Write Sort Algorithms with Doubly Linked Lists
COSC2430: Data Structures and Programming

Introduction

Your objective will be to write a C++ program using doubly linked lists that will implement five sorting algorithms: `select`, `insert`, `quick`, `merge`, and `heap`. The program must be able to sort a list of integers. You will also need to output measurements related to "big-O" for the sorting algorithms. Each integer must be stored using a doubly linked list.

Input/output

The input will be a simple text file. In addition, you should output the sorted numbers to standard output (i.e. `cout` or `printf`).

An *example* of what a text file and corresponding output is below. The input text contains (<= **10000**) integers (one integer in one line). Each integer is less than **256** digits.

```
1
-1
-2
0
-200000
2
1
999999999
1234890
1950192
```

```
-200000
-2
-1
0
1
1
2
1234890
1950192
999999999
```

Additional Output

In addition to the above output, you will need to output an analysis of the runs as well. It will be **appended** to another file (named exactly the same as "**bigO.txt**") with formatting (if file does not exist then create it). The column are as follows:

1. `algorithm`: sorting algorithm used.
2. `#numbers(n)`: number of integers sorted.
3. `#Comparisons`: number of comparisons to complete sort
4. `#Swaps`: number of swaps to complete sort
5. `#bigOComparisons`: number of comparisons needed in the worst case.
6. `#bigOSwaps`: number of swaps needed in the worst case.

The output to the **bigO.txt** file should like as below:

```
algorithm #numbers(n) #Comparisons #Swaps #bigOComparisons #bigOSwaps
heap              10            40      8               45          50
quick            100          2000     77             5050        5050
select            10            45     10               45          45
insert           100          5050      0             5050           0
```

Note that the header line should only be printed if the file does not exist. If the file already exists then just append the new results.

Command

The program must be called sort. And it will executed as follows:

sort "input=in1.txt;digitsPerNode=8;algorithm=heap;output=out1.txt"

Description of each option:

1. input=<*file_name*>: this is the name of the file that has the input.
2. digitsPerNode=<*number*>: this is the digit per node (1-8) for the doubly linked list. See hw1.
3. algorithm=<*sort_type*>: the sorting algorithm to use.
4. output=<*file_name*>: name of the file to output the sorting results.

Additional Requirements

You will be coding the doubly linked list yourself. Do not use libraries or other data structures like (std::vector or std::string) to store the integers. You can use an array of doubly linked lists to store all the doubly linked lists;

You must do memory management. This means each node is created using the new operator. And you must delete those nodes when program completes execution.

Each sorting should be done within 10 seconds. You will get a timeout error if your program cannot get the result within 10 seconds.