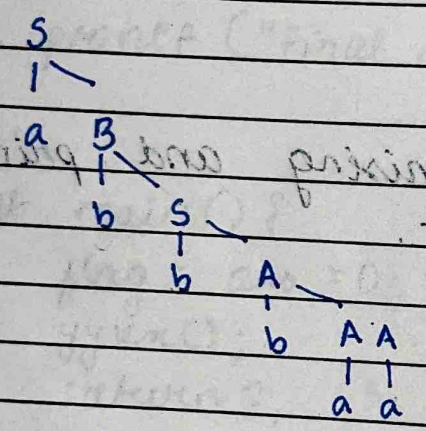
TUTORIAL-4

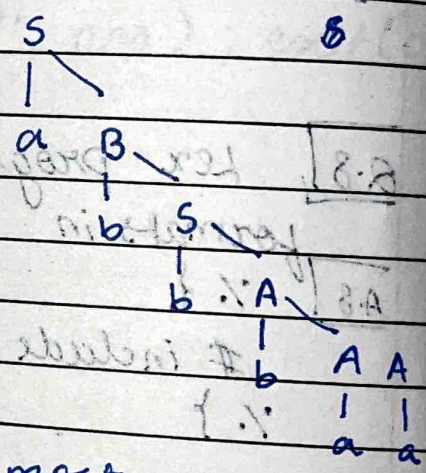
Q.1 Construct leftmost derivation and right most derivation and parse trees for the string -

a) $S \rightarrow aB \mid bA$
$A \rightarrow a \mid aS \mid bAA$
$B \rightarrow b \mid bS \mid aBB$

Input string 1 : abbbaa



Left most derivation tree



Right most derivation tree

$S \rightarrow aB$
abS
$abbA$
$abbbAA$
$abbbaA$
$abbbaa$

Left most derivation

$S \rightarrow aB$
abS
$abbA$
$abbbAA$
$abbbAa$
$abbbaa$

Rightmost derivation

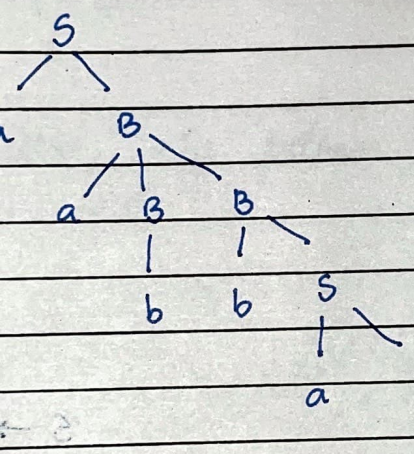
Input String 2: aabbab

$S \to aB$
$aaBB$
$aabB$
$aabbS$
$aabbaB$
$aabbab$

Leftmost derivation

$S \to aB$
$aaBB$
$aaBbS$
$aaBbaB$
$aaBbab$
$aabbab$

Rightmost derivation

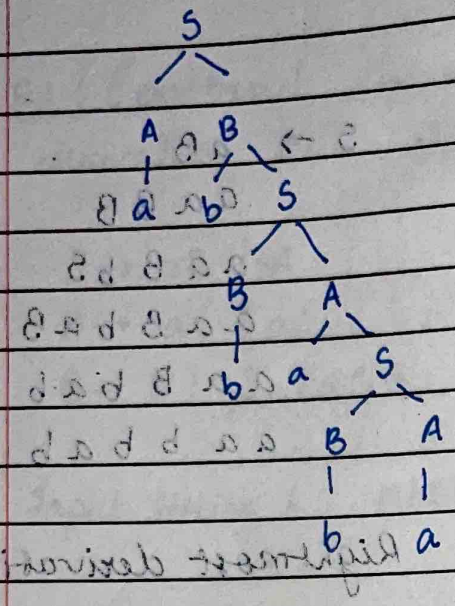


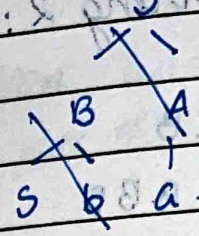
b) $S \to AB \mid BA$
$A \to a \mid aS$
$B \to b \mid bS$

