COMP 481: Automata, Formal Languages, and Computability
Spring 2008
Homework Assignment #8 (Due date: 28 March 2008)

1. Give a decision procedure for each of the following questions:

   (a) Given a CFG G, is $|L(G)| \geq 3$?

   (b) Given a CFG G, does G generate any even length strings?

   (c) Given a regular grammar G, is $L(G)$ context-free?

2. Consider the following CFG:

   $S \rightarrow AB\$|AC\$$

   $A \rightarrow aA|a$

   $B \rightarrow bB|b$

   $C \rightarrow c$

   Show an equivalent grammar that is LL(1) and prove that it is.

3. Consider the following CFG:

   $E \rightarrow E + T|T$

   $T \rightarrow T * F|F$

   $F \rightarrow (E)|\text{id}$

   Trace the execution of a CKY parser on the input string id+id$*$id, given the unambiguous arithmetic expression grammar shown above, by:

   (a) Converting the CFG into CNF.

   (b) Showing the steps of the parser.

4. Describe a TM that decides each of the following languages.

   (a) $\{a^i b^j : i < j\}$.

   (b) $\{www : w \in \{a, b\}^*\}$.

   (c) $\{x \in \{a, b, c\}^* : \#_a(x) = \#_b(x) = \#_c(x)\}$.