

CSE331
ASSIGNMENT-5

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Sec: 04

Ans to the ques. No. 1

(a)

Given that,

$$S \rightarrow AACD$$

$$A \rightarrow aAb|ac|\epsilon$$

$$C \rightarrow aC|a$$

$$D \rightarrow aDa|bDb|d|\epsilon$$

↓

ϵ -Elimination:

$$S \rightarrow AACD|ACD|CD|AAC|AC|C$$

$$A \rightarrow aAb|ac|ab$$

$$C \rightarrow aC|a$$

$$D \rightarrow aDa|bDb|d|aa|bb$$

Unit production Elimination:

$$S \rightarrow AACD|ACD|CD|AAC|AC|aC|a$$

$$A \rightarrow aAb|ac|ab$$

$$C \rightarrow aC|a$$

$$D \rightarrow aDa|bDb|d|aa|bb$$

CNF:

$S \rightarrow MN | AN | CD | MC | AC | OC | a$

$A \rightarrow OAP | OQ | OP$

$C \rightarrow OC | a$

$D \rightarrow ODO | PDP | d | OO | PP$

$M \rightarrow AA$

$N \rightarrow CD$

$O \rightarrow a$

$P \rightarrow b$

$Q \rightarrow c$

↓

Final:

$S \rightarrow MN | AN | CD | MC | AC | OC | a$

$A \rightarrow UP | OQ | OP$

$C \rightarrow OC | a$

$D \rightarrow VO | WP | d | OO | PP$

$M \rightarrow AA$

$N \rightarrow CD$

$O \rightarrow a$

$P \rightarrow b$

$Q \rightarrow c$

$U \rightarrow OA$

$V \rightarrow OD$

$W \rightarrow PD$

(Ans)

(b)

Given that,

$$S \rightarrow XSB \mid \epsilon$$

$$X \rightarrow pXS \mid p$$

$$B \rightarrow SbS \mid X \mid bb$$

Start Symbol: \downarrow

$$S_0 \rightarrow S$$

$$S \rightarrow XSB \mid \epsilon$$

$$X \rightarrow pXS \mid p$$

$$B \rightarrow SbS \mid X \mid bb$$

ϵ -elimination:

$$S_0 \rightarrow S$$

$$S \rightarrow XSB \mid XB$$

$$X \rightarrow pXS \mid p \mid pX$$

$$B \rightarrow SbS \mid X \mid bb \mid Sb \mid bS \mid b$$

Unit Production: Elimination:

$$S_0 \rightarrow XSB \mid XB$$

$$S \rightarrow XSB \mid XB$$

$$X \rightarrow pXS \mid p \mid pX$$

$$B \rightarrow SbS \mid pXS \mid p \mid pX \mid bb \mid Sb \mid bS \mid b$$

CNF:

$$s_0 \rightarrow MB \mid XB$$

$$S \rightarrow MB \mid XB$$

$$X \rightarrow NM \mid P \mid NX$$

$$B \rightarrow SQS \mid NM \mid P \mid NX \mid QQ \mid SQ \mid QS \mid b$$

$$M \rightarrow XS$$

$$N \rightarrow P$$

$$Q \rightarrow b$$

Final:

$$s_0 \rightarrow MB \mid XB$$

$$S \rightarrow MB \mid XB$$

$$X \rightarrow NM \mid P \mid NX$$

$$B \rightarrow RS \mid NM \mid P \mid NX \mid QQ \mid SQ \mid QS \mid b$$

$$M \rightarrow XS$$

$$N \rightarrow P$$

$$Q \rightarrow b$$

$$R \rightarrow SQ$$

(Ans)

(c)

Given that,

$$S \rightarrow aAa \mid bBb \mid \epsilon$$

$$A \rightarrow C \mid a$$

$$B \rightarrow C \mid b$$

$$C \rightarrow CD \mid \epsilon$$

$$D \rightarrow A \mid B \mid ab$$

ϵ -elimination:

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

$$A \rightarrow C \mid a$$

$$B \rightarrow C \mid b$$

$$C \rightarrow CD \mid D \mid C$$

$$D \rightarrow A \mid B \mid ab$$

Unit production elimination:

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

$$A \rightarrow CD \mid D \mid C \mid a$$

$$B \rightarrow CD \mid D \mid C \mid b$$

$$C \rightarrow CD \mid A \mid B \mid ab$$

$$D \rightarrow CD \mid C \mid a \mid b \mid ab$$

↓

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

$A \rightarrow CD \mid C \mid a \mid b \mid ab$

$B \rightarrow CD \mid C \mid a \mid b \mid ab$

$C \rightarrow CD \mid a \mid b \mid ab$

$D \rightarrow CD \mid a \mid b \mid ab$

↓

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

$A \rightarrow CD \mid a \mid b \mid ab$

$B \rightarrow CD \mid a \mid b \mid ab$

$C \rightarrow CD \mid a \mid b \mid ab$

$D \rightarrow CD \mid a \mid b \mid ab$

CNF:

$S \rightarrow MAM \mid NBN \mid MM \mid NN$

$A \rightarrow CD \mid a \mid b \mid MN$

$B \rightarrow CD \mid a \mid b \mid MN$

$C \rightarrow CD \mid a \mid b \mid MN$

$D \rightarrow CD \mid a \mid b \mid MN$

$M \rightarrow a$

$N \rightarrow b$

↓

Final CNF:

$S \rightarrow UM \mid VN \mid MM \mid NN$

$A \rightarrow CD \mid a \mid b \mid MN$

$B \rightarrow CD \mid a \mid b \mid MN$

$C \rightarrow CD \mid a \mid b \mid MN$

$D \rightarrow CD \mid a \mid b \mid MN$

$M \rightarrow a$

$N \rightarrow b$

$U \rightarrow MA$

$V \rightarrow NB$

(Ans)

Answer to the ques. No-2

(a)

String: $xxyy$

Grammar:

$$S \rightarrow xY | YY$$

$$x \rightarrow zz | XY | \epsilon$$

$$Y \rightarrow YY | ZX | y$$

$$z \rightarrow Yx | xX | y$$

| | | | |
|-------------------------|----------------------|----------------------|-------------------|
| $\{S, x, Y, z\}$ 1,4 | | | |
| $\{z, x\}$ 1,3 | $\{S, x, z\}$ 2,4 | | |
| $\{z\}$ 1,2 | $\{S, x\}$ 2,3 | $\{S, x, y\}$ 3,4 | |
| $\{x\}$ 1,1 | $\{x\}$ 2,2 | $\{Y, z\}$ 3,3 | $\{Y, z\}$ 4,4 |
| x | x | y | y |

The CFG accepts the give string w.

(b)

String, $w: xxxyxy$

Grammar:

$S \rightarrow XY|YZ$

$X \rightarrow YX|x$

$Y \rightarrow ZZ|y$

$Z \rightarrow XY|x$

| | | | | |
|----------------------|-------------------|-------------------|-------------------|----------------|
| $\{S, Z\}$ 1,5 | | | | |
| $\{S, X, Z\}$ 1,4 | $\{Y\}$ 2,5 | | | |
| $\{Y\}$ 1,3 | $\{Y\}$ 2,4 | $\{S, Z\}$ 3,5 | | |
| $\{Y\}$ 1,2 | $\{S, Z\}$ 2,3 | $\{S, X\}$ 3,4 | $\{S, Z\}$ 4,5 | |
| $\{X, Z\}$ 1,1 | $\{X, Z\}$ 2,2 | $\{Y\}$ 3,3 | $\{X, Z\}$ 4,4 | $\{Y\}$ 5,5 |
| x | x | y | x | y |

The CFG accepts the given string 'w'.

(c)

String, w : abaab

Grammar:

$S \rightarrow XY | SS | a$

$X \rightarrow YS | ZT | b$

$Y \rightarrow TT | b$

$Z \rightarrow TR | a | b$

$T \rightarrow a$

$R \rightarrow SS$

| | | | | |
|----------------------|----------------------|-------------------------|----------------------|----------------------|
| $\{S, R\}$ 1,5 | | | | |
| $\{S, R\}$ 1,4 | $\{S, X\}$ 2,5 | | | |
| \emptyset 1,3 | $\{S, X\}$ 2,4 | $\{S\}$ 3,5 | | |
| \emptyset 1,2 | $\{X\}$ 2,3 | $\{S, R, X, Y\}$ 3,4 | \emptyset 4,5 | |
| $\{S, Z, T\}$ 1,1 | $\{X, Y, Z\}$ 2,2 | $\{S, Z, T\}$ 3,3 | $\{S, Z, T\}$ 4,4 | $\{X, Y, Z\}$ 5,5 |
| a | b | a | a | b |

The CFG accepts the given string (w).