

**Subject Name: Theory of Computation** 

Subject Code: IT-5001

Semester: 5<sup>th</sup>





## **Notes on Left Factoring and Left Recursion**

## 2.12 Left Factoring

In a CFG more than one productions contain common prefix substring it is called Left Factoring.

$$A \rightarrow \alpha \beta \mid \alpha \gamma \mid \alpha Z$$

Left factoring has to be eliminated from the grammar. It can be done by rewriting left factoring production as followes

A -> 
$$\alpha D$$
  
D ->  $\beta \mid \gamma \mid Z$ 

( A new variable D is introduced )

## **Example of elimination of Left Factoring**

Consider productions of CFG

 $S \rightarrow aBD \mid aBbD \mid aBbE$ 

 $B \rightarrow a$ 

 $D \rightarrow b$ 

 $E \rightarrow a$ 

In S productions aB are common prefix substring

Therefore new productions can be created with new variable F

 $S \rightarrow aBF$ 

 $F \rightarrow D \mid bD \mid bE$ 

 $B \rightarrow a$ 

 $D \rightarrow b$ 

 $E \rightarrow a$ 



Now F productions has common prefix sub string b, Therefore new productions can be created with new variable H

 $S \rightarrow aBF$ 

 $F \rightarrow D \mid bH$ 

 $h \rightarrow D \mid E$ 

 $B \rightarrow a$ 

 $D \rightarrow b$ 

 $E \rightarrow a$ 

#### 2.13 Direct Left Recursion

Left recursion is a case when the left-most variable in a production of a variable is the variable itself is known as direct left recursion.

Consider production  $A \to A \alpha \mid \beta$ . In this production  $A \to A \alpha$  is direct left recursion . In buliding of parser ( component of Cmpiler ) Left recursion have to be removed.

#### **Elimination of Left Recursion**

Consider A  $\rightarrow$  A  $\alpha$  |  $\beta$  . Left Recursion can be eliminated by introducing a new variale Z as followes

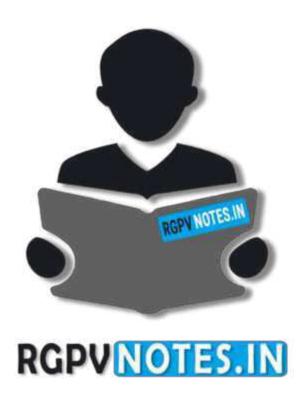


$$A \rightarrow \beta \mid \beta Z$$
  
 $Z \rightarrow \alpha \mid \alpha Z$ 

# **Example on Elimination of Left Recursion**

## Solution





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