibach
- B. Backus
- C. Chomsky
- D. None of the mentioned

Answer: C

Explanation: Chomsky hierarchy defines 4 types of grammar.

23. CFG for a^+

- A. $S \rightarrow aS \mid a \mid \wedge$
- B. $S \rightarrow aS \mid b$
- C. $S \rightarrow aS \mid a$
- D. None of these

Answer: D

Explanation: $S \rightarrow aS \mid a$ $L = \{a, aa, aaa, aaaa, \dots\}$

24. $S \rightarrow aSa \mid bSb \mid a \mid b$;

The language generated by the above grammar over the alphabet $\{a, b\}$ is the set of A. All length palindrome

- B. Even length palindrome
- C. Odd length palindrome
- D. String starts and end with different character

Answer: C

Explanation: $L = \{a, b, abb, bbb, aaa, aba, bab, \dots\}$

25. A CFG is ambiguous if

- A. It has more than one rightmost derivations
- B. It has more than one leftmost derivations
- C. No parse tree can be generated for the CFG
- D. Both A & B

Answer: D

Explanation: A context free grammar is ambiguous if it has more than one parse tree generated or more than one leftmost derivations. An unambiguous grammar is a context free grammar for which every valid string has a unique leftmost derivation.

26. Which of the following are always unambiguous?

- A. Deterministic Context free grammars
- B. Non-Deterministic Regular grammars
- C. Context sensitive grammar
- D. None of the mentioned

Answer : A

Explanation: Deterministic CFGs are always unambiguous , and are an important subclass of unambiguous CFGs; there are non-deterministic unambiguous CFGs, however.

27. A CFG is not closed under

- A. Dot operation
- B. Union Operation
- C. Concatenation
- D. Iteration

Answer: D

Explanation: The closure property of a context free grammar does not include iteration or kleene or star operation.

28. Which of the following is an real-world programming language ambiguity? A. dangling else problem

- B. halting problem
- C. maze problem
- D. none of the mentioned

Answer:A

Explanation: Dangling else problem: In many languages,the else in an if-then-else statement is optional, which results into nested conditionals being ambiguous, at least in terms of the CFG.

29.State true or false:

Statement: $R \rightarrow R|T$ $T \rightarrow \epsilon$ is an ambiguous grammar

A. true

B. false

Answer: A

Explanation: The production can be either itself or an empty string. Thus the empty string has more than one leftmost derivations, depending on how many times $R \rightarrow R$ is being used.

30.Non-Linear grammar has two non-terminals on the right-hand side.

A. True

B. False

Answer: A

Explanation: The above stated grammar is non-linear because it has two non-terminals on the right-hand side.

31.

Linear grammar has more than one non-terminal on the right-hand side.

A. True

B. False

Answer: B

Explanation: Grammar is linear because no rule has more than one non terminal on the right hand side.

32. In Right-Linear grammars, all productions have the form: $A \rightarrow xB$.

A. True

B. False

Answer: A

Explanation: Right-Linear grammars, following are the form of productions: $A \rightarrow xB$ or $A \rightarrow x$ where x is some string of terminals.

33. Which type of grammar is it?

$S \rightarrow abS$ $S \rightarrow a$

A. Right Linear Grammar

B. Left Linear Grammar

C. Right & Left Linear Grammar

D. None of the mentioned

Answer: A

Explanation: grammars in which all of the rules contain only one non-terminal on the left-hand side, and where in every case that non-terminal is the first symbol are called right Linear.

34. What are the two types of Linear Grammar?

A. Right Linear

- B. Left Linear
- C. None of the mentioned
- D. Right & Left Linear

Answer: D

Explanation: Linear grammar is of 2 types Left and Right Linear Grammar

35. Which Grammar is it?

$S \rightarrow Aa \quad A \rightarrow Aab \mid \lambda$

- A. Right Linear
- B. Left Linear
- C. None of the mentioned
- D. Right & Left Linear

Answer: B

Explanation: In this case they both correspond to the regular expression $(ab)^*a$.

36. A Regular Grammar is any right-linear or left-linear grammar.

- A. True
- B. False

Answer: A

Explanation: As it turns out the languages that can be generated by Regular Grammars is equivalent to those that can be specified by Regular Expressions.

37. Regular Grammars generate Regular Languages.

- A. True
- B. False

Answer: A

Explanation: Language generated by regular grammar is called regular languages.

