* Theory of computation (TOC) - Assignment Number - 3

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★ Convert the following grammar to CNF - S → AB
A → CA/^
B → DB/^
C → 011/1
D → 01

→ Eliminating ^ production.

A → CA/^
A → CA/011/1.

B → DB/^
B → DB/01

Production Rule

S → AB
A → CA
A → 011

CNF

already in CNF
already is CNF
A → XY
X → 0, Y → ZZ, Z → 1

$B \to DB$ already in CNF
$B \to XZ$

★ Convert the grammer into GNF, $S \to AB$
$A \to BS \mid b$
$B \to SA \mid a$.

→ The grammer is simplified and CNF,

Step 1: $S = A_1$, $A = A_2$, $B = A_3$.

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

Step 2 :- $A_1 \longrightarrow A_2 A_3$
$A_2 \longrightarrow A_3 A_1 \mid b$
with $A_i \longrightarrow A_j A_k$ .... $i<j$

But, $A_3 \longrightarrow A_1 A_2 \mid a$ $i>j$, $3>1$.

∴ Process A_3 rule first
$A_3 \longrightarrow A_1 A_2 \mid a$.
$A_3 \longrightarrow A_2 A_3 A_2 \mid a$ ∵ $A_1 \longrightarrow A_2 A_3$
$A_3 \longrightarrow A_3 A_1 A_3 A_2 \mid b A_3 A_2 \mid a$. ∴ $A_2 \longrightarrow A_3 A_1 \mid b$.

Step 3: Left recursion elimination.

$A_3 \longrightarrow A_3 A_1 A_3 A_2 \mid b A_3 A_2 \mid a$.

$A \longrightarrow A\alpha / \beta$ then $A \longrightarrow \beta A' / \beta$

$A' \longrightarrow \alpha A' / \alpha$

Hence,

$A_3 \longrightarrow bA_3A_2A' / aA'$ — (1)

$A' \longrightarrow A_1A_3A_2A' / A_1A_3A_2$

$A_3 \longrightarrow \underbrace{A_3A_1A_3A_2}_{\alpha} / \underbrace{bA_3A_2}_{\beta_1} / \underbrace{a}_{\beta_2}$

A_3 is in GNF

Step 4:

$A_2 \longrightarrow A_3A_2 / b$ — (2)

$A_2 \longrightarrow bA_3A_2A'A_1 / aA'A_1 / b$ — (3) from (2) and (1).

A_2 is in GNF.

Step 5:

$A_1 \longrightarrow A_2A_3$ — (4)

$A_1 \longrightarrow bA_3A_2A'A_1A_3 / aA'A_1A_3 / bA_3$ — (5) from (3) and (4).

A_1 is in GNF.

Step 6: $A' \longrightarrow A_1A_3A_2A' / A_1A_3A_2$ — (6) from (5) and (4).

$A' \longrightarrow bA_3A_2A'A_1A_3A_2A' \mid aA'A_1A_3A_1A_3A_2A' \mid bA_3A_3A_2A' \mid bA_3A_2A'A_1A_3A_2 \mid aA'A_1A_3A_3A_2 \mid bA_3A_3A_2.$

A' is now GNF.

Step 7: all the rules are in GNF

$A_1 \longrightarrow bA_3A_2A'A_1A_3 \mid aA'A_1A_3 \mid bA_3.$

$A_2 \longrightarrow bA_3A_2A'A_1 \mid aA'A_1 \mid b$

$A_3 \longrightarrow bA_3A_2A' \mid GA'$

$A' \longrightarrow bA_3A_2A'A_1A_3A_2A' \mid aA'A_1A_3A_1A_3A_2A' \mid bA_3A_3A_2A' \mid bA_3A_2A'A_1A_3A_2A_3 \mid aA'A_1A_3A_3A_2 \mid bA_3A_3A_2.$