GLA University, Mathura

Department of Computer Engineering & Applications

Course: B. Tech CSE Year: 3rd Section: A and B
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Assignment questions for II-Module

Note:

1. **You have to submit your assignment on university portal along with your class roll no and name in each page.**
2. **At the last of assignment some solved questions are given for practice purpose.**

1. Explain why the given grammar is ambiguous. S → 0A | 1B A → 0AA | 1S | 1 B → 1BB | 0S | 0
2. Given the following ambiguous context free grammar S → Ab | aaB A → a | Aa B → b
   (a)Find the strings generated by the grammar that has two leftmost derivations. Show the derivations.
   (b) Show the two derivation trees for the strings.
3. State and prove pumping lemma for CFG. Prove that the given language is not context free:

   i) $L=\{a^i b^j c^i d^j / i,j \geq 0\}$

   ii) $L=\{a^i b^i c^i / i \geq 1\}$

4. Eliminate null productions

   i) S -> aSb/aAb/ab/a
      A -> ε

   ii) S->aXbX
      X->aY/bY/ ε
      Y->X/d

5. Eliminate null productions

   S -> AB
   A -> aAA/ε
   B -> bBB/ε

6. Prove that given grammar is ambiguous

   S->0s/1AA

   A->0/1A/0B

   B->1/0BB for string 0100110

7. For the grammar S->aAS/a, A->SbA/SS/ba. To generate the string aabaaabbaaa find:

a. LMD

b. RMD

c. Parse tree

8. Reduce the given CFG into CNF

   S->~S/[SX]/p/q (S being only variable)

9. Reduce the given CFG into CNF

   i) S->bA/aB

      A->bAA/aS/a

      B->aBB/bS/b

   ii) S->ASA/bA

      A->B/S

      B->a

10. Convert the grammar into GNF

   i) S->AB

      A->BS/a

      B->SA/b

   ii) S->ABb/a

      A->aaA

      B->bAb

11. Eliminate unit production from the given grammar and convert it into GNF.

      E->E+T/T

      T->T*F/F

      F->(E)/a

12. Eliminate unit production from the given grammar

   S->AB, A->a, B->C/b, C->D, D->E E->a

13. Remove the useless symbol from the given context free grammar:
S->aB/bX
A->BAd/bSX/a
B->aSB/bBX
X->SBD/aBx/ad

14. Consider a context free grammar G with the following productions:

   S->1S1 / T

   T->1 X 1 / X

   X->0 X 0 / 1.

   i) Write four strings of L(G).

ii) Give an example of a string wϵ{0,1}$^+$ such that |w|>7 and w$\notin$ L(G).

15. Give a CFG for the language L={xϵ{a,b}*/ x starts and ends with different symbols}.

☞*Some solved questions for (for study / Practice purpose only)*

1. Give context-free grammars that generate the following languages.

(a) { w ∈ {0, 1}* | w contains at least three 1s }

Answer: G = (V, Σ, R, S) with set of variables V = {S, X}, where S is the start variable;

set of terminals Σ = {0, 1}; and rules S → X1X1X1X X → 0X | 1X | ε

(b) { w ∈ {0, 1}* | w = wR and |w| is even }

Answer: G = (V, Σ, R, S) with set of variables V = {S}, where S is the start variable;

set of terminals Σ = {0, 1}; and rules S → 0S0 | 1S1 | ε

(c) { w ∈ {0, 1}* | the length of w is odd and the middle symbol is 0 }

Answer: G = (V, Σ, R, S) with set of variables V = {S}, where S is the start variable;

set of terminals Σ = {0, 1}; and rules S → 0S0 | 0S1 | 1S0 | 1S1 | 0

(d) { $a^i b^j c^k$ | i, j, k ≥ 0, and i = j or i = k }

Answer: G = (V, Σ, R, S) with set of variables V = {S, W, X, Y, Z}, where S is the start variable;

set of terminals Σ = {a, b, c}; and rules S → XY | W, X → aXb | ε, Y → cY | ε, W → aW c | Z, Z → bZ | ε

(e) { $a^i b^j c^k$ | i, j, k ≥ 0 and i + j = k }

Answer: G = (V, Σ, R, S) with set of variables V = {S, X}, where S is the start variable;

set of terminals Σ = {a, b, c}; and rules S → aSc | X, X → bXc | ε

2. Eliminate null production (λ) and find equivalent grammar

```
S -> ABCd
A -> BC
B -> bB | λ
C -> cC | λ
```

```
Sol. S -> ABCd | ABd | ACd | BCd | Ad  |  Bd  |Cd | d
A -> BC | B | C
B -> bB | b
C -> cC | c
```

