PROGRAM 3 / CSC1310

SEARCHING & SORTING ALGORITHM EFFICIENCY

IMPORTANT DATES

Assignment Date: Thursday, October 18, 2018

Due Date: Thursday, November 8, 2018

PROGRAM ASSIGNMENT DESCRIPTION

You will be given a version of the Movies program (that you did for program 1) where the movies library is implemented as a linked list of movie pointers instead of an array of moivie pointers.

You will add a function for the following search & sort algorithms: **linear search, binary search, bubble sort, insertion sort, insertion sort descending, selection sort, merge sort, and quick sort.** Some of these functions