

## **Homework #6 due May 9, 2023 before recitation**

### **Question 1**

Consider the CFG  $G = (V, \Sigma, R, S)$  where  $V = \{S, A, B, C, D, E\}$ ,  $\Sigma = \{a, b, c\}$  and  $R$  is as given below

$R$ :

$S \rightarrow AE \mid EB \mid C$

$A \rightarrow aA \mid a$

$B \rightarrow Bb \mid b$

$C \rightarrow Cc$

$D \rightarrow aCb \mid a \mid b \mid c$

$E \rightarrow aEb \mid e$

- (a) Remove all the null productions of  $G$ , if any, and call the result  $G_1$ .
- (b) Remove all the unitary productions of  $G_1$ , if any, call the result  $G_2$ .
- (c) Remove all the non-generative and non-reachable symbols of this grammar, if any, and call the result  $G_3$ .
- (d) Compute the Chomsky Normal Form of  $G_3$  using your results above.
- (e) State in the simplest possible way the language generated by  $G$

### **Question 2**

Consider the alphabet  $T$  of terminals consisting of 3 pairs of matching left and right parentheses of three types, namely :  $\{, \}, [, ], (, )$

(a) Describe a CFG,  $G = (V, T, R, S)$  such that  $L_G$  has the following properties:

(i) every left parenthesis is balanced by a distinct right parenthesis somewhere on its right side and of its own type; (ii) a priority rule holds : no curly parenthesis - i.e.  $\{$  or  $\}$  - is contained within a rectangular pair - i.e.  $[ ]$  - or a plain pair - i.e.  $( )$  - ; and no rectangular parenthesis is contained within a plain pair; (iii) empty string is not a member of  $L_G$ .

(b) Using your grammar find a parse tree that derives the string:  $\{ ( ) [ ( ) ] \} \}$

**Main Text: Exercise 6.4.1 (a),(c) ; 6.4.2**