Tutorial -5 (07/10/2020)

1. S -> aSa|bSb|a|b; The language generated by the above grammar over the alphabet {a,b} is the set of
   a.) All Palindromes
   b.) All odd length palindromes
   c.) Strings that begin and end with the same symbol
   d.) All even length palindromes

2. Context Free Grammars are of _____

3. If a grammar is Regular it is definitely _____ but if a grammar is context free it may not be _____

4. The machine which is used to accept context free grammar is _____

5. Consider the context-free grammars over the alphabet {a,b,c} given below. S and T are non-terminals.

   G1:S→aSb|T,T→cT|∈
   G2:S→bSa|T,T→cT|∈

   The language L(G1)∩L(G2) is
   - (A) Finite
   - (B) Not finite but regular
   - (C) Context-Free but not regular
   - (D) Recursive but not context-free

6. Consider the following Context-Free Grammar (CFG) G:

   $S \rightarrow X \mid XY$
   $X \rightarrow aXb \mid aY\,b$
   $Y \rightarrow bY\,c \mid \varrho$

   where S, X, Y are nonterminal symbols, S is the start symbol, and a,b, c are terminal symbols.Which of the following statements about the language L(G) generated by G are correct?

   (i) $\varrho \in L(G)$
   (ii) aaabbbcc ∈ L(G)
   (iii) aabbbbcc ∈ L(G)
   (iv) {a^ib^ib^jc^j | i, j ∈ N, i > 0} = L(G)
   (v) The following CFG G′is equivalent to G above, i.e. L(G′) =L(G):

   $$S \rightarrow XY$$
   $$X \rightarrow aXb \mid ab$$

$$Y \rightarrow bY\,c \mid \varrho$$

7. Is the following CFG ambiguous? If yes, show this. If no, explain why.
$$A \rightarrow aBbA \mid aBbAcA \mid d$$
$$B \rightarrow e$$
A and B are nonterminals, A is the start symbol, a, b, c, d, and e are terminals.

Questions to solve within 10/10/2020 (Saturday)

1. Convert the given CFG into an equivalent CNF. Explain all the steps.
      (a) $S \rightarrow BSB \mid B \mid \varepsilon$
         $B \rightarrow 00 \mid \varepsilon$
      (b) $S \rightarrow S1 \mid S2$
         $S1 \rightarrow S1b \mid Ab \mid \lambda$
         $A \rightarrow aAb \mid ab$
         $S2 \rightarrow S2a \mid Ba \mid \lambda$
         $B \rightarrow bBa \mid ba$

2. Convert the given CFG into an equivalent GNF. Explain all the steps.
    $S \rightarrow XA \mid BB$
    $B \rightarrow b \mid SB$
    $X \rightarrow b$
    $A \rightarrow a$

3. Consider the following Context-Free Grammar (CFG):
$$S \rightarrow ABC \mid BC$$
$$A \rightarrow aA \mid a$$
$$B \rightarrow b \mid C$$
$$C \rightarrow cc \mid dd \mid \varrho$$
S, A, B, and C are nonterminals, a, b, c, and d are terminals, and S is the start symbol. What is the set N_ϱ of nullable nonterminals for this grammar? Provide a brief justification.

NOTE: *Upload your solutions only through the given link. Name your pdf file with the format* **<rollno_name_tutorialno>**. *Do not mail your solutions elsewhere.*
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