COMPUTER ENGINEERING DEPARTMENT

ASSIGNMENT NO-06

Sub: Theory of Computer Science

COURSE: T.E. Year: 2020-2021 Semester: V
DEPT: Computer Engineering
SUBJECT CODE: CSC504 DUE DATE: 22/11/2020
==========

Roll No. 50 Name: Amey Thakur

Class: TE-Comps B Date of Submission: 20/11/2020

Tutorial 6

1. What is ambiguous grammar? Give one example

2. Let G be the grammar
   S→ aB | bA
   A→ a |aS| bAA
   B→ b |bS| aBB
   Find leftmost derivation, rightmost derivation and parse tree for the string **"bbaaabbaba".**

3. The following grammar generates the language of RE 0*1(0+1)*
   S → A|B
   A → 0A|ϵ
   B → 0B|1B|ϵ
   Give leftmost and rightmost derivations of the following strings
   a) 00101 b) 1001 c) 00011

4. Consider the grammar
   S → aS|aSbS|ϵ
   Show that derivation for the string aab is ambiguous

5. Consider the grammar where P=
   S → aAS | a
   A → SbA | SS |ba
   Perform LMD, RMD and construct Parse Tree for string **'aabbaa**'

Q.1 What is Ambiguous Grammar ? Give one example.

Ans:

Ambiguous Grammar

A Grammar is said to be Ambiguous if there exists two or more derivation tree for a string w (that means two or more left derivation trees)

Example : $G = (\{S\}, \{a, b, +, *\}, P, S\}$ where P consists of

$S \rightarrow S+S \mid S*S \mid a \mid b$

The string a + a * b can be generated as :

$S \rightarrow S+S$
$\rightarrow a+S$
$\rightarrow a+S*S$
$\rightarrow a+a*S$
$\rightarrow a+a*b$

$S \rightarrow S*S$
$\rightarrow S+S*S$
$\rightarrow a+S*S$
$\rightarrow a+a*S$
$\rightarrow a+a*b$

Thus, this Grammar is Ambiguous.

Q2. Let G be the grammar

$S \rightarrow aB \mid bA$

$A \rightarrow a \mid aS \mid bAA$

$B \rightarrow b \mid bS \mid aBB$

Find leftmost derivation, rightmost derivation and parse tree for the string "bbaaabbaba".

Ans:

