POORNIMA

Date	Unit No.	Lecture No.	Faculty	Subject Name	Subject Code	Main Topics:-
				Regular Grammar.		

Construction of finite Automata from RG

construction of RG from FA

RG → FA :- $G = (V_N, \Sigma, P, S)$

$V_N \rightarrow A_0, A_1 \text{ ---------- } q_0 q_1$

(states)

$\Sigma \rightarrow a, b.$

S → Corresponds to system

Production Rules (P) :-

(1) $A_i \rightarrow a$ ⟶ Transition Terminates & unique final state is created.

(2.1) $A_i \rightarrow a A_j$ ⟶ $q_i \longrightarrow q_j \Rightarrow a \mid q_i \xrightarrow{a} q_j$

(2.2) $A_i \rightarrow a$

Main Ideas, Questions & Summary:

Library / Website Ref.:-

RG → FA

Q. $G = \{\{S, A\}, \{a, b\}, P, S\}$

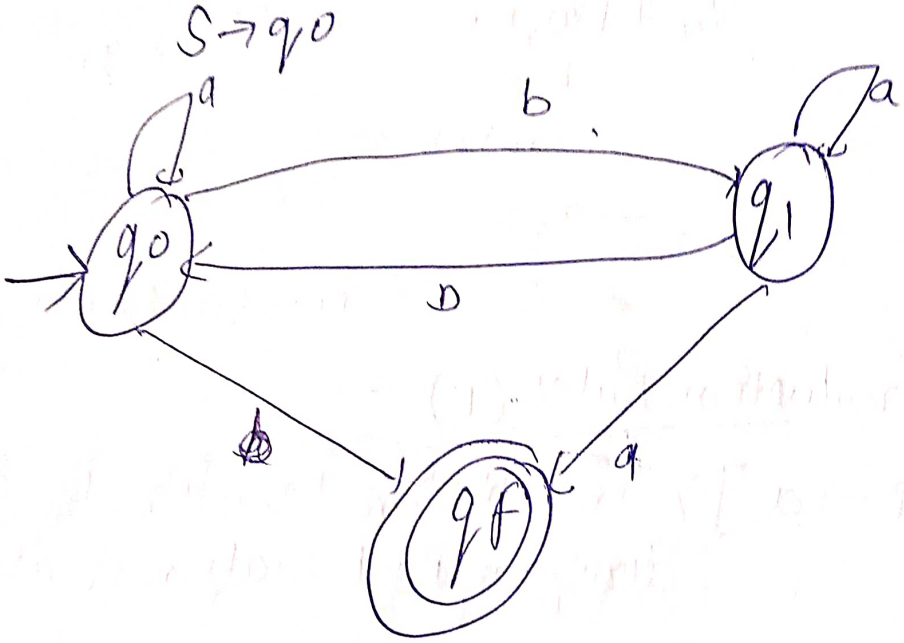
$P \rightarrow S \rightarrow aS \mid bA \mid b$

