lecture 22:- CFG.

Ex:- $S \to aSb$. (1)

$S \to \Lambda$. (2)

$\{\Lambda, ab, aabb, aaabbb$ ---- $\}$.

$= \{a^n b^n . \ n = 0, ---- \}$.

Non Regular.

aSb

$aaSbb$

$aaaSbbb$

Simplification of Rules.

Example:-

$S \to aSa$
$S \to aBa$
$B \to bB$
$B \to b$.

$S \to aSa \mid aBa$
$B \to bB \mid b$.

the left sides of the production must be same.

$L = \{a^n b^m a^n \quad n \geq 0, m \geq 0\}$.

Ex:- $S \to aXb \mid bXa \mid \Lambda$.
$X \to aX \mid bX \mid \Lambda$.

HW.

A Grammar that generates even length of strings $\{a,b\}$.

$S \to aO \mid bO \mid \Lambda$.
$O \to aS \mid bS$.

$\{\Lambda, aa, ab, ba, bb, ---\}$.

aO	aO	bO	bO
aaS	abS	baS	bbS
$aa\Lambda$.	$ab\Lambda$	$ba\Lambda$	$bb\Lambda$
aa	ab	ba	bb

aO
aaS

aO
aaS
aaaO
aaaaS.
aaaah
aaaa.

Ex:- $S \to AB$, $A \to aA \mid a$, $B \to bB \mid \lambda$. $\quad a^+b^*$.

$S \to aS \mid aB$, $B \to bB \mid \lambda$. $\quad a^+b^*$.

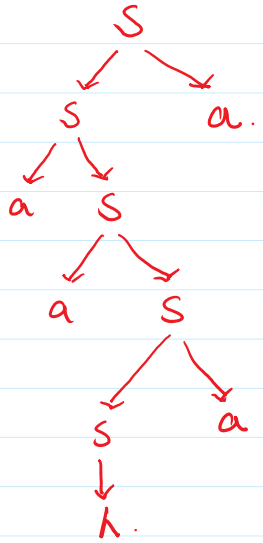
Multiple Grammars may exist for a Certain language.

PARSE TREE :- (Syntax Tree, Generation Tree, Production Tree, Derivation).

$S \to Sa$ ①
$S \to aS$ ②
$S \to \lambda$ ③.

aaaa.

$S \to Sa$ — ① ✓
$\to aSa$ — ② ✓
$\to aaSa$ — ② ✓
$\to aaSaa$ — ① ✓
$\to aa\lambda aa$ — ③ ✓
$\to aaaa$

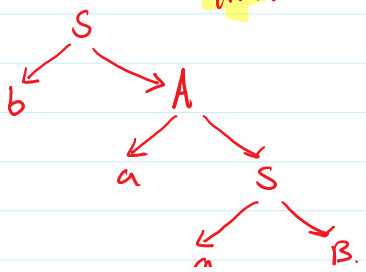


baaabbab.

1- $S \to \lambda$
2- $S \to bA$
3- $S \to aB$
4- $A \to a$
5- $A \to aS$

$S \to bA$ ②
$\to baS$ ⑤
$\to baaB$. ③
$\to baaaBB$. ④
$\to baaaBb$ ①

HW.



4- $A \to a \to baaaBB.$ (9)

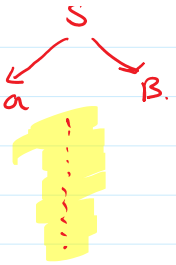
5- $A \to aS \to baaaBb$ (7)

6- $A \to bAA \to baaabSb.$ (8)

7- $B \to b \to baaabbAb.$ (2)

8- $B \to bS \to baaabbab.$ (4)

9- $B \to aBB$



Tree.

Ambigious

" A CFG is called ambigious if ∃ word which has two different parse. Trees."

Ex:- $S \to aS \mid Sa \mid \lambda.$

$S \to Sa$ — (1) ✓

$\to asa$ — (2) ✓

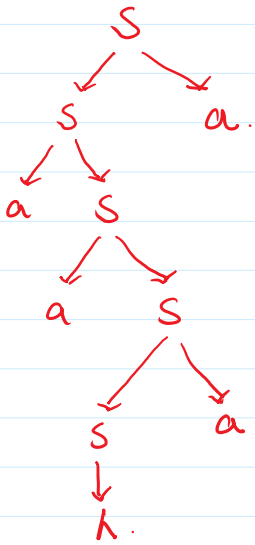
$\to aasa$ — (2) ✓

$\to aaSaa$ — (1) ✓

$\to aa\lambda aa$ — (3) ✓

$\to aaaa$

$\Longleftrightarrow$



$S \to aS \mid Sa \mid \lambda.$

$S \to aS$

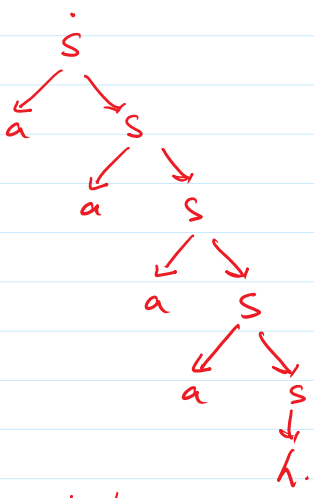
$\to aaS$

$\to aaaS$

$\to aaaaS$

$\to aaaa\lambda$

$\to aaaa.$



Ex:- Arithmetic Expression.

$S \to A$

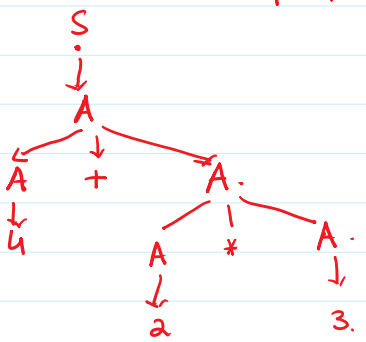
$A \to \underline{\text{Integer}} \mid \underline{A+A} \mid \underline{A-A} \mid \underline{A*A} \mid \underline{A/A} \mid \underline{(A)}.$

$A \rightarrow \underline{\text{integer}} \mid \underline{A+A} \mid \underline{A-A} \mid \underline{A*A} \mid \underline{A/A} \mid \underline{(A)}$.

↑ = Terminals.

$4+2*3$

$S \rightarrow A$.
$\rightarrow A+A$.
$\rightarrow A+A*A$.
$\rightarrow 4+2*3$.



$S \rightarrow A$
$\rightarrow A*A$
$\rightarrow A+A*A$
$\rightarrow 4+2*3$.

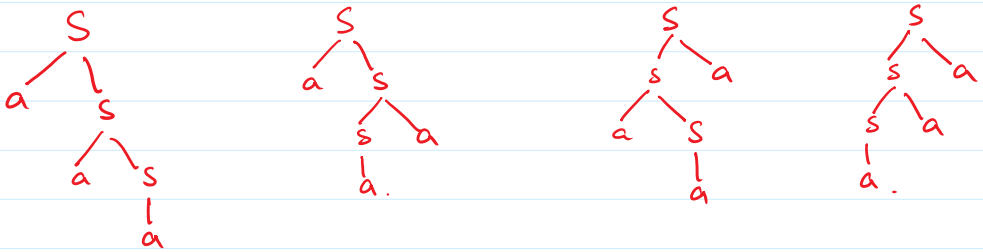
$\Rightarrow$ Parse Tree (HW).

This Creates Ambiguity.

Ex:- $S \rightarrow aS \mid Sa \mid a$.

Derive a^3 Using 4 Different Derivations.

aaa.



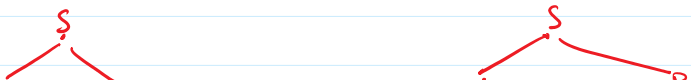
Write the derivations. (Hint).

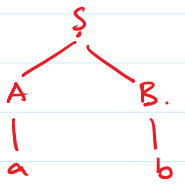
Ex:- $S \rightarrow AB$
$A \rightarrow a$
$B \rightarrow b$.

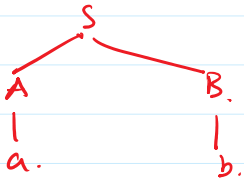
ab.

$S \rightarrow AB$
aB
ab.

$S \rightarrow AB$.
$\rightarrow Ab$
$\rightarrow ab$.







If Derivations are different but ST are same
So the word is not Ambiguous.

LEFT MOST DERIVATION.

RIGHT MOST DERIVATION.

↓ = Terminals.

$S \to E$
$E \to T+E \mid T-E \mid T$
$T \to F*T \mid F/T \mid F$
$F \to$ INTEGER $\mid (E)$.

$4+2*3$.

$S \to E$
$\to T+E$
$\to F+E$.
$\to 4+E$
$\to 4+T$
$\to 4+F*T$
$\to 4+2*T$
$\to 4+2*F$
$\to 4+2*3$.

$S \to E$
$E \to T+E \mid T-E \mid T$
$T \to F*T \mid F/T \mid F$
$F \to$ INTEGER $\mid (E)$.

$S \to E$
$\to T+E$
$\to T+T$
$\to T+F*T$
$\to T+F*F$
$\to T+F*3$
$\to T+2*3$.
$\to F+2*3$.
$\to 4+2*3$.