COT 4210 Homework #3: Context Free Grammars
Due Date: Tuesday September 21, 2010 (in class)

1) Give parse trees and derivations for the following two strings

     a) a + a + a
     b) ((a))

in the CFG G_4 defined below:

$$E \rightarrow E + T \mid T$$
$$T \rightarrow T \times F \mid F$$
$$F \rightarrow (E) \mid a$$

2) Give context free grammars that generates the following languages with the alphabet {0,1}:

     a) $\{w \mid w = w^R$, namely w is a palindrome$\}$
     b) $\{w \mid w$ contains at least three 1s $\}$
     c) $\{w \mid$ the length of w is odd and its middle symbol is 0$\}$
     d) $\{w \mid w$ contains more 1s than 0s$\}$

For each grammar, briefly justify why it generates the desired language.

3) Give an informal description and state diagram of a PDA that accepts the language in question 2 part d.

4) Convert the following CFG into an equivalent CFG in Chomsky normal form, using the algorithm shown in class.

     $A \rightarrow BAB \mid B \mid \varepsilon$
     $B \rightarrow 00 \mid \varepsilon$

5) Use the pumping lemma to show that the following language is not context free:

     $\{0^n \# 0^{2n} \# 0^{3n} \mid n \geq 0\}$