$A \rightarrow aA \mid bS \mid a.$

Soln $V_N = \{S, A\}$

$S \quad A$

$q_0 \quad q_1 \longrightarrow q_f$



Q. Construct the finite Automata from the given Regular Grammar

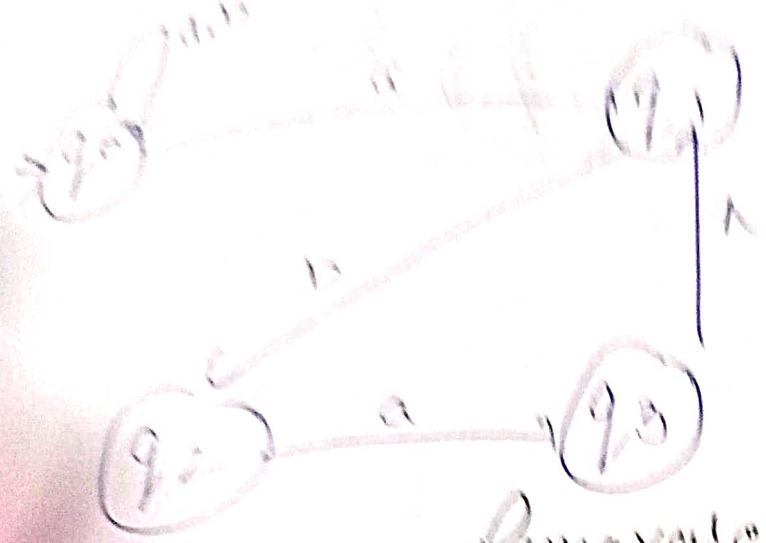
$S \rightarrow aS \mid bS \mid aA.$

$A \rightarrow bB$

$B \rightarrow aC.$

$C \rightarrow A.$

$G = \{V_N, \Sigma, P, S\}$



→ Null moves Removal
→ NFA to DFA

FA → RG

$G = (V_N, \Sigma, P, S)$

$V_N = q_0, q_1, q_2 \ldots\ldots A_0, A_1, A_2$

Σ = set of inputs

S → start state → $q_0 \rightarrow A_0$.

P → Production Rules.

Questions & Summary:

Construction of Production Rules :-

⇒ Non-final state

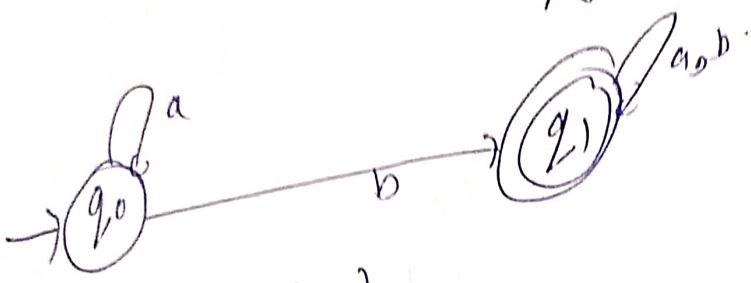
(i) $A_p \to aA_q$ if $\delta(q_i, a) = q_j$, $q_j \neq F$ ①

⇒ Final state.

(ii) $A_i \to aA_q$ and $A_i \to a$ if $\delta(q_i, a) = q_j$.

$q_j \in F$ ②

Q.



$G = \{V_N, \Sigma, P, S\}$

$V_N = \{A_0, A_1\}$.

$\Sigma = \{a, b\}$

$S \to \{q_0\}$

$P \to A_0 \to aA_0 \mid bA_1 \mid b$

$A_1 \to aA_1 \mid bA_1$

Production Rules.

① Non-final state :-

$\delta(q_0, a) \to q_0 \to A_0 \to aA_0$

② Final state

$\delta(q_0 \to b) \to q_1 \quad A_0 \to bA_1$ & $A_0 \to b$ ②

$\delta(q_1 \to a) \to q_1 \quad A_1 \to aA_1$ & $A_1 \to b$ ③

$\delta(q_1 \to b) \to q_1 \quad A_1 \to bA_1$ & $A_1 \to b$

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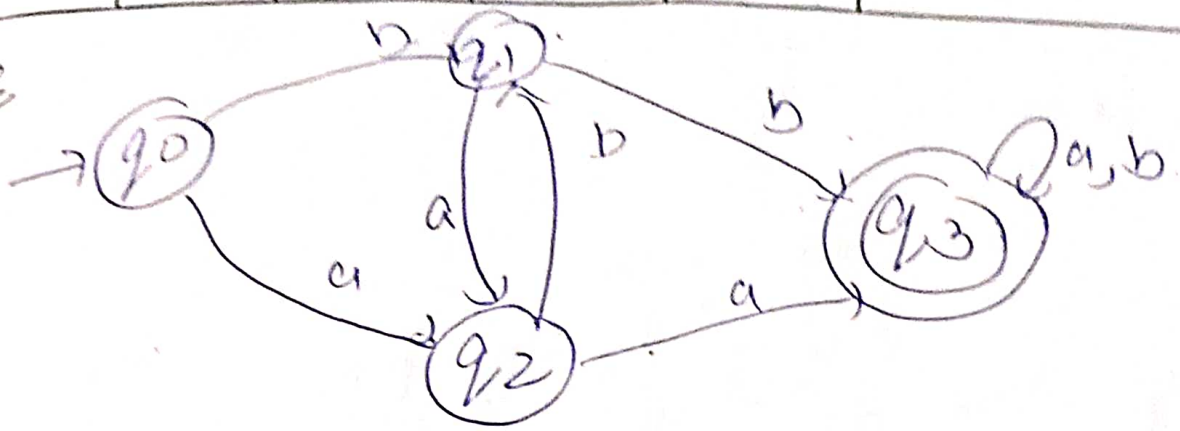
Date	Unit No.	Lecture No.	Faculty	Subject Name	Subject Code	Main Topics:-

Q.



$G = (V_N, \Sigma, \delta, S)$

$V_N = \{A_0, A_1, A_2, A_3\}$

$\Sigma = \{a, b\}$

$S = \{q_0\}$

Production Rules :→

① Non final state.

$\delta(q_0, b) \rightarrow q_1 \Rightarrow A_0 \rightarrow bA_1$

$\delta(q_0, a) \rightarrow q_2 \Rightarrow A_0 \rightarrow aA_2$

$\delta(q_1, a) \rightarrow q_2 \Rightarrow A_1 \rightarrow aA_2$

$\delta(q_2, b) \rightarrow q_1 \Rightarrow A_2 \rightarrow bA_1$

② final state.

$\delta(q_1, b) \rightarrow q_3 \Rightarrow A_1 \rightarrow bA_3 \;\&\; A_1 \rightarrow b$

$\delta(q_2, a) \rightarrow q_3 \Rightarrow A_2 \rightarrow bA_3 \;\&\; A_2 \rightarrow b$

$\delta(q_3, a) \rightarrow q_3 \Rightarrow A_3 \rightarrow aA_3 \;\&\; A_3 \rightarrow a$

$\delta(q_3, b) \rightarrow q_3 \Rightarrow A_3 \rightarrow bA_3 \;\&\; A_3 \rightarrow b$

s, Questions & Summary:

ebsite Ref.:-

POORNIMA

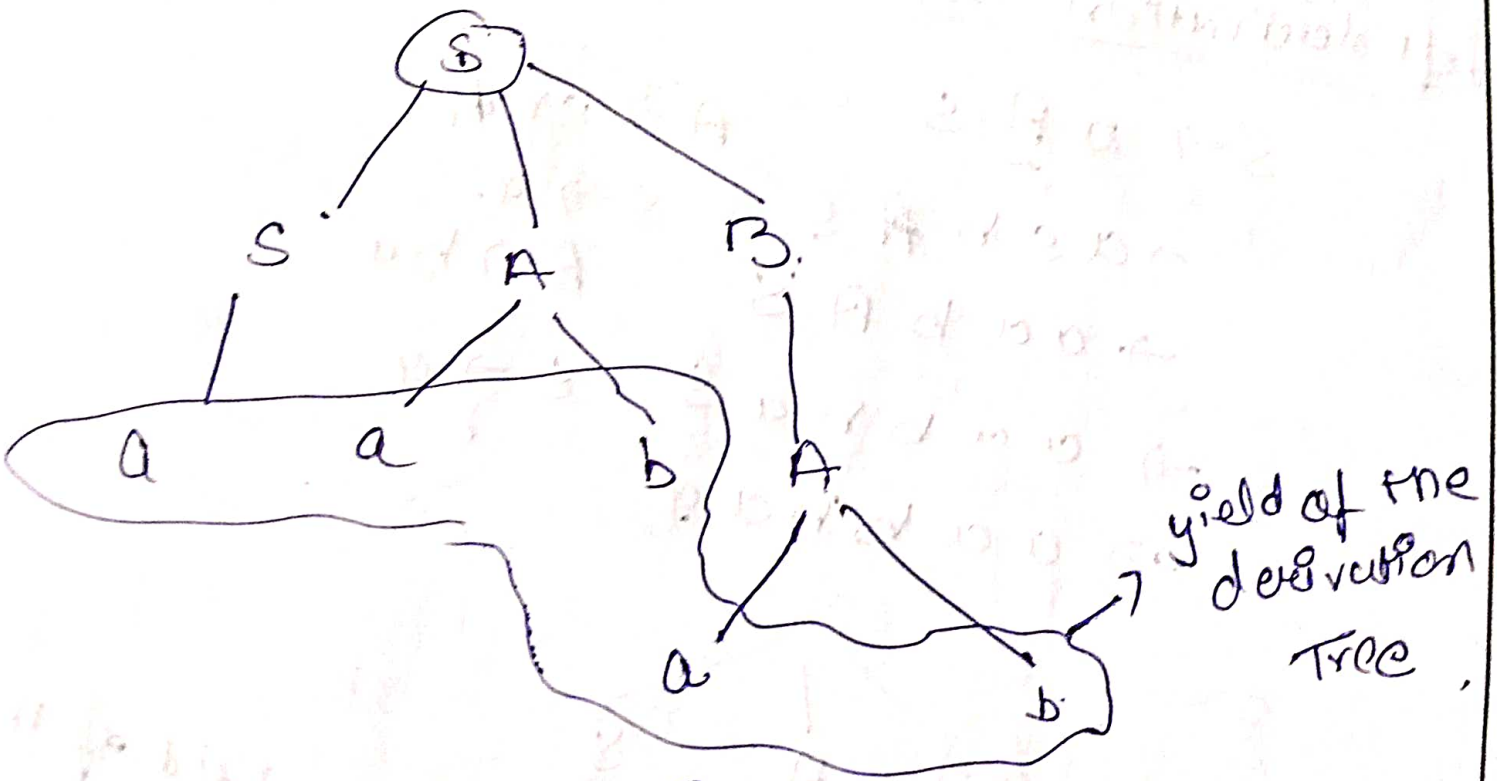
Date	Unit No.	Lecture No.	Faculty	Subject Name	Subject Code	Main Topics:-

