CS117 (Programming Languages) Fall 2015 HW 1 (25 pts.) Due: Sept. 16 (W)

1. Rewrite the following prefix expressions in postfix notations.
   Note: **sqrt** is a unary operator.

   (a) * * a + b c - d e
   (b) - * 2 sqrt - / / b 2 / b 2 * * 4 a c a

2. Draw abstract syntax trees for the expressions in #1.

3. Write a CFG for a language in which strings are matched parentheses each of which contains a real number, including nested ones and ε (empty string).
   In the case of nested parentheses, only the innermost one has a real number.
   legal strings: (0.5), ((1.123)), (1.21)(21.3), (0.5)((1.1)), (((12))), ((1.1)(2.2)), ε
   illegal strings: ( ), ( )), ((( ), (0.5)( ), ((1.1) 2.2)

   Using your grammar for #3,
   (a) Verify that string (1.12)(21.5) is in the language.
   (b) Verify that string ((1.12)(21.5)) is in the language.

4. Consider the following grammar for a simplified-postfix-expression.

   E ::= E T + | E T – | T
   T ::= T F * | T F / | F
   F ::= Num
   Num ::= 0 | 1 | 2 | 3 | . . . | 9

   Rewrite the grammar in EBNF.

5. The following EBNF grammar is based on the syntax of statements in Modula-2:

   S ::= ε
   | id := expr
   | if expr then SL { elsif expr then SL } [else SL] end
   | while expr do SL end
   SL ::= S { ; S }

   Note that all words with lower characters are regarded as terminals.

   (a) Rewrite the grammar in BNF.
   (b) Draw syntax charts for S and SL.