

Tutorial no 7

GoodLuck

Page No.

Date

Q1 what language is generated by following CFG

$$a) S \rightarrow asa | bsbl \Lambda$$

Q2 Find CFG generating following language

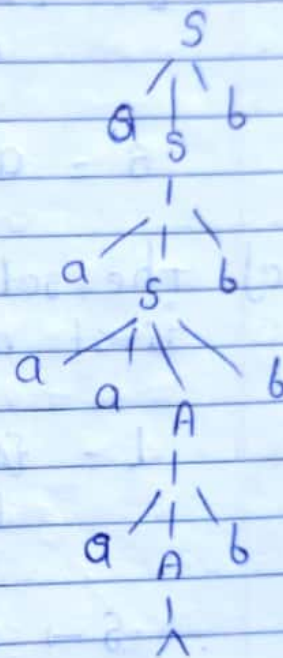
$$b) L = \{ x_c x^R \mid x \in \{a, b\}^* \}$$

$$L = \{ a^m b^n \mid m > n \text{ and } n > 0 \}$$

$$S \rightarrow asb$$

$$S \rightarrow aqAb$$

$$A \rightarrow aAb | \Lambda$$



c) the set of odd length string in $\{a, b\}$ with middle symbol a

$$L = \{ a, baqa, bab, aab, baa, aaaaaa, bbabb, abaab, \dots \}$$

$$S \rightarrow asa | bs_2a$$

$$s \rightarrow as_1a | bs_2$$

$$S \rightarrow | S_1 a S_1 | S_2 b S_2 | S_1 a S_2$$

$$S_2 a S_1$$

$$S_1 \rightarrow a A_1$$

$$S_2 \rightarrow b S_2$$

$$d) L = \{x \in x^R \mid x \in \{a, b\}^*\}$$

$$S \rightarrow aAa \mid bAb \mid aAb \mid bAa$$

$$A \rightarrow AaA \mid \Lambda$$

d) The set of even length string in $\{a, b\}^*$ with middle two symbols equal

$$L = \{\Lambda, aa, bb, aaaa, baab, aabb, bbaa, abba, abbb, bbaa, \dots\}$$

$$S \rightarrow asa \mid asb \mid bsa \mid bsb \mid aab \mid bba$$

c) The set of odd length string in $\{a, b\}$ whose first middle last symbol same

$$L = \{a, b, aaa, bbb, aaaaa, babab, bbbbb, \dots\}$$

$$S \rightarrow asa \mid bsb \mid asasa \mid bsbbsb \mid a \mid b \mid \Lambda$$

$$f) L = \{a^i b^j c^k \mid j = i \text{ or } j = k\}$$

$$L = \{\Lambda, abc, aabbc, \dots\}$$

$$S_0 \rightarrow S_1 \mid S_4$$

$$S_1 \rightarrow aS_2bS_3 \mid \Lambda$$

$$S_2 \rightarrow aS_2b \mid \Lambda$$

$$S_3 \rightarrow cS_3 \mid \Lambda$$

$$S_4 \rightarrow S_5bS_6c \mid \Lambda$$

$$S_5 \rightarrow aS_5 \mid \Lambda$$

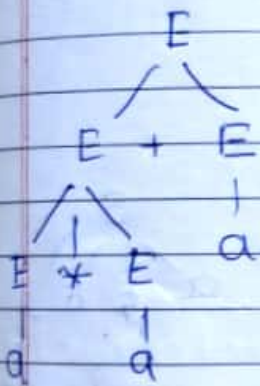
$$S_6 \rightarrow bS_6c \mid \Lambda$$

g) $L = \{a^i b^j c^k \mid i = j + k\}$
 $S_0 \rightarrow aS_1, bS_2 \mid S_1 bS_2 c \mid \Lambda$
 $S_1 \rightarrow aS_1, b \mid \Lambda$
 $S_2 \rightarrow bS_2 c \mid \Lambda$

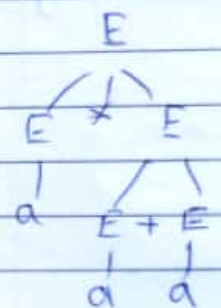
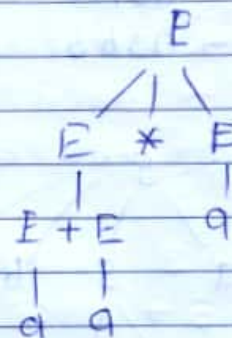
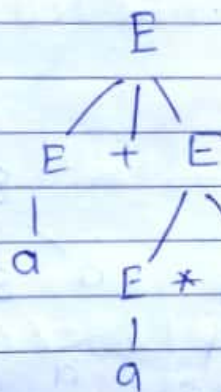
h) $L = \{a^i b^j \mid j < 2j\}$
 $S \rightarrow Bb \mid aBb$
 $B \rightarrow Bb \mid aBb \mid aaBb \mid \Lambda$

q3 show following grammar as ambiguous grammar

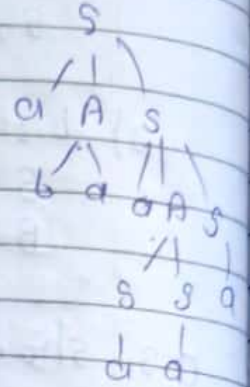
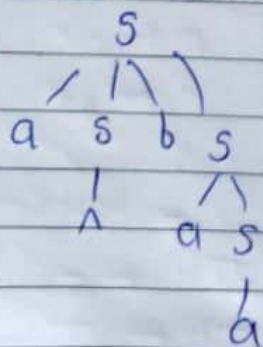
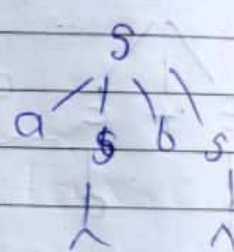
a) $E \rightarrow E + E \mid E * E \mid a$



or



b) The grammar has more than two derivation trees. Therefore above grammar is ambiguous grammar.

$$A \rightarrow sbA/sbA$$

$$s \rightarrow asbs$$


Q4 covert following Grammr to CNF form

$$a) S \rightarrow PQP | Q | PP$$

$$P \rightarrow OP | \Lambda$$

$$Q \rightarrow IQ | \Lambda$$

step 1

$$S \rightarrow PQP | Q | PP$$

$$P \rightarrow OP | \Lambda$$

$$Q \rightarrow IQ | \Lambda$$

step 2

$$S \rightarrow PQP | Q | PP$$

$$P \rightarrow OP | \Lambda$$

$$Q \rightarrow IQ | \Lambda$$

step 3

$$S \rightarrow PQP | Q | PP$$

$$P \rightarrow x_0 P | \Lambda$$

$$Q \rightarrow x_1 Q | \Lambda$$

$$x_1 \rightarrow 1$$

$$x_0 \rightarrow 0$$

step 4

$$S \rightarrow PT$$

$$T \rightarrow QP$$

$$S \rightarrow PQ | QP | x_1 Q | PP$$

$$P \rightarrow x_0 P | \Lambda$$

$$Q \rightarrow x_1 Q | \Lambda$$

$$x_1 \rightarrow 1$$

$$x_0 \rightarrow 0$$

b)

$$\begin{aligned} S &\rightarrow AACD \\ A &\rightarrow aAb1A \\ C &\rightarrow aca \\ D &\rightarrow aDa | bDb1A \end{aligned}$$

step 1

$$\begin{aligned} S &\rightarrow AACD | ACD | AAC1CD | AC \\ A &\rightarrow aAb1ab \\ C &\rightarrow aca \\ D &\rightarrow aDa | bDb | aa1bb \end{aligned}$$

step 2

$$\begin{aligned} S &\rightarrow AACD | ACD | AAC | CD | aca \\ A &\rightarrow aAb1ab \\ C &\rightarrow aca \\ D &\rightarrow aDa | bDb | aa1bb \end{aligned}$$

step 3

$$\begin{aligned} S &\rightarrow AACD | ACD | AAC | CD | AC | ~~aca~~ | XaC | Xa \\ A &\rightarrow XaAXb | XaXb \\ C &\rightarrow XaC | Xa \\ D &\rightarrow XaDXa | XbDXb | XaXa | XbXb \end{aligned}$$

$$Xa \rightarrow a$$

$$Xb \rightarrow b$$

step 4

$$\begin{aligned} S &\rightarrow AT_1 \\ T_1 &\rightarrow AT_2 \\ T_2 &\rightarrow CD \end{aligned} \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} AACD$$

$$\begin{aligned} S &\rightarrow AV_1 \\ V_1 &\rightarrow CD \end{aligned} \quad \left. \begin{array}{l} \\ \end{array} \right\} ACD$$

$$S \rightarrow cD|Ac|Xac|a$$

$$\left. \begin{array}{l} A \rightarrow XaW, \\ W_1 \rightarrow AXb \\ A \rightarrow XaXb \end{array} \right\} XaAXb$$

$$C \rightarrow XaC|Xa$$

$$D \rightarrow XZ_1$$

$$Z_1 \rightarrow DXa$$

$$D \rightarrow XZ_2$$

$$Z_2 \rightarrow DXb$$

$$D \rightarrow XaXa|XbXb$$

$$Xa \rightarrow a$$

$$Xb \rightarrow b$$

q5 write Regular Grammar for

a) $L = \{x \mid n_0(x) \text{ and } n_1(x) \text{ are even}\}$

b) $L = \{a^n b^m \mid n, m > 0\}$

$$S \rightarrow aS_1 | bS_2 | \Lambda$$

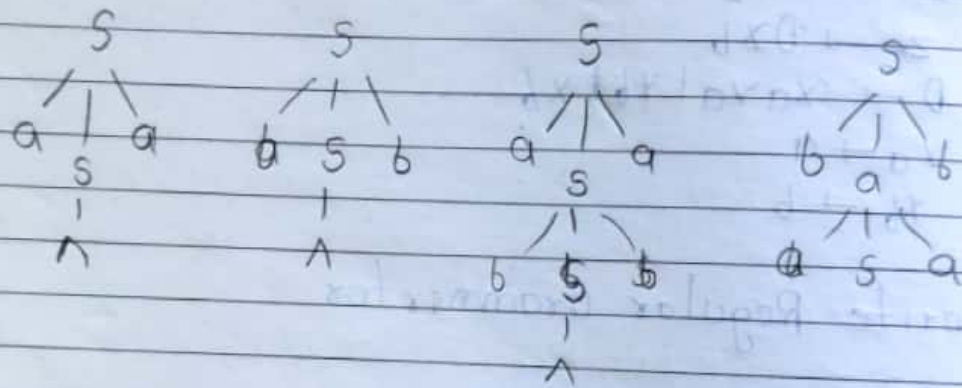
$$S_1 \rightarrow aS_1 | \Lambda$$

$$S_2 \rightarrow bS_2 | \Lambda$$

d) $\Sigma = a^* + b^*$
 $S \rightarrow as, | bs$
 $S_1 \rightarrow a, | \Lambda$
 $S_2 \rightarrow b, | \Lambda$

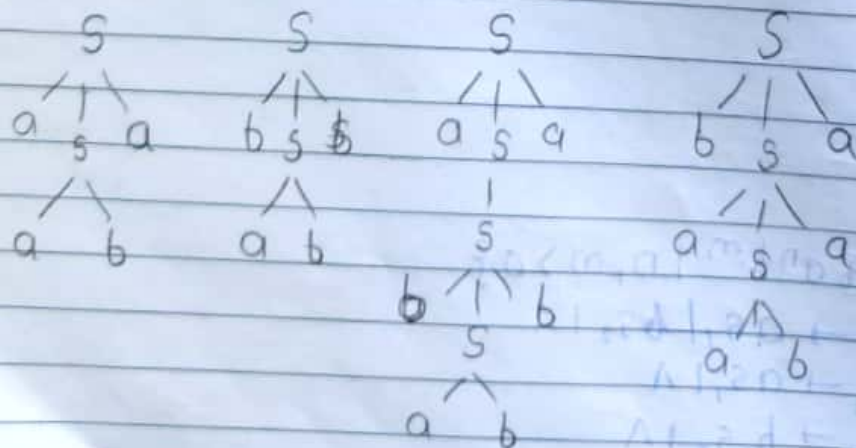
Q1 what language is generated by following CFG

a) $S \rightarrow asa | bsb | \Lambda$



$L = \{ \Lambda, aa, bb, abba, baab \}$

b) $S \rightarrow asa | bsb | a | b$



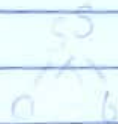
$L = \{a, b, aaba, babb, ababba, baabaa, \dots\}$

q3 c) $S \rightarrow asb | bsa | \Lambda$

$L = \{\Lambda, ab, ba, aabab, babab, \dots\}$

d) $\rightarrow S \rightarrow asa | bsb | aAb | bAa$
 $A \rightarrow aAa | bAb | a | b | \Lambda$

$L = \{\Lambda, a, b, ab, ba, aaba, abba, baaa, bbaa, aabab, \dots\}$



aAb

bAa