Unit-2 Context Free Grammar

Derivation Tree

An ordered Tree in which nodes are labeled with the left side of productions & children of the node represent its corresponding right side.

Concatenation of the labels of leaves without repetition is called yield of derivation Tree



Derivation Tree / Parse Tree.

Tips, Questions & Summary:

Website Ref.:-

Derivation Tree.

- Left Derivation
- Right Derivation.
- Another

Q. $S \rightarrow aAS \mid a$

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

Show that S derives aabbaa with the derivation tree.

Left derivation Tree

$S \rightarrow aAS$

$\rightarrow aSbAS$

$\rightarrow aabAS$

$\rightarrow aabbaS$

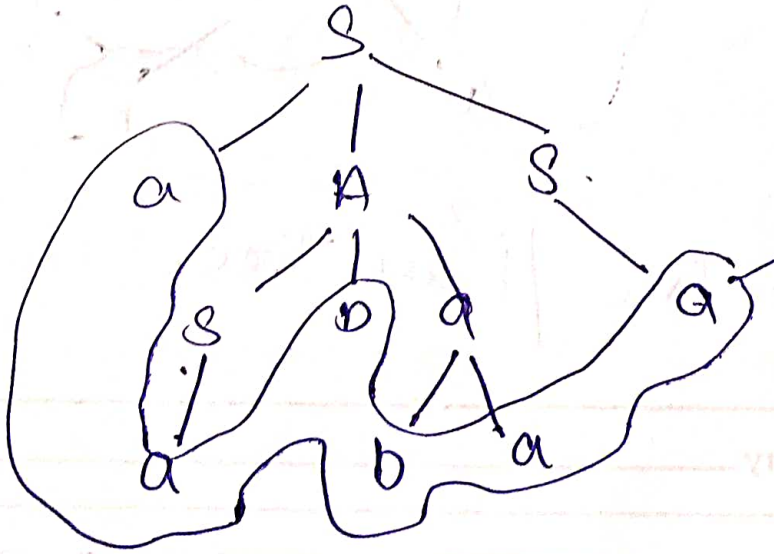
$\rightarrow aabbaa$

$A \rightarrow SbA$

$S \rightarrow a.$

$A \rightarrow ba$

$S \rightarrow a$



yield of the derivation Tree.