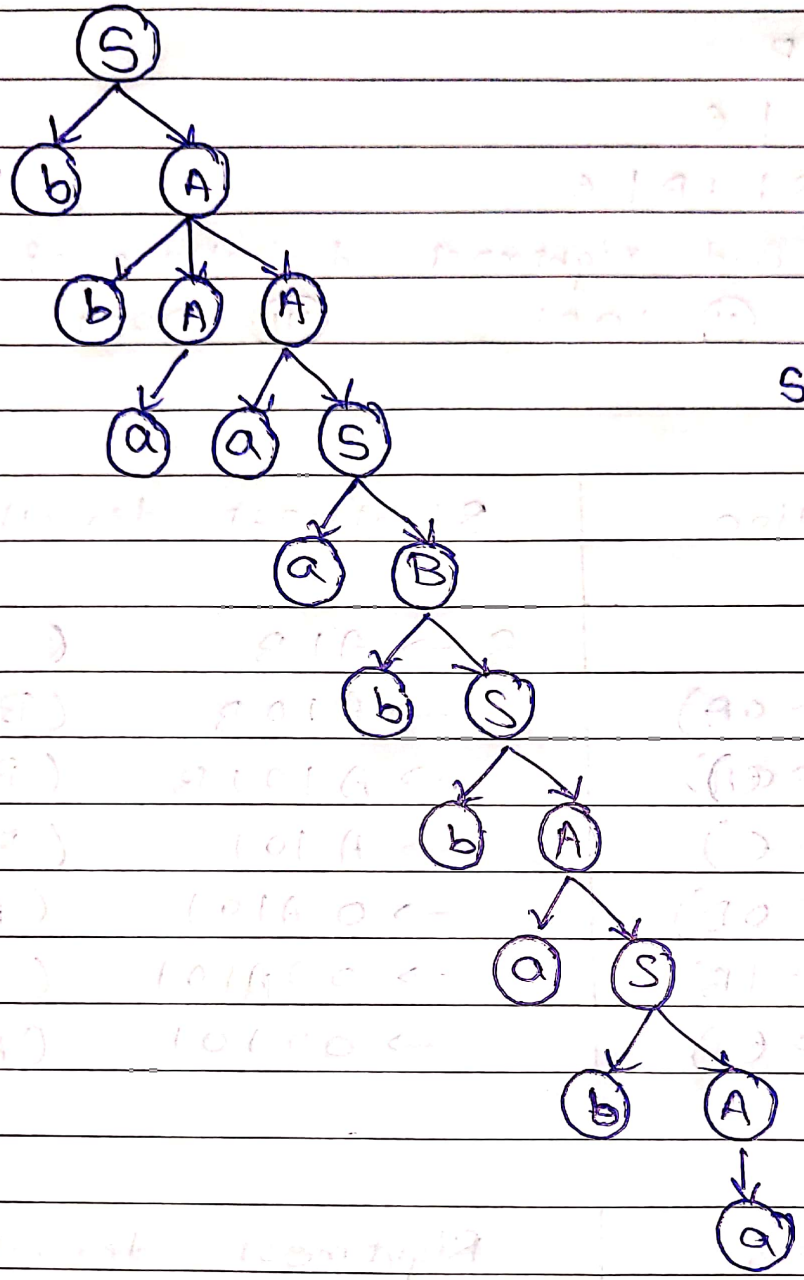
(i) Leftmost derivation

$S \rightarrow bA$
$\rightarrow bbAA$ $(A \rightarrow bAA)$
$\rightarrow bbaA$ $(A \rightarrow a)$
$\rightarrow bbaaS$ $(A \rightarrow aS)$
$\rightarrow bbaaaB$ $(S \rightarrow aB)$
$\rightarrow bbaaabS$ $(B \rightarrow bS)$
$\rightarrow bbaaabbA$ $(S \rightarrow bA)$
$\rightarrow bbaaabbaS$ $(A \rightarrow aS)$
$\rightarrow bbaaabbabA$ $(S \rightarrow bA)$
$\rightarrow bbaaabbaba$ $(A \rightarrow a)$