38. Match the following :

(i) Regular Grammar (a) Pushdown automaton (ii) Context free Grammar (b) Linear bounded automaton (iii) Unrestricted Grammar (c) Deterministic finite automaton (iv) Context Sensitive Grammar (d) Turing machine

(i) (ii) (iii) (iv)

A. (c) (a) (b) (d)

B. (c) (a) (d) (b)

C. (c) (b) (a) (d)

D. (c) (b) (d) (a)

Answer: B

Explanation: As per concept Regular Grammar - Deterministic finite automaton ,

Context free Grammar - Pushdown automaton , Unrestricted Grammar - Turing machine, Context Sensitive Grammar- Linear bounded automaton

39. 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.

Answer: D

Explanation: Context-free languages are closed under Kleene

closure. 40. Which of the regular expressions corresponds to

this grammar ?

$S \rightarrow AB / AS,$

$A \rightarrow a / aA,$

$B \rightarrow b$

A. aa^*b^+

B. aa^*b

C. $(ab)^*$

D. $a(ab)^*$

Answer: B

Explanation: $L = \{ab, aab, aaab, aaaab, \dots\}$

41. The production of the form $A \rightarrow B$, where A and B are non terminals is called

- A. Null production
- B. Greibach Normal Form
- C. Unit production
- D. Chomsky Normal Form

Answer: C

Explanation: A unit production is a production $A \rightarrow B$ where both A and B are non-terminals. Unit productions are redundant and hence should be removed.

42. The closure property of context free grammar includes :

- A. Kleene operation
- B. Union
- C. Concatenation
- D. All of the mentioned

Answer: D

Explanation: CFL's are closed under union, concatenation, and Kleene closure. Also, under reversal, homomorphisms and inverse homomorphisms. But not under

intersection or difference. Let L and M be CFL's with grammars G and H, respectively.

43. CFG is not closed under

- A. Kleene
- B. Concatenation
- C. Complement
- D. Union

Answer: C

Explanation: : If L1 and L2 are two context free languages, their intersection $L1 \cap L2$ need not be context free. For example,

$L1 = \{ a^n b^n c^m \mid n \geq 0 \text{ and } m \geq 0 \}$ and $L2 = \{ a^m b^n c^n \mid n \geq 0 \text{ and } m \geq 0 \}$
 $L3 = L1 \cap L2 = \{ a^n b^n c^n \mid n \geq 0 \}$ need not be context free.

L1 says number of a's should be equal to number of b's and L2 says number of b's should be equal to number of c's. Their intersection says both conditions need to be true, but push down automata can compare only two. So it cannot be accepted by pushdown automata, hence not context free. Similarly, complementation of context free language L1 which is $\Sigma^* - L1$, need not be context free.

44. Every grammar in Chomsky Normal Form is:

- A. Regular
- B. Context free
- C. Context sensitive
- D. Unrestricted

Answer: B

45. While converting the context free grammar into chomsky normal form, which of the following is necessary

- A. Elimination of null production
- B. Elimination of unit production
- C. Elimination of epsilon production
- D. All of these

Answer: D

Explanation: Simplification of CFG is required in CNF

46. Which of the following grammars are in Chomsky Normal Form:

- A. $S \rightarrow AB \mid BC \mid CD$ $A \rightarrow 0$ $B \rightarrow 1$ $C \rightarrow 2$ $D \rightarrow 3$
- B. $S \rightarrow AB$ $S \rightarrow BCA \mid 0 \mid 1 \mid 2 \mid 3$
- C. $S \rightarrow Aba$ $A \rightarrow aab$ $B \rightarrow Ac$
- D. All of the mentioned

Answer: A

Explanation:

47. The variable which produces epsilon is called:

- A. Empty variable
- B. Nullable variable
- C. Terminal
- D. All of the mentioned

Answer: B

Explanation: Removal of *Null* Productions. In a CFG, a *non-terminal* symbol 'A' is a *nullable* variable if there is a production $A \rightarrow \epsilon$

48. $G = \{S \rightarrow SS, S \rightarrow ab, S \rightarrow ba, S \rightarrow ?\}$ is the context free grammar whose statements are given below:

- a. G is ambiguous
- b. G produces all strings with equal number of a's and b's.
- c. Deterministic PDA accepts G

Which of the following statement is true about G?

- A. a, b, c all are true
- B. Only a and b are true
- C. Only b and c are true
- D. Only a is true

Answer: A

Explanation: G is ambiguous , G produces all strings with equal number of a's and b's. And Deterministic PDA accepts G

49. Which among the following is the root of the parse tree?

- A. Production P
- B. Nonterminal V
- C. Terminal T
- D. Starting symbol S

Answer: D

Explanation: Starting symbol is the root of parse tree

50. _____ is the graphical representation of a grammar.

- A. Binary tree
- B. Red black tree
- C. Parse tree
- D. None of the mentioned

Answer: C

Explanation: Parse tree shows graphical representation of given grammar