Left derivation Tree

POORNIMA

Date	Unit No.	Lecture No.	Faculty	Subject Name	Subject Code	Main Topics:-

Right derivation Tree

aabbaa

$S \rightarrow aAS$

$S \rightarrow aAa$

$S \rightarrow aSbAa$

$S \rightarrow aSbbaa.$

$S \rightarrow aabbaa$

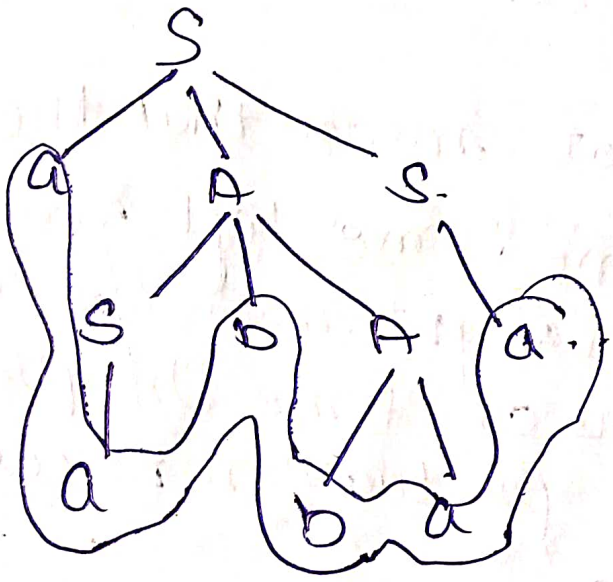
~~$S \rightarrow aAb$~~

$S \rightarrow a.$

$A \rightarrow SbA$

$A \rightarrow ba$

$S \rightarrow a$



Ideas, Questions & Summary:

ry / Website Ref.:-

Another Derivation Tree

S →

Ambiguity in Context Free Grammar.

Ambiguity does not means that the derivation will do from one time left most derivation or one time Right most derivation.

Ambiguity means one time One production and two time another production is used.

② S → SbS | a

~~S → abababa~~

Prove that this Grammar is ambiguous for the string w → ababa

POORNIMA

Date	Unit No.	Lecture No.	Faculty	Subject Name	Subject Code	Main Topics:-

$S \to SbS$

$S \to SbS$

$SbSbS$

$S \to SbS$

$SbSbSbS$

$S \to a$

$abSbSbS$

$S \to a$

$ababSbS$

$S \to a$

$ababaSb$

$S \to a$

$ababab$

$S \to a$

$ababa$

$S \to SbS$

$S \to SbS$

$S \to SbSbS$

$S \to a$

$S \to abSbS$

$S \to SbS$

$\to abSbSbS$

$S \to a$

$\Rightarrow ababSbS$

$S \to a$

$\Rightarrow ababaS$

$S \to a$

$\Rightarrow ababaa$

Ideas, Questions & Summary:

/ Website Ref.:-

Dnyaneshwar

Simplification of CFG

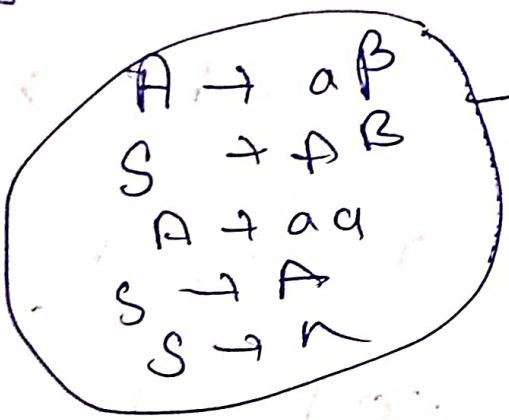
$\alpha \rightarrow \beta$

$\beta \in (NUT)^*$

Always be NT

non-terminal

Terminal



Ex:- $G(\alpha, S, A, B, C, E, \{a, b, c\}, P, S)$

$P \rightarrow$

$S \rightarrow AB$

$A \rightarrow a$

$B \rightarrow b$

$B \rightarrow C$

$E \rightarrow C \mid \wedge$

$E \rightarrow C$

$E \rightarrow \wedge$

① $E \rightarrow \wedge$

② $B \rightarrow C$

NT NT

C → useless symbols

POORNIMA

Date	Unit No.	Lecture No.	Faculty	Subject Name	Subject Code	Main Topics:-

CFG

1. Useless Symbols
2. Null productions
3. Unit productions

Construction of Reduced Grammar

- Elimination / Removal of useless symbols.
- Removal of Null productions.
- Removal of Unit productions

(1) Elimination of useless symbols

Non-generating

↓

That Non Terminal.

No variables is Generated from Non-Terminal.

$N \to T \to$ Terminal ✗

Non-Reachable

↓

$A \to a$

Main Ideas, Questions & Summary:

Library / Website Ref.:-

Q: Find the reduced Grammar.