(ii) Rightmost derivation

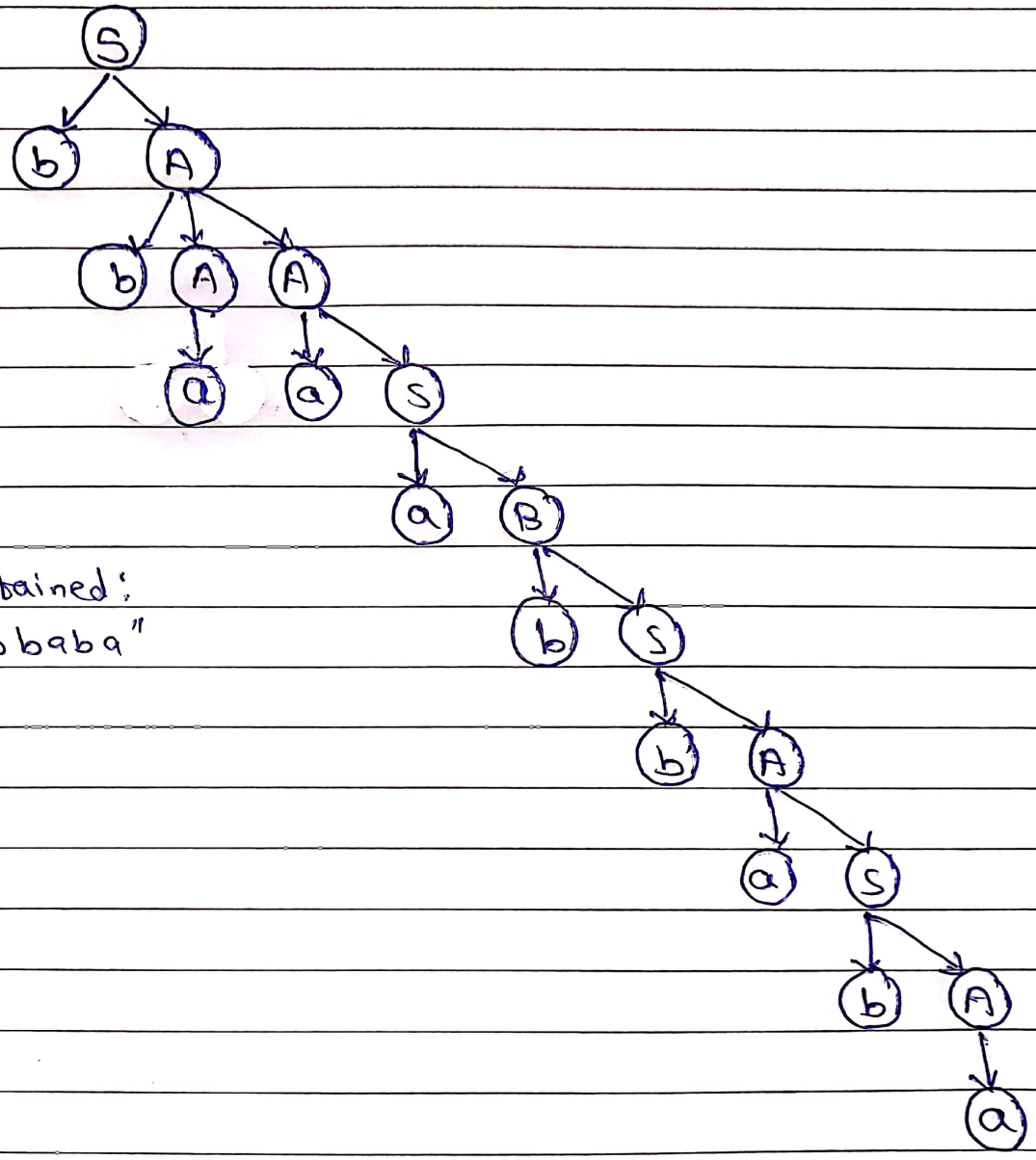
$S \rightarrow bA$
$\rightarrow bbAA$ $(A \rightarrow bAA)$
$\rightarrow bbAaS$ $(A \rightarrow aS)$
$\rightarrow bbAaaB$ $(S \rightarrow aB)$
$\rightarrow bbAaabS$ $(B \rightarrow bS)$
$\rightarrow bbAaabbA$ $(S \rightarrow bA)$
$\rightarrow bbAaabbaS$ $(A \rightarrow aS)$
$\rightarrow bbAaabbabA$ $(S \rightarrow bA)$
$\rightarrow bbAaabbaba$ $(A \rightarrow a)$
$\rightarrow bbaaabbaba$ $(A \rightarrow a)$

(iii) Parse Tree for Leftmost Derivation



String obtained:
"bbaaabbaba"

(iv) Parse Tree for Rightmost Derivation.



String Obtained:
"bbaaaabbaba"

Q.3 The following grammar generates the language of RE $0^*1(0+1)^*$

$S \rightarrow A \mid B$

$A \rightarrow 0A \mid \epsilon$

$B \rightarrow 0B \mid 1B \mid \epsilon$

Give leftmost and rightmost derivation of the following

(i) 00101 (ii) 1001 (iii) 00011

Ans:

(i) 00101

leftmost derivation

$S \rightarrow B$

$\rightarrow 0B$ $(B \rightarrow 0B)$

$\rightarrow 00B$ $(B \rightarrow 0B)$

$\rightarrow 001B$ $(B \rightarrow 1B)$

$\rightarrow 0010B$ $(B \rightarrow 0B)$

$\rightarrow 00101B$ $(B \rightarrow 1B)$

$\rightarrow 00101$ $(B \rightarrow \epsilon)$

Note:
Rightmost derivation is same as leftmost derivation

(ii) 1001

leftmost derivation

$S \rightarrow B$

$\rightarrow 1B$ $(B \rightarrow 1B)$

$\rightarrow 10B$ $(B \rightarrow 0B)$

$\rightarrow 100B$ $(B \rightarrow 0B)$

$\rightarrow 1001B$ $(B \rightarrow 1B)$

$\rightarrow 1001$ $(B \rightarrow \epsilon)$

Note:
Rightmost derivation is same as leftmost derivation

(iii) 00011

leftmost derivation

S →	B	
→	0 B	(B → 0B)
→	0 0 B	(B → 0B)
→	0 0 0 B	(B → 0B)
→	0 0 0 1 B	(B → 1B)
→	0 0 0 1 1 B	(B → 1B)
→	0 0 0 1 1	(B → ∈)

