

COT 4210 Homework #2: Context Free Grammars
Due Date: Monday June 6, 2011 (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:

$$\begin{aligned} E &\rightarrow E + T \mid T \\ T &\rightarrow T x F \mid F \\ F &\rightarrow (E) \mid a \end{aligned}$$

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

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

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.

$$\begin{aligned} A &\rightarrow BAB \mid B \mid \epsilon \\ B &\rightarrow 00 \mid \epsilon \end{aligned}$$

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

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