$S \to AB/CA$

$A \to a$

$B \to BC/AB$

$C \to aB/b$

$S \to AB$
$\to aBC$
$\to aABb$
$\to aaBb$
↓
Non-generating

$B \to AB$, $S \to X$ → ✗ → $A \to a$, $B \to X$

$S \to CA$, $S \to ba$ ✓ → $C \to b$, $A \to a$

$B \to BC$, $B \to X$ → ✗

$B \to AB$, $B \to X$ → ✗

$C \to aB$, $C \to X$ → ✗

Reduced Grammar:

$S \to CA$

$A \to a$

$C \to b$

POORNIMA

Date	Unit No.	Lecture No.	Faculty	Subject Name	Subject Code	Main Topics:-

Q. $S \to aS \mid A \mid C$.

$A \to a$

$B \to aa$

$C \to aCb$

$C \to \epsilon$

$S \to aS$

$S \to \epsilon$

$S \to A$

$S \to a$

$S \to \epsilon$

$S \to aCb$

$S \to aS$ $B \to aa$

Reduced Grammar:

$S \to aA \mid aS$

$A \to a$

~~$B \to aa$~~

(2) Elimination of Null production

Replacing the value of A in $S \to$

$S \to aA$

$A \to b \mid \epsilon$

$S \to aA$

$S \to a.\epsilon$

$A \to \epsilon$.

$S \to a$

$S \to aA$

$A \to b$

$S \to a$

$S \to aA \mid a$

$A \to b$

Ideas, Questions & Summary:

Q $S \to aS \mid aB$

$A \to \wedge$

$B \to \wedge$

$\nabla \to b$

$S \to aS$
$S \to a$
$\nabla \to b$

Elimination of Unit Production

$S \to AB$

$A \to a$

$A \to \in \mid b$

$C \to \nabla$

$\nabla \to E$

$E \to a$

$B \to C$

$C \to \nabla$ → chain rule

$\nabla \to E$

$B \to a$

$E \to a$

$S \to AB$

$A \to a$

$B \to b$

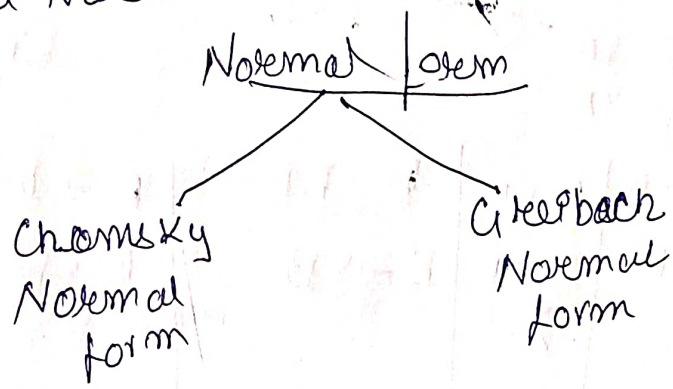
$B \to a$.

POORNIMA

Date	Unit No.	Lecture No.	Faculty	Subject Name	Subject Code	Main Topics:-

Normal form

When the production in cfg (Context free Grammar) satisfy certain restrications than Grammar G is said to be a Normal form



⇒ Chomsky Normal form (CNF)

$A \to BC$

$A \to a$

1. cfg → Reduce the cfg
2. CNF
3. GNF

ain Ideas, Questions & Summary:

brary / Website Ref.:-

[redacted] → Conversion to CNF

(1) Eliminate useless symbols.
(2) Eliminate Null production
(3) Eliminate Unit Production

→ Skip these steps as we are simplifying CFG

Assumed
X → a
Y → b

P → XA
Q → YB

S → aAbB | A → aA | A → a | B → bB | B → b
S → XAYB | A → XP | A → a (X) | B → YB | B → b
S → XBYB | | | | X
S → PQ

X → a
Y → b
P → XA
Q → YB
S → PQ
A → XA
A → a
B → YB
B → b

→ CNF

POORNIMA

Date	Unit No.	Lecture No.	Faculty	Subject Name	Subject Code	Main Topics:-

Q. $S \to aSa$
$S \to bSb$
$S \to a$
$S \to b$
→ Convert Into a CNF

Solution

$S \to aSa$ | $S \to bSb$ | $S \to a$ | $S \to b$

$A \to X$
$XS \to P$
$B \to Y$
$YS \to Q$

$S \to XSX$ | $S \to YSY$ | ✗ | ✗

$S \to PSX$ | $S \to QSY$

$X \to a$
$Y \to b$
$XS \to P$
$YS \to Q$
$S \to PX$
$S \to QY$
$S \to a$
$S \to b$

→ CNF

Main Ideas, Questions & Summary:

Library / Website Ref.:-

⇒ Greibach Normal Form.

