CS 3800, Spring 2010
Homework 3
Assigned: Tuesday, 9 February 2010
Due: Tuesday, 16 February 2010

Good students should get at least 50 of the 80 possible points.

1. [4 pts] Do exercise 2.11 in the textbook.
2. [4 pts] Do exercise 2.13 in the textbook (both parts).
3. [5 pts] Do exercise 2.14 in the textbook.
4. [10 pts] Do exercise 2.16 in the textbook.
5. [5 pts] Do exercise 2.17 in the textbook.
6. [10 pts] Do problem 2.26 in the textbook.
7. [16 pts] For each of the following languages, give a context-free grammar with alphabet $\{0,1\}$ that recognizes the language.
   (a) $\{1, 10, 11, 100\}$
   (b) $\{w \mid w$ contains at most three 0s$\}$
   (c) $\{w \mid w$ is a binary numeral divisible by 3$\}$
   (d) $\{w \mid w$ is a binary numeral divisible by 7$\}$
   (e) $\{w \mid w$ contains an even number of 0s and an even number of 1s$\}$
   (f) $\{w \mid w$ contains at least twice as many 0s as 1s$\}$
   (g) $\{w \mid$ there exist strings x, y, and z such that z is the reverse of x and $w = xyz\}$
   (h) the complement of $\{0^n1^n \mid n \in \mathcal{N}\}$
8. Prove that the following languages are context-free:
   (a) [5 pts] $\{0^m1^{m+n}0^n \mid m, n \geq 0\}$
   (b) [5 pts] $\{0^i1^n0^j1^n0^k \mid i, j, k, n \geq 0\}$
   (c) [5 pts] $\{w \mid w \in \{0,1\}^*$and w contains the same number of 0s as 1s$\}$
   (d) [5 pts] $\{w \mid w \in \{0,1\}^*$and w contains twice as many 0s as 1s$\}$
9. [6 pts] Prove that the following CFG is unambiguous:

$$\begin{aligned} E &\rightarrow T \mid E \texttt{ + } T \\ T &\rightarrow 0 \mid \texttt{(} E \texttt{)} \end{aligned}$$