Input String 1: abbaba , Input String 2: bbbaaaab

(i) $S \to AB$
aB
abS
$abBA$
$abbA$
$abbaS$
$abbaBA$
$abbaba$

$S \to BA$
$\cancel{A \to S}$ Ba
$\cancel{Ab}$ Sba
$BAba$
$Baba$
$Sbaba$
$ABbaba$
$Abbaba$ abbaba





$S \rightarrow AB$

AbS

$AbBA$

$AbBaS$

$AbBaBA$

$AbBaBa$

$AbBaba$

$Abbaba$

$abbaba$

(ii) bbb aaaab

$S \rightarrow BA$

bSA

$bBAA$

$bbSAA$

$bbBAAA$

~~bbbSAAA~~

$bbbAAA$

$bbbaAA$

$bbbaaA$

$bbbaaaS$

$bbbaaaAB$

$bbbaaaaB$

$bbbaaaab$

$S \rightarrow BA$

BaS

$BaAB$

$BaAb$

$Baab$

$bSaab$

$bBAaab$

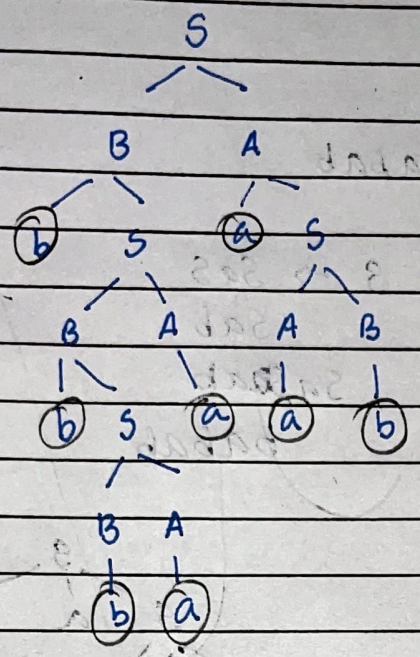
~~bbSAaab~~ $bBaaab$

$bbSaaab$

$bbBAaaab$

$bbBaaaab$

$bbbaaaab$



Q.2 Check whether the below grammar is ambiguous or not.

a) $S \rightarrow SS \mid a \mid \varepsilon$

$S \rightarrow SS$
εS
a

$S \rightarrow SS$
$S\varepsilon$
a

∵ We get multiple possible parse trees for string 'a' this grammar is ambiguous.

b) $E \rightarrow E + E \mid E - E \mid id$

For string 'id + id - id'

$E \rightarrow E + E$
$id + E$
$id + E - E$
$id + id - id$

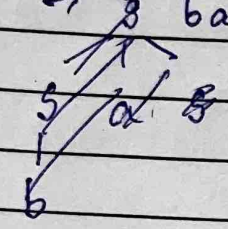
This string cannot be produced in multiple ways. ∴ Not Ambiguous.

