Leftmost and Rightmost Derivations

→ A CFG that is not linear (i.e. having more than one NT in a production) can have more than one derivation depending on NT choosen for replacement.

→ A derivation is said to be leftmost if in each step leftmost variable is choosen for replacement

→ if rightmost variable is choosen then it is rightmost derivation

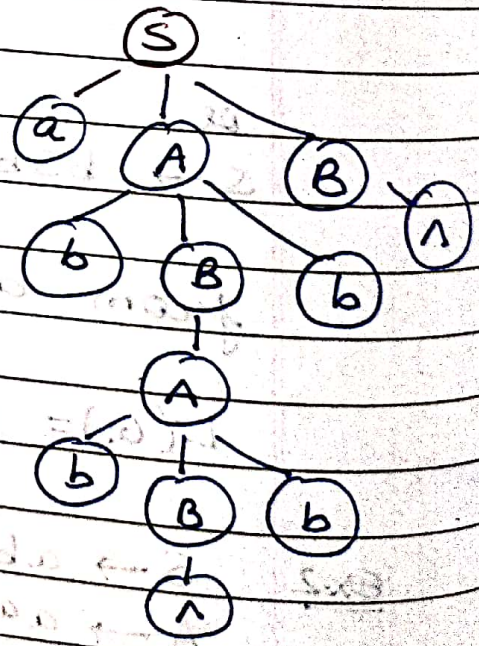
Ex.

$S \rightarrow aAB$

$A \rightarrow bBb$

$B \rightarrow A|\wedge$

$w = abbbb$



derivation tree

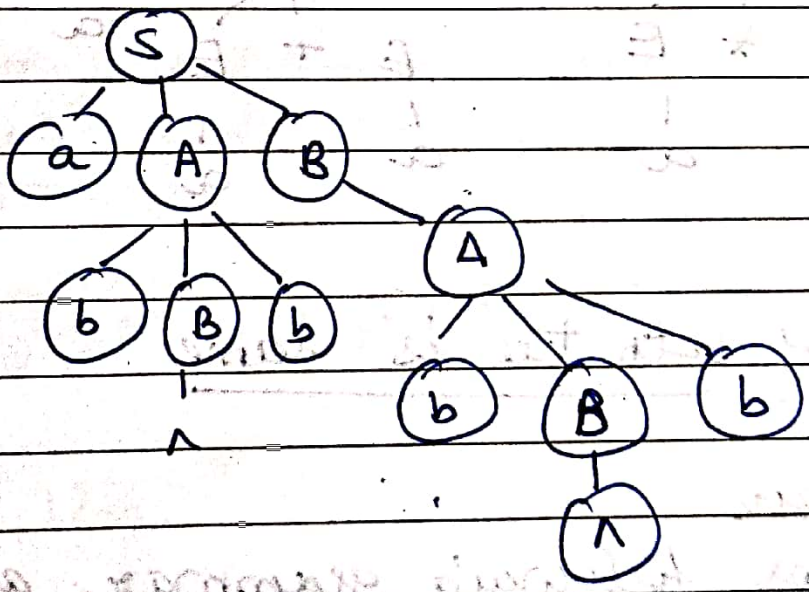
yield (Reading leaf of tree from L→R) gives the string

PAGE NO. :
DATE : / /

Leftmost derivation	Rightmost derivation
$S \rightarrow aAB$	$S \rightarrow aAB$
$\rightarrow abBbB$	$\rightarrow aA$
$\rightarrow abAbB$	$\rightarrow abBb$
$\rightarrow abbBbbB$	$\rightarrow abAb$
$\rightarrow abbbbbB$	$\rightarrow abbBbb$
$\rightarrow abbbbb$	$\rightarrow abbbbb$

Ans:

In above grammar another alternative exist to generate same string i.e.



The above method gives a new issue in CFG i.e. **Ambiguity**

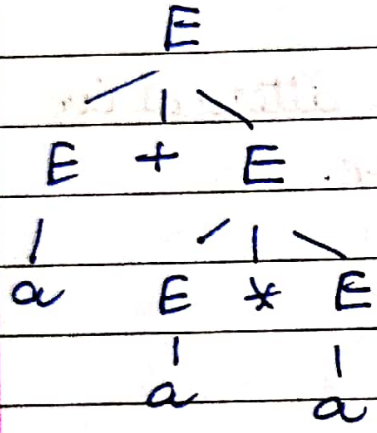
Ambiguous grammar → A CFG G is said to be ambiguous if there exist more than one derivation tree from a string

Ex:

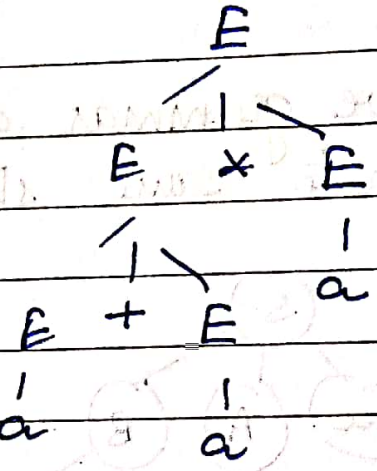
$E \to E+E \mid E*E \mid a$

$w = a+a*a$

Tree-1



Tree-2



Yield of both tree is same

Question

Check for following grammar are ambiguous or not.

$S \to SS \mid aSb \mid bSa \mid \wedge$

$S \to AB \mid aaB$

$A \to a \mid Aa$

$B \to b$

3. $S \to iCtS \mid iCtSeS \mid a$

$C \to b$

4. $S \to aSbS \mid bSaS \mid \wedge$

PAGE NO.:
DATE: / /

Ambiguous → Unambiguous

for L is grammar is ambiguous we can generate unambiguous version by imposing some rules ie.

$E \to E+E \mid E*E \mid E-E \mid E/E \mid E \uparrow E \mid a$ is a ambiguous grammar

→ We can generate unambiguous version by following

precedence	Associativity	
H	R→L	↑
M	L→R	* /
L	L→R	+ -

Procedure

→ The NT nearer to leaf node has high precedence

→ Same NT at LHS make operator left-associative similarly same NT at RHS make it right associative

So unambiguous grammar is

$F \to a$

$P \to F \uparrow P \mid F$

$T \to T * P \mid T / P \mid P$

$E \to E+T \mid E-T \mid T$