Greibach Normal Form

Tag CFL

A context-free grammar (CFG) is in Greibach Normal Form (GNF) if all production rules satisfy one of the following conditions:

- A non-terminal generating a terminal (e.g.; X→x)
- A non-terminal generates a terminal followed by any number of non-terminals (e.g.; X→xX1X2…X3)

Steps:

Step 1. If the given grammar is not in CNF, convert it to CNF.

Step 2. Change the names of non terminal symbols to A1 till AN in same sequence.

Step 3. Check for every production rule if RHS has first symbol as non terminal say Aj for the production of Ai, it is mandatory that i should be less than j. Not great and not even equal.

If i> j then replace the production rule of Aj at its place in Ai.

If i=j, it is the left recursion. Create a new state Z which has the symbols of the left recursive production, once followed by Z and once without Z, and change that production rule by removing that particular production and adding all other production once followed by Z.

Step 4. Replace very first non terminal symbol in any production rule with its production until production rule satisfies the above conditions.

For converting a CNF to GNF always move left to right for renaming the variables.

$S \rightarrow CA \mid BB$

$B \rightarrow b \mid SB$

$C \rightarrow b$

$A \rightarrow a$

Change the names of the non-terminal symbols into some A_i in ascending order of i.

S with A_1

C with A_2

A with A_3

B with A_4

$A_1 \rightarrow A_2 A_3 \mid A_4 A_4$

$A_4 \rightarrow b \mid A_1 A_4$

$A_2 \rightarrow b$

$A_3 \rightarrow a$

After the rules so that the non-terminals are in ascending order, such that, if the production is of the form $A_i \rightarrow A_j x$, then, $i < j$ and should never be $\geq j$

('j' is the subscript of the first non-terminal on the right side e.g. in $A_1 \rightarrow A_2 A_3 \mid A_4 A_4$, 'j' is $A_2 A_3$ and $A_4 A_4$

$A_1 < A_2$ ✓

$A_1 < A_4$ ✓

For 2nd production,

$A_4 \rightarrow b \mid A_1 A_4$

$A_4 > A_1$ ✗ not in GNF

Replace A_1 with some other ~~non terminal~~ value. (A_1)

$A_4 \rightarrow b \mid A_2 A_3 A_4 \mid A_4 A_4 A_4$

Still $A_4 > A_2$

$A_4 \rightarrow b \mid bA_3 A_4 \mid A_4 A_4 A_4$

Still $A_4 > A_3$ but there is a ~~no~~ terminal followed by non-terminals so it's als in GNF.

$A_4 = A_4$ ($i == j$)

When $i == j$, remove left recursion.

introduce a new variable.

$A_4 \rightarrow b \mid bA_3 A_4 \mid A_4 A_4 A_4$.

$Z \rightarrow A_4 A_4 Z \mid A_4 A_4$

$A_4 \rightarrow bZ \mid bA_3 A_4 Z \mid b \mid ~~bA_3 A_4~~ bA_3 A_4$.