3. Eliminate unit production and find equivalent grammar

```
S -> Aa | B
A -> b | B
```

```
B -> A | a
```

Sol.

```
S -> Aa | b | a
A -> b | a
B -> a | b
```

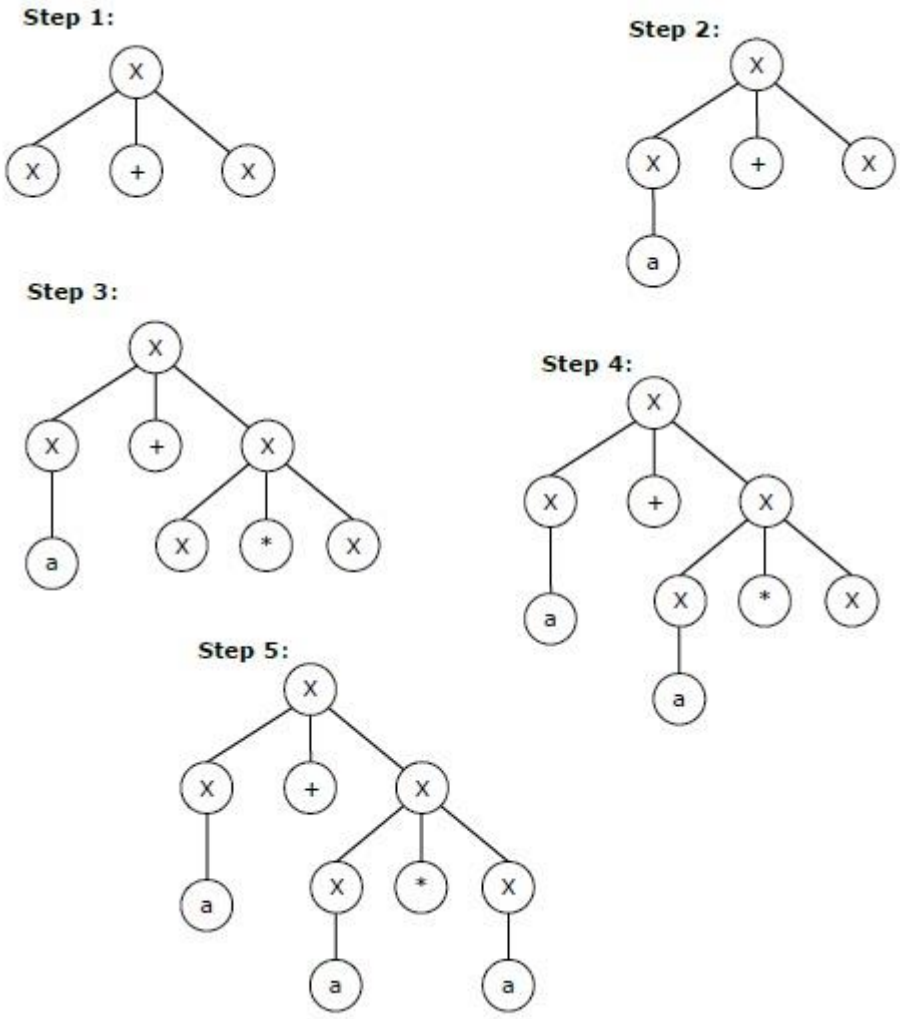
4. Let any set of production rules in a CFG be

X → X+X | X*X |X| a, over an alphabet {a}.

The leftmost derivation for the string "a+a*a" may be −

X → X+X → a+X → a + X*X → a+a*X → a+a*a

The stepwise derivation of the above string is shown as below −

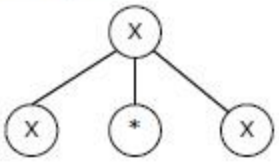


The rightmost derivation for the above string "a+a*a" may be −

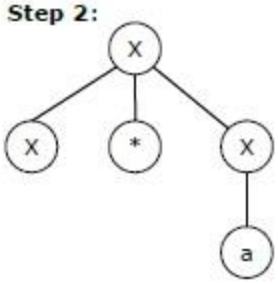
X → X*X → X*a → X+X*a → X+a*a → a+a*a

The stepwise derivation of the above string is shown as below −

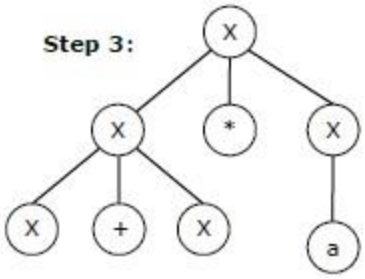
Step 1:



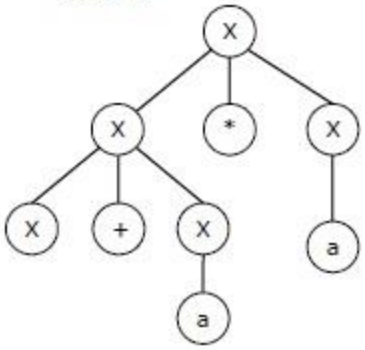
Step 2:



Step 3:



Step 4:



Step 5: