CPSC 2150 – Algorithms and Data Structures II

Lab4: Expressions and Sorting

Total - 50 Marks

Learning Outcomes

- Apply recursion as a problem-solving technique
- Implement and program recursive functions using the stack of system to solve the problem

Resources

- Chapter 5 and 11 of the text book

Description

Question 1: We are going to have a program that represents an expression in different formats such infix, prefix and postfix. The input expressions can be represented in infix, prefix or postfix expression. The infix expressions are fully parenthesised expression. The expressions contains identifiers as operands and +, - , * , / or % as operators. An identifier is defined by a letter. Any sequence of spaces is considered as separator. Add and subtract operation have less priority than multiply, divide and modular.

The following are examples of different expressions:

Infix expressions: "((A+ B) * t)" or "((x % d) + (Y - c))"
Prefix expressions: "* + A Bt" or "+ %xd-Yc"
Postfix expressions: "AB+t*" or " x d % Y c - +"

A. **[10 marks]** write a function named **in2prefix** that given an infix expression returns the prefix expression of the input.
B. **[10 marks]** write a function named **pre2infix** that given a prefix expression returns the fully parenthesized parenthesised infix expression of the input.
C. **[10 marks]** write a function named **post2infix** that given a postfix expression returns the fully parenthesized parenthesised infix expression of the input.

D. **[5 marks]** write a main function to test your above functions.

Question 2: A 3-way merge sort on an array with N elements works as follows:

1. divide the array into 3 subarrays of size N/3 ;
2. recursively sort the 3 subarrays;
3. merge the 3 subarrays together.

[5 marks] Find the time complexity of 3-way merge sort. You may assume that N is a power of 3. Show your work. **(answers.pdf)**

[5 marks] Between 3-way and 2-way merge sort, which one has better time complexity? Justify your answer. **(answers.pdf)**

[5 marks] An in-place sorting algorithm is an algorithm that sorts the data in O(1) as for space complexity. We learned that the merge sort algorithm is not an in-place sorting algorithm because the space complexity of the merge sort is O(n). Write an algorithm using an appropriate data structure that implements an in-place merge sort algorithm. **(answers.pdf)**

Submit to D2L

*Make a **zip file** named* **StudentNumber-*lab4.zip*** *including **answers.pdf** and **lab4.cpp*** by the end of the lab time**.** For example, if your student number is 10023449, the submitted file must be named as **10023449-lab4.zip**.