



PES UNIVERSITY, Bangalore
(Established under Karnataka Act No. 16 of 2013)
Department of Computer Science & Engineering

Automata Formal Languages & Logic

Question Bank - Context Free Grammar

Questions from the Prescribed Textbook

Topic	Exercise No.	Question No's
Context-Free Grammars	5.1	Q7-Q9,Q11,Q15,Q18-25
Parsing and Ambiguity	5.2	Q-6-Q8,Q12-Q19
Context-Free Grammars and programming languages	5.3	Q1,Q2

Extra Questions

1. Construct a context free grammar for $a^n b^m c^k$ where $2n = m$ and $k \geq 2$.
2. Describe the language generated by $G = (\{S, A\}, \{a, b\}, P, S)$. The set of productions P is given as:
 $S \rightarrow aA \mid bA$
 $A \rightarrow aAa \mid bAb \mid aAb \mid bAa \mid \lambda$
3. Construct the CFG for the language given by $L = \{0^i 1^j 2^k \mid i+j=k\}$.
4. Construct the CFG for the language given by $L = \{w_1 c a^n b^m a^i b^j w_2 \mid w_1, w_2 \in \{a, b\}^*, \text{length}(w_1) = \text{length}(w_2), j = 2i, n \leq m\}$.
5. Construct the CFG for the language $L = \{a^n b^m c^k \mid n \neq m \text{ or } m \neq k\}$.
6. Consider the grammar $S \rightarrow 0B \mid 1A, A \rightarrow 0 \mid 0S \mid 1AA, B \rightarrow 1 \mid 1S \mid 0BB$. Given the string 1100, find a leftmost derivation and/or a rightmost derivation with corresponding parse trees. Repeat for the strings 001110 and 001101.
7. Given the CFG $S \rightarrow AB \mid \lambda, A \rightarrow aB, B \rightarrow Sb$, construct a derivation tree for $aaabbbbbb$.
8. For the regular expression $(011+1)^*(01)^*$ obtain a context free grammar.



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9. Give a context-free grammar for the language $L \subseteq \{0,1,\#\}^*$, where $L = \{x\#y \mid x \neq y^R, |x| = |y|\}$.
For example, $00\#10, 101\#000 \in L$ but $00\#0, 11\#11 \notin L$
10. Consider the language $L = \{a^m b^{2n} c^{3n} d^p \mid p > m, \text{ and } m, n \geq 1\}$.
(a) What is the shortest string in L ?
(b) Write a context-free grammar to generate L .
11. Give unambiguous grammar for the following languages.
a. $\{w \mid \text{the number of a's and b's in } w \text{ are equal}\}$
b. $\{w \mid \text{the number of a's is at least the number of b's}\}$.
12. Prove the context free grammar is ambiguous.
 $S \rightarrow aSbT \mid T$
 $T \rightarrow aT \mid bT \mid \lambda$
13. Is the following grammar ambiguous?
 $S \rightarrow iCtS \mid iCtSeS \mid a$
 $C \rightarrow b$
14. Show that $S \rightarrow SaS \mid b$ is ambiguous. Construct an unambiguous equivalent of the grammar.
15. Given the grammar,
 $S \rightarrow P \mid Q$
 $P \rightarrow AA$
 $A \rightarrow aAb \mid ab$
 $Q \rightarrow aQb \mid aRb$
 $R \rightarrow bRa \mid ba$
a. Give description in English of $L(G)$.
b. Construct the leftmost and rightmost derivation for the string $abab$.



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16. Let G be a grammar $S \rightarrow 0B/1A$, $A \rightarrow 0/0S/1AA$, $B \rightarrow 1/1S/0BB$. For the string 00110101 find its leftmost derivation and rightmost derivation tree.
17. Using the grammar $G=(V,T,P,S)$, with $V=\{S\}$ $P=\{S \rightarrow S \cup S | SS | S^* | (S) | 0 | 1 | \lambda\}$, give the left most derivation and the corresponding parse tree for the string $(0U(10)^*1)^*$.
18. Construct leftmost and rightmost derivations for the strings, if the language is given
 $S \rightarrow AS | \epsilon$
 $A \rightarrow aa | ab | ba | bb$
Strings:
a. aabbba
b. baabab
c. aaabbb
19. Construct the parse tree for the string $a^*(a+b00)$ for the following CFG using both leftmost and rightmost derivation.
 $E \rightarrow I | E+E | E^*E | (E)$
 $I \rightarrow a | b | Ia | Ib | IO | I1$
20. Construct the parse tree for the string $a^*(a+a)$ for the following CFG using both leftmost and rightmost derivation. The CFG is $E \rightarrow E + E | E * E | (E) | a$.