

Q.1 Construct CFG for the following

- i. Alternate sequences of 0 and 1.
- ii. Do not contain 3 consecutive 1's
- iii. CFG equivalent to Regular Expression $(0+1)^*1$
- iv. $S \rightarrow SS \mid 0S1 \mid 1S0 \mid \text{null}$, which type of Grammar is it? Generate any valid string using this grammar and construct a parse tree
- v. CFG for $a^n b^n$, where $n \geq 1$
- vi. CFG for $a^n b^n$, where $n \geq 0$
- vii. CFG for $a^n b^{2n}$, where $n \geq 1$
- viii. CFG for $a^{n+1} b^n$, where $n \geq 0$
- ix. CFG for $a^n b^{n+1}$, where $n \geq 0$
- x. CFG for $(1+01)^* 00 (1+10)^*$
- xi. CFG for equal number of 0's and 1's
- xii. CFG for all palindromes
- xiii. CFG for parenthesis matching
- xiv. CFG for $a^n b^m c^k$ where $k = n+m$
- xv. CFG for unequal number of a's and b's
- xvi. CFG for $a^m b^n$ where $m > n$
- xvii. What does the given CFG define? $S \rightarrow 0S1S \mid 1S0S \mid \lambda$? Explain with example

Q.2 Design Turing machine for the following

- i. accepting the Even Palindromes
- ii. which adds 2 unary numbers. Show simulation
- iii. two's complement of a given binary number
- iv. TM for $L = \{ 0^n 1^n \mid n \geq 1 \}$
- v. TM to recognize the language $L = \{ a^n b^n a^n \mid n \geq 1 \}$

Q.3 Let G be the grammar. Find the leftmost derivation, rightmost derivation and parse tree

- i. for the string **001222**.
G: $S \rightarrow 0S \mid 1A \mid 2B \mid \epsilon$
 $A \rightarrow 1A \mid 2B \mid \epsilon$
 $B \rightarrow 2B \mid \epsilon$

- ii. Let G be the Grammar. Find Leftmost derivation, Rightmost derivation and Parse tree for the string **bbaababab**

$$S \rightarrow bB \mid aA / \varepsilon$$

$$A \rightarrow b \mid bS \mid aAA / \varepsilon$$

$$B \rightarrow a \mid aS \mid bSS / \varepsilon$$

- iii. Consider the grammar $S \rightarrow 0S0 \mid 1S1 \mid SS \mid \lambda$. Given the string **0101101110**, find a leftmost derivation and a rightmost derivation with corresponding parse trees.

Q.4 Design PDA for

- for odd length palindrome, let $\Sigma = \{0,1\}$, $L = \{W X W^R\}$
- PDA that checks the well formedness of parenthesis
- PDA for $\{a^n b^{2n+1} \mid n \geq 1\}$
- NPDA for Palindromes

Q.5 Find CNF for the following CFG

- $S \rightarrow aAbB$, $A \rightarrow aA \mid a$, $B \rightarrow bB \mid b$.
- Write a CFG to generate equal number of 1's and 0's ($0^n = 1^n$) and convert to CNF
- $S \rightarrow AB0$ $A \rightarrow 001$ $B \rightarrow A1$ $B \rightarrow 001$
- $S \rightarrow ABA$, $A \rightarrow aA \mid bA \mid \lambda$, $B \rightarrow bB \mid aA \mid \lambda$

Q.6 Convert the given grammar Right Linear Grammar to Left Linear Grammar

$$S \rightarrow bB, B \rightarrow bC \mid aB \mid b$$

$$C \rightarrow a$$

Q.7 What is Ambiguous Grammar, find if the following grammar is ambiguous or not?

$$S \rightarrow S+S$$

$$S \rightarrow S*S$$

$$S \rightarrow a$$

$$S \rightarrow b$$

Q.8 .Explain the following

- Variations of Turing machine
- Halting Problem
- Chomsky's Hierarchy