$A \to a\alpha$

$\alpha \to \lambda \mid A \mid AA \mid ABC \mid ABCD \mid ABCDE \mid \ldots$

$A \to aB$ ✓

$A \to aBa$ ✗

$A \to aDB$ ✗

$A \to a$ ✓

$A \to aBCDEFGHIJKL$ ✓

$N \to TN^*$

CFG
↓
Simplify CFG
↓
CNF
↓
GNF

Q. Check whether the Grammar G with Production Rules is Ambiguous or not.

$X \to X+X \mid X*X \mid X \mid a.$

i/p "a+a*a"

$X \to X+X$

$X \to a$

$X \to a+X$

$* \to X*X$

$X \Rightarrow a+X*X$

$X \to a+a*a$

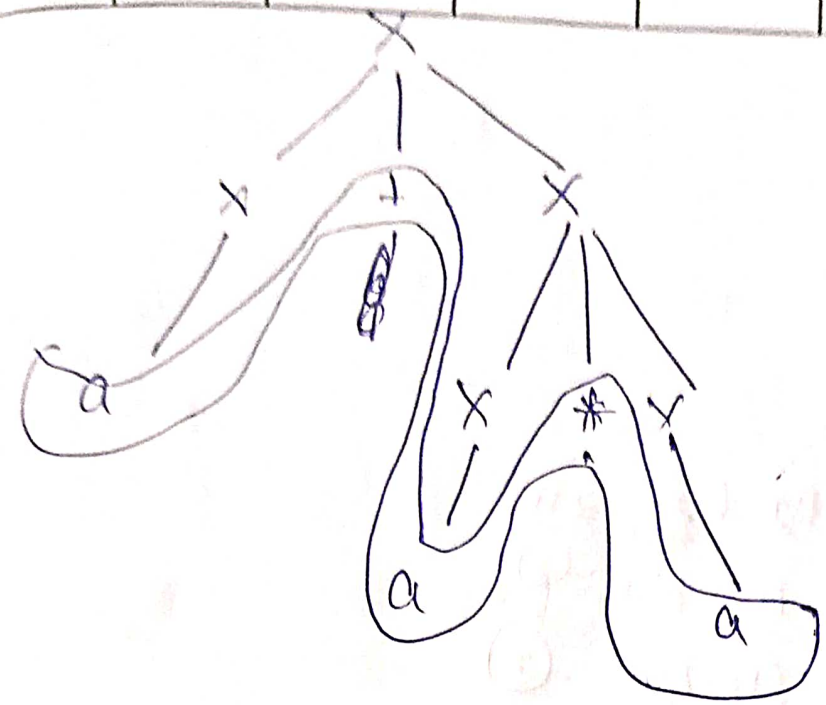
$X \to X*X$

$X \to a$

$X \to X+X*X$

$X \to a$

$X \to a+a*a$



GNF

Q. $S \rightarrow AB$
$A \rightarrow BS \mid b$ } → GNF.
$B \rightarrow SA \mid a$

Step (1) →
→ Elimination of useless Symbols
→ Elimination of Null Symbols.] → skip this step
→ Elimination of Unit Symbols.

This Grammar is in Simplified form.

Ideas, Questions & Summary:

y / Website Ref.:-

Q(2)

S → A B A → B S B → S A	A → a B → b

CNF

Step ①

Assume:-

S — A1
A — A2
B — A3.

S → A B — A1 → A2 A3 — ①
A → B S — A2 → A3 A1 — ②
B → S A — A3 → A1 A2 — ③
A2 → b
A3 → a.

