

## Programs #4 & #5 - Due Tuesday, Sept. 29

1. This program should accept a properly parenthesized arithmetic expression. This means you should check to be certain the expression has been entered appropriately. As examples, the expression

$$((4 + 6) - (5 \times 8)) \div (6 + 1)$$

is properly parenthesized, but

$$(5 - 7) - (4 + 2) \times 8$$

is not. (We know how to evaluate this expression, but to code in order of operations into this program is beyond what I want you to do at this point.) Also, an expression with a different number of opening and closing parentheses is not properly parenthesized.

- (a) Your program should allow the user to enter a properly parenthesized arithmetic expression. The allowed operations will be “+”, “-”, “×”, “÷”, and “^”. If the user enters an expression incorrectly, your program should state this is the case and allow the user to reenter the expression.
  - (b) Your program should store the expression as a binary tree. (You may want to use a stack to help you do this.)
  - (c) Your program should evaluate and output the value of the expression by using an inorder traversal of the tree.
  - (d) Your program should use a postorder traversal of the tree to output the expression in postfix form.
  - (e) Your program should use a preorder traversal of the tree to output the expression in prefix form. (Prefix form of the expression  $((4 + 6) - (5 \times 8)) \div (6 + 1)$  is  $\div - + 4 6 \times 5 8 + 6 1$ .)
2. This program should store data in a binary search tree.
    - (a) Your program should read in data from a text file and store the data in a binary search tree.
    - (b) Your program should allow the user to determine whether a piece of data he/she enters is in the tree.
    - (c) Your program should allow the user the option to add a piece of data to the tree.
    - (d) Your program should allow the user to delete a piece of data from the tree.
    - (e) Your program should allow the user to see the contents of the search tree in either ascending or descending order.
    - (f) Your program should allow the user to do this multiple times for one run of the program (meaning the user needs to tell the program to quit in order for it to quit).