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Subject Name: **Theory of Computation**

Subject Code: **IT-5001**

Semester: **5th**

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 rewrtting left factoring production as followes

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

(A new variable D is introduced)

Example of elimination of Left Factoring

Consider productions of CFG

S → aBD | aBbD | aBbE

B → a

D → b

E → a

In S productions aB are common prefix substring

Therefore new productions can be created with new variable F

S→ aBF

F→ D | bD | bE

B → a

D → b

E → a

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

S→ aBF

F→ D | bH

h → D | E

B → a

D → b

E → 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 → A α | β . In this production A → A α is direct left recursion .

In buliding of parser (component of Cmpiler) Left recursion have to be removed.

Elimination of Left Recursion

Consider A → A α | β . Left Recursion can be eliminated by introducing a new variale Z as followes

A -> β | βZ
Z -> α | αZ

Example on Elimination of Left Recursion

A -> AB | BA | a
B -> b |c

Solution

A -> BA | a | BAZ | aZ
Z -> B | BZ
B-> b |c

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