Note:
Rightmost derivation is same as leftmost derivation

Q.4. Consider the grammar

$S \rightarrow aS \mid aSbS \mid \epsilon$

Show the derivation for the string aab is ambiguous

Ans:

Leftmost Derivation

(I) $S \rightarrow aS$
$\rightarrow aaSbS \quad (S \rightarrow aSbS)$
$\rightarrow aabS \quad (S \rightarrow \epsilon)$
$\rightarrow aab \quad (S \rightarrow \epsilon)$

(II) $S \rightarrow aSbS$
$\rightarrow aaSbS \quad (S \rightarrow aSbS)$
$\rightarrow aabS \quad (S \rightarrow \epsilon)$
$\rightarrow aab \quad (S \rightarrow \epsilon)$

∵ There exists two derivation tree for given grammar

∴ This grammar is ambiguous

Q.5 Consider the grammar where P =

$S \rightarrow aAS \mid a$

$A \rightarrow SbA \mid SS \mid ba$

Perform LMD, RMD and construct Parse Tree for String 'aabbaa'.

Ans:

Leftmost Derivation

$S \rightarrow aAS$

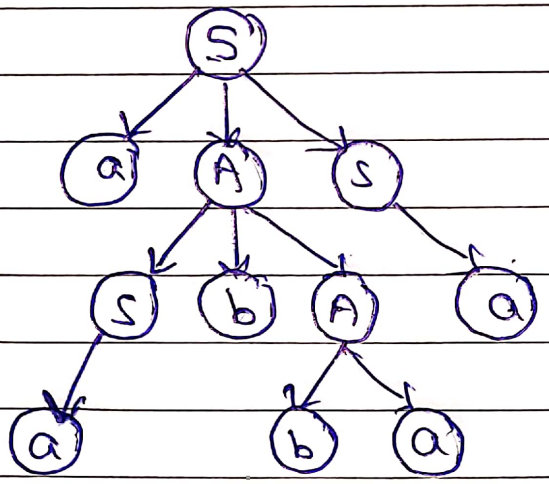
$\rightarrow aSbAS \quad (A \rightarrow SbA)$

$\rightarrow aabAS \quad (S \rightarrow a)$

$\rightarrow aabbaS \quad (A \rightarrow ba)$

$\rightarrow aabbaa \quad (S \rightarrow a)$

Parse Tree for Leftmost Derivation



String obtained:
"aabbaa"

Rightmost Derivation

$S \rightarrow aAS$

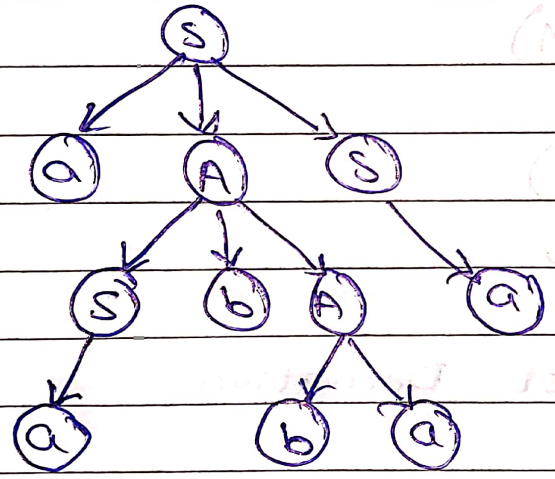
$\rightarrow aAa \quad (S \rightarrow a)$

$\rightarrow aSbAa \quad (A \rightarrow SbA)$

$\rightarrow aSbbaa \quad (A \rightarrow ba)$

$\rightarrow aabbaa \quad (S \rightarrow a)$

Parse Tree for Rightmost Derivation



String Obtained:
"aabbaa"