1. Find CFGs for the following languages:

   (a) $L_1 = \{w \mid w \text{ is } \textit{not} \text{ a palindrome } \}$

   (b) $L_2 = \{w \mid \text{the nr. of 0s and 1s of } w \text{ is } \textit{not} \text{ the same } \}$

   In each case, prove why your CFG works.

2. Let $X = \{x_1, x_2, x_3, \ldots\}$ be the set of boolean variables; variables which take the values T and F (true and false) only. A boolean expression is formed as follows:

   (a) **Basis Case:** x_i, T, F, are boolean expressions.

   (b) **Induction Step:** if E_1, E_2 are boolean expressions, then so are:

      i. $(E_1 \wedge E_2)$ (i.e., the AND of E_1 and E_2),

      ii. $(E_1 \vee E_2)$ (i.e., the OR of E_1 and E_2),

      iii. $\neg E_1$ (i.e., the NOT of E_1),

      iv. (E_1)

   For example, $(\neg x_2 \wedge (x_1 \vee F))$ is a boolean expression.

   Give a CFG which generates all (and only) boolean expressions. Let x_i be represented by $x i_{\text{bin}}$, where i_{bin} is the binary expression for i. For example, x_5 is $x101$. So $x, 0, 1, T, F$ would be the terminal symbols.

   Also show that the set of boolean expressions is not regular.