updated gramar :-

$A_1 \rightarrow A_2 A_3 \mid A_4 A_4$ ✗

$A_4 \rightarrow b \mid bA_3 A_4 \mid bZ \mid bA_3 A_4 Z$ ✓

$Z \rightarrow A_4 A_4 \mid A_4 A_4 Z$ ✗

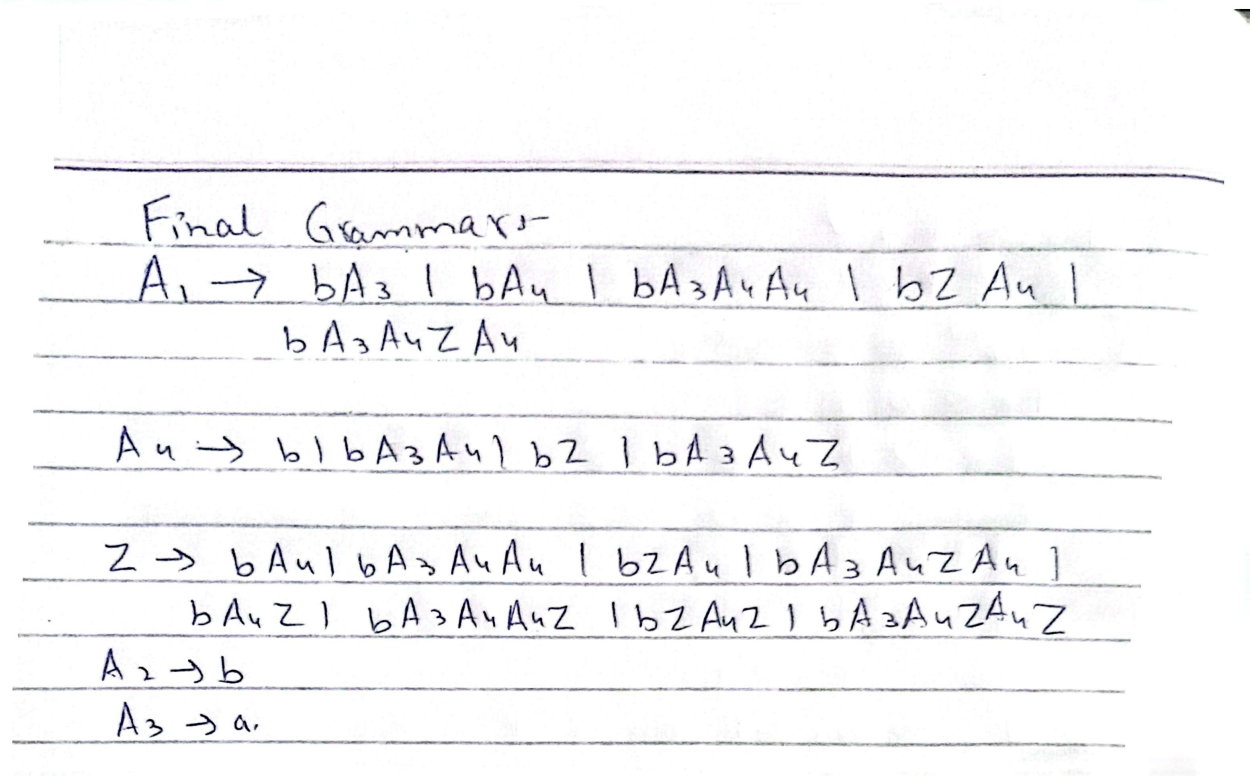
$A_2 \rightarrow b$ ✓

$A_3 \rightarrow a$ ✓

right side must not start with a non terminal.

$A_1 \rightarrow bA_3 \mid bA_4 \mid bA_3 A_4 A_4 \mid bZA_4 \mid bA_3 A_4 Z A_4$

$Z \rightarrow bA_4 \mid bA_3 A_4 A_4 \mid bZA_4 \mid bA_3 A_4 Z A_4 \mid bA_4 Z \mid bA_3 A_4 A_4 Z \mid bZA_4 Z \mid bA_3 A_4 Z A_4 Z$



▼ Past Paper Qs

Convert the following grammar to its equivalent Greibach Normal Form.

S → aAb|a

A → SS|b

Convert the following grammar to its equivalent Greibach Normal Form.

S → ab|a

A → SS|b

GNF:

Convert to GNF. You must convert to intermediary grammar to get full marks.

S → AB | Δ

A → AB | BB | a

B → AB | a

Convert to GNF. You must convert to intermediary grammar to get full marks.

S → AB

A → AB | a

B → AB | a

Convert the following grammar to GNF.

S → Xa | Yb | YYYb

W → ZZ | SZZ | W | Δ

X → Sb | b | SZZ

Y → Sa | a | Z| Δ

Z → ZZ | SZZ