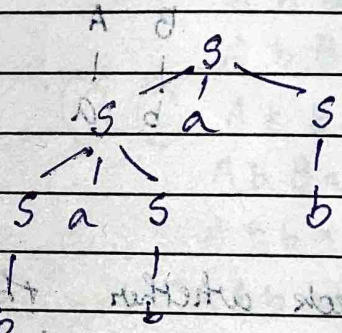
c) $S \to SaS \mid b$

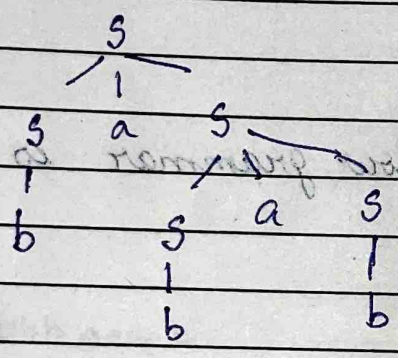
Using string babab

$S \to SaS$
$\to baS$
$\to baSaS$
$\to babab$

$S \to SaS$
$\to SaSab$
$\to SaSaab$
$\to babab$





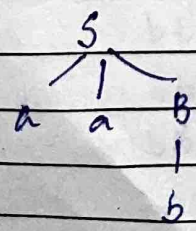


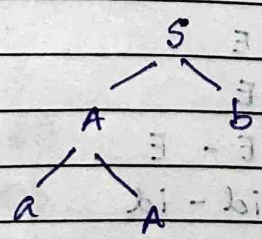
∴ Ambiguous

d) $S \to aaB \mid Ab$
$B \to b$
$A \to a \mid aA$

Using aab

→



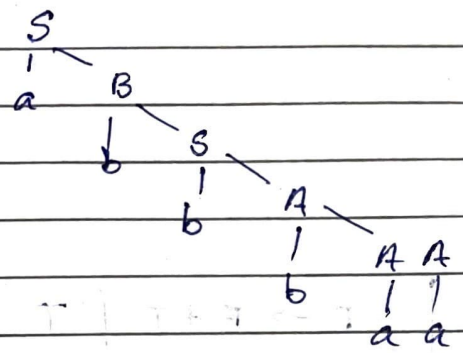


∴ Ambiguous

e) $S \to aB \mid bA$
$A \to a \mid aS \mid bAA$
$B \to b \mid bS \mid aBB$

Using abbbaa

∵ Left ~~recursive~~ most derivation & right most are same
∴ ~~M~~. Probably not ambiguous.



Q.3 Consider the following grammar & eliminate left recursion –

a) $A \to ABd \mid Aa \mid a$
$B \to Be \mid d$
$\alpha \quad \beta$

$\left[\begin{array}{l} A \to \beta A' \\ A' \to \alpha A' \mid \varepsilon \end{array}\right]$

$\to B \to dB'$
$B' \to eB' \mid \varepsilon$

Similarly, in
$A \to \underbrace{ABd}_{\alpha} \mid \underset{\beta}{a}$

$\to A \to aA'$
$A' \to BdA' \mid \varepsilon$

$A \to \underset{\alpha}{Aa} \mid \underset{\beta}{a}$

$\Rightarrow A \to aA'$
$A' \to aA' \mid \varepsilon$

$$\boxed{\begin{array}{l} A \to aA' \mid a \\ A' \to BdA' \mid aA' \mid \varepsilon \\ B \to dB' \\ B' \to eB' \mid \varepsilon \end{array}}$$

b) $E \to \underbrace{E + E}_{\alpha_2} \mid \underbrace{E \times E}_{\alpha_1} \mid \underset{\beta_1}{a}$

$\therefore$ $E \to aE'$
$E' \to \times E E' \mid + E E' \mid \varepsilon$

c) $E \to E + T \mid T$
$T \to T \times F \mid F$
$F \to id$

$\to T \to \underbrace{T \times id}_{\alpha} \mid \underset{\beta}{id}$

$T \to id\, T'$
$T' \to \times id\, T' \mid \varepsilon$

$E \to E + T \mid T$

$\Rightarrow E \to E + T \times F \mid E + F \mid T \times F$

$\Rightarrow E \to \underbrace{E + T \times id}_{\alpha_1} \mid \underbrace{E + id}_{\alpha_2} \mid T \times id$

$\Rightarrow E \to \underset{\beta}{id}\, E'$
$E' \to + T \times id\, E' \mid + id\, E' \mid \varepsilon$

$\therefore$ $E \to id\, E'$
$E' \to + T \times id\, E' \mid + id\, E' \mid \varepsilon$
$T \to id\, T'$
$T \to \times id\, T' \mid \varepsilon$

d) $S \to \underbrace{S0S1S}_{\alpha} \mid \underbrace{01}_{\beta}$

$S \to 01S'$
$S' \to 0S1SS' \mid \varepsilon$

e) $A \to AA\alpha \mid \beta$

$\Rightarrow A \to \beta A'$
$A' \to A\alpha A' \mid \varepsilon$