CPSC 326 Problem Set 2

Due March 19

1. Given the following grammar G_1:

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

   a. What are the variables?

   b. Which is the start variable?

   c. What are the terminals?

   d. How many productions does the grammar have?

2. Give parse trees for the following strings using grammar G_1 above:

   a. a

   b. $a + b \times c$

   c. $a \times b + c$

   d. $(a + b) \times c$

   e. $(((a)))$

   f. $a + b + c$

3. Design a PDA which recognizes the same language as the grammar G_1 generates.

4. Create a context-free grammar which recognizes all strings of "properly-matched" parenthesis. The strings on the left are examples of properly-matched parenthesis, and should be produced from your grammar. The strings on the right are not properly matched and should not be produced:

Proper:	Improper:
(())	())
()()	())(
(()())	(()

5. Create a push-down automaton which recognizes the language of properly-matched parenthesis.

6. Is the language of properly-matched parenthesis a regular language? Justify your answer.

7. Give context-free grammars for the following two languages:

   a. $\{a^m b^n c^n \mid m, n \geq 0\}$
   b. $\{a^n b^n c^m \mid m, n \geq 0\}$

8. Given your answers to the previous problem, and the fact that the language $\{a^n b^n c^n \mid n \geq 0\}$ is *not* context-free, are context-free languages closed under intersection? Explain your reasoning.

9. Show that context-free languages are closed under the regular operations of union, concatenation, and star.