

Theory of Computation

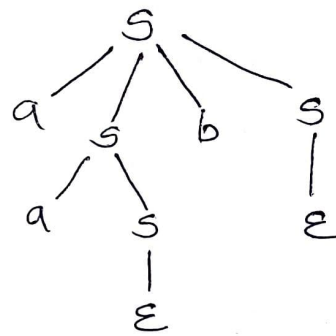
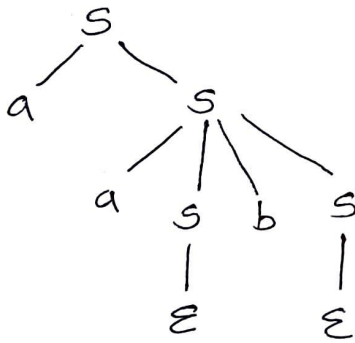
Assignment No :- 04

Tushar Chaudhari
TE4 , → 46
Batch - D

(Q.1) Consider the following grammar.
 $S \rightarrow aS \mid aSbS \mid \epsilon$

show that derivation for the single aab is Ambiguous.

→ The two parse tree can be represented as:



Hence, proved Derivation of aab is Ambiguous.

(Q.2) Simplify the given grammar:

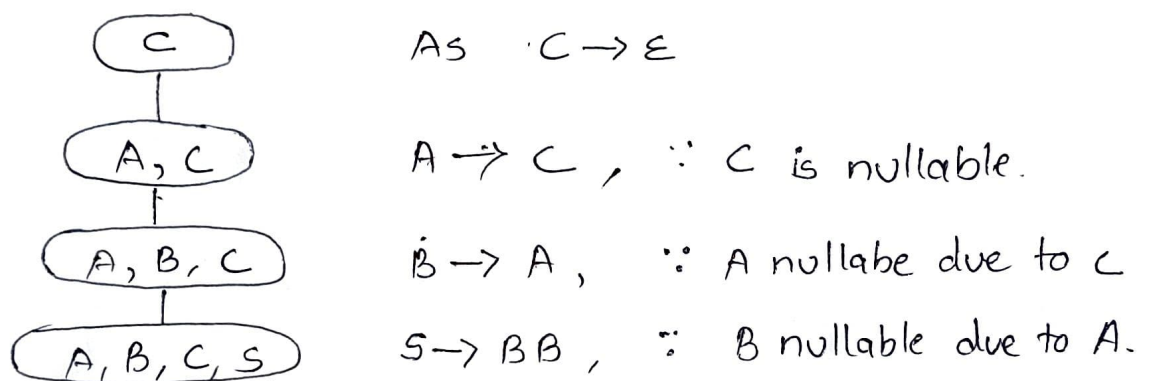
$$S \rightarrow aAa \mid bBb \mid BB$$

$$A \rightarrow C$$

$$B \rightarrow A \mid S$$

$$C \rightarrow S \mid \epsilon$$

→ Step 1: Elimination of ϵ production from given grammar. The set of nullable symbols are:



The grammar after removal of null position,
 $S \rightarrow aAa \mid bBb \mid BB \mid B \mid bb$
 $A \rightarrow C, B \rightarrow A \mid S, C \rightarrow S$

Step 2: Following unit production $S \rightarrow B, B \rightarrow A, A \rightarrow C$
 $B \rightarrow S, C \rightarrow S.$

There is a chain formed.

$$B \rightarrow A \rightarrow C \rightarrow S \rightarrow B \text{ and } S \rightarrow B \rightarrow S$$

These are cyclic, production will be.

$$S \rightarrow aAa \mid aa \mid bBb \mid bb \mid BB$$

$$A \rightarrow aAa \mid aa \mid bBb \mid bb \mid BB$$

$$B \rightarrow aAa \mid aa \mid bBb \mid bb \mid BB$$

$$C \rightarrow aAa \mid aa \mid bBb \mid bb \mid BB.$$

Step 3: Symbol c is not reachable and hence is deleted.

Final Production.

$$S \rightarrow aAa \mid aa \mid bBb \mid bb \mid BB$$

$$A \rightarrow aAa \mid aa \mid bBb \mid bb \mid BB$$

$$B \rightarrow aAa \mid aa \mid bBb \mid bb \mid BB$$

(Q.3) Generate and reduce the grammar for the following to CNF:

$$L = \{ a^n b^m c^n \mid n \geq 1, m \geq 1 \} \text{ over } \Sigma = \{a, b, c\}$$

→ The set of productions for the given language is

$$P = \{ S \rightarrow aSc \mid axc \\ x \rightarrow bx \mid b \}$$

CFG to CNF : $S \rightarrow aSc \mid axc$
 $x \rightarrow bx \mid b$

(1) This context free grammar has no null unit and useless production.

(2)

production	Solution
$S \rightarrow aSc$	$C_1 \rightarrow a$
$S \rightarrow C_1Sc$	$C_2 \rightarrow c$
$S \rightarrow C_1SC_2$	$C_3 \rightarrow C_1S$
$S \rightarrow C_3C_2$	$S \rightarrow C_3C_2$
$S \rightarrow axc$	
$S \rightarrow C_1xC_2$	$C_4 \rightarrow C_1x$
$S \rightarrow C_4C_2$	$S \rightarrow C_4C_2$
$x \rightarrow bx$	$C_5 \rightarrow b$
$x \rightarrow C_5x$	$x \rightarrow C_5x$
$x \rightarrow b$	$x \rightarrow b$

The grammar in CNF is,

$$S \rightarrow C_3C_2 \mid C_4C_2$$

$$x \rightarrow C_5x \mid b$$

$$C_1 \rightarrow a$$

$$C_2 \rightarrow c$$

$$C_3 \rightarrow C_1 S$$

$$C_4 \rightarrow C_1 X$$

$$C_5 \rightarrow b$$

\therefore aaabbbccc is a valid string.

(Q.4) Convert the following grammar into GNF.

$$S \rightarrow AA \mid 0$$

$$A \rightarrow SS \mid 1$$

→ Step 1: The grammar is Already in CFG form.

Step 2:

Production	Solution
$A \rightarrow AAS \mid OS \mid 1$	
$A \rightarrow OSB \mid 1B$	
$B \rightarrow ASB \mid \epsilon$	
$B \rightarrow AS \mid ASB$	
$A \rightarrow OS \mid OSB \mid 1 \mid 1B$	$A \rightarrow OS \mid OSB \mid 1 \mid 1B$
$S \rightarrow AA \mid 0$	
$S \rightarrow OSA \mid OSBA \mid ISA \mid IA \mid 0$	$S \rightarrow OSA \mid OSBA \mid ISA \mid IA \mid 0$
$B \rightarrow AS \mid ASB$	
$B \rightarrow OSS \mid OSBS \mid IS \mid IBS \mid$ $OSSB \mid OSBSB \mid ISB \mid IB SB$	$B \rightarrow OSS \mid OSBS \mid IS \mid IBS \mid$ $OSSB \mid OSBSB \mid ISB \mid IB SB$

$$S \rightarrow OSA \mid OSBA \mid ISA \mid IA \mid 0$$

$$A \rightarrow OS \mid OSB \mid 1 \mid 1B$$

$$B \rightarrow OSSB \mid OSBSB \mid ISB \mid IB SB$$