CMPE471 – Tutorial 2

Q1. Let $L_1 = \{w \in \{a, b\}^* \mid n_a(w) > n_b(w)\}$ and $L_2 = \{w \in \{a, b\}^* \mid n_a(w) < n_b(w)\}$. Let $L = \{a, b\}^* - (L_1 \cup L_2)^*$. Describe L and justify your answer.

Q2. Construct CFGs for the following languages:

   i) $L = \{a^j b^k a^n \mid k = j + n\}$

   ii) $L = \{a^k b^{2k} c^n \mid k, n > 0\}$

   iii) $L = \{a^j b^k c^n \mid 0 \leq j + k \leq n\}$

Q3. Find the languages generated by the following CFGs:

   i) $S \rightarrow aSbb \mid aSb \mid aS \mid \varepsilon$

   ii) $S \rightarrow aScc \mid aAcc$
         $A \rightarrow bAc \mid bc$

   iii) $S \rightarrow aSb \mid aSbb \mid aSbbb \mid \varepsilon$

   iv) $S \rightarrow aSbS \mid bSaS \mid \varepsilon$

   v) $S \rightarrow aSbb \mid A$
         $A \rightarrow cA \mid c$

Q4. Show that the grammar $S \rightarrow aSb \mid bSa \mid SS \mid \varepsilon$ is ambiguous.

Q5. Consider the CFG with the following products. Find the derivation tree of $aababbbbb$.

$S \rightarrow AB \mid \varepsilon$
$A \rightarrow aB$
$B \rightarrow Sb$