④ Lemma → Left factoring

$A_i \to A_j \cdot A_3$

$i = j$
$i < j$ → no problem
$i > j$ → problem

Eqn ①.

$A_1 \to A_2 A_3$

no problem @ $i = 1$
$j = 2$
@ $i < j$
$i < 2$.

PADHNIMA

Date	Unit No	Lecture No	Faculty	Subject Name	Subject Code	Main Topics:-

$A_1 \; B_2 \rightarrow A_3 \; A_1$

no problem

$p = 2$
$j = 3$.
$p < j$
$2 < 3$

$A_3 \rightarrow A_1 \; A_2$

problem

$p < q$
$2 < 3$
$q = 3$
$j = 1$

$i < j$ X
$3 < 1$ X

$A_1 \rightarrow A_2 \; A_3$

$A_3 \rightarrow A_1 \; A_2$

$A_3 \rightarrow A_2 \; A_3 \; A_2$

$q = 3$
$j = 2$
$8 < 9$
$3 < 2$
} problem.

$A_2 \rightarrow$ values replace

$A_2 \rightarrow A_3 A \mid b$

$A_3 \rightarrow A_3 A_1 \mid A_3 A_2$
$A_3 \rightarrow b A_3 A_2$
$A_3 \rightarrow a$

→ All the values of A_3 are removed

$A_3 \rightarrow A_3 A_1 \mid A_3 A_2 \mid b A_3 A_2 \mid a$

$A_1 \rightarrow A_1 \alpha \mid B_1 \mid B_2$

$A_3 \to A_3\alpha \mid A_1A_3A_2$

$\beta_1 = bA_3A_2$

$\beta_2 = a$

$\beta_1 \qquad \beta_2$

Step:- $A_3 \to A_3A_1A_3A_2 \mid bA_3A_2 \mid a$

$i = j$

Left Recursion:

1) $(A_i \to A_i\alpha \mid \beta_1 \mid \beta_2 \mid \beta_3 \text{ ------})$

Solⁿ $A_i \to \beta_1 \mid \beta_2 \mid \beta_3 \text{ ---} \mid \beta_1 Z_i \mid \beta_2 Z_i \mid \beta_3 Z_i$

$Z_i = \alpha \mid \alpha Z_i$

$Z_3 = \cdot A_1A_3A_2 \mid A_1A_3A_2Z_3$

$A_3 \to bA_3A_2 \mid a \mid bA_3A_2Z_3 \mid aZ_3$ —

$A_3 \to bA_3A_2 \mid a \mid bA_3A_2A_1A_3A_2 \mid bA_3A_2A_1A_3A_2Z_3 \mid$

$aA_1A_3A_2 \mid aA_1A_3A_2Z_3$

→ or

$A_3 \; bA_3A_2 \mid bA_3A_2Z_3 \mid a \mid aZ_3$

POORNIMA

Date	Unit No.	Lecture No.	Faculty	Subject Name	Subject Code	Main Topics:-

$A_2 \to A_3 A_1 \mid b$

$A_2 \to b A_3 A_2 A_1 \mid a A_1 \mid \to b A_3 A_2 A_1 Z_3 A_1 \mid a Z_3 A_1 \mid$

$A_1 \to A_2 A_3$

$A_1 \to b A_3 A_2 A_1 A_3 \mid a A_1 A_3 \mid b A_3 A_2 A_1 Z_3 A_1 A_3 \mid$

$a Z_3 A_1 A_3 \mid b A_3 \mid$

$Z_3 \to A_1 A_3 A_2 \mid A_1 A_3 A_2 Z_3$

$Z_3 \to b A_3 A_2 A_1 A_3 A_2 \mid a A_1 A_3 A_3 A_2 \mid b A_3 A_2 A_1 Z_3 A_1 A_3 A_3 A_2 \mid$

$a Z_3 A_1 A_3 A_3 A_2 \mid b A_3 A_3 A_2 \mid b A_3 A_2 A_1 A_3 A_3 A_2 Z_3 \mid$

$a A_1 A_3 A_3 A_2 Z_3 \mid b A_3 A_2 A_1 Z_3 A_1 A_3 A_3 A_2 Z_3 \mid$

$a Z_3 A_1 A_3 A_3 A_2 \mid b A_3 A_3 A_2 Z_3$

Main Ideas, Questions & Summary: