TOC - Assn 5

Problem 1:

L be a language over {a,b}

Given grammar:

1. $S \rightarrow aSa$
2. $S \rightarrow \epsilon$

~~Right Linear Grammar~~: $\left.\begin{array}{l} X \rightarrow zY \\ X \rightarrow z \end{array}\right\}$ $X, Y \in V$ & $z \in \Sigma^*$

Left Linear Grammar: $\left.\begin{array}{l} X \rightarrow Yz \\ X \rightarrow z \end{array}\right\}$ $X, Y \in V$ & $z \in \Sigma^*$

So, by considering the above two grammars, we can say that the given grammar is neither right linear grammar nor left linear grammar. So, it is not linear. 1

Language generated by given grammar is:

$L = \{\epsilon, aa, aaaa, \dots\}$

$S \rightarrow a\epsilon a \rightarrow aa$ $\quad$ $S \rightarrow aaSaa \rightarrow aa\epsilon aa \rightarrow aaaa$

So, it is generating a strings with even number of a's.

The above language can also be represented as

$\left.\begin{array}{l} S \rightarrow aT \\ T \rightarrow aS \\ S \rightarrow \epsilon \end{array}\right\}$ Right Linear Grammar. So it is linear. 2

Hence, All languages generated by non-linear grammar need not be non-linear.

problem 2:

The content-free grammar G that generates all strings of balanced left and balanced right parenthesis e.g., (),(()), ()(), (()()), etc. is

$$S \rightarrow (S)$$
$$S \rightarrow SS$$
$$S \rightarrow \epsilon$$

stack machine:

Read	Pop	Push
ϵ	S	(S)
ϵ	S	SS
ϵ	S	ϵ
(	(	ϵ
)	)	ϵ

problem 3:

The content free grammar G for the language of palindromes over {a,b}.

$$S \rightarrow aSa$$
$$S \rightarrow bSb$$
$$S \rightarrow a$$
$$S \rightarrow b$$
$$S \rightarrow \epsilon$$

Stack machine:

Read	Pop	Push
ε	S	aSa
ε	S	bSb
ε	S	a
ε	S	b
ε	S	ε
a	a	ε
b	b	ε

Problem 4:

Given CFG: 1. $S \rightarrow 0B \mid 1A$

2. $A \rightarrow 0 \mid 0S \mid 1AA$

3. $B \rightarrow 1 \mid 1S \mid 0BB$

$S \rightarrow 0B \rightarrow \underline{01}$ $(\because B \rightarrow 1)$

$S \rightarrow 0B \rightarrow 01S \rightarrow 011A \rightarrow \underline{0110}$

$S \rightarrow 0B \rightarrow 00BB \rightarrow \underline{0011}$

$S \rightarrow 0B \rightarrow 00BB \rightarrow 0011S \rightarrow 00110B \rightarrow \underline{001101}$

$S \rightarrow 1A \rightarrow \underline{10}$

$S \rightarrow 1A \rightarrow 10S \rightarrow 100B \rightarrow \underline{1001}$

$S \rightarrow 1A \rightarrow 11AA \rightarrow \underline{1100}$

~~S → 1A → 11AA → 111S0BB → 1110B011~~

~~→ 11101011~~

$S \rightarrow 1A \rightarrow 11AA \rightarrow 1100S \rightarrow 11001A \rightarrow \underline{110010}$

The above CFG generates many sequences which consists of equal number of 0's & 1's.

problem 5:

Given CFG: 1. $S \rightarrow \epsilon \mid 0S \mid 1T$

2. $T \rightarrow 0T \mid 1S$

$S \rightarrow 0S \rightarrow 01T \rightarrow 010T \rightarrow 0101S \rightarrow 0101$

$S \rightarrow 1T \rightarrow 10T \rightarrow 101S \rightarrow 101$

$T \rightarrow 0T \rightarrow 01S \rightarrow 010S \rightarrow 010$

$T \rightarrow 1S \rightarrow 10S \rightarrow 101T \rightarrow 1011S \rightarrow 101$

The given CFG generates a sequences of strings which contains even number of 1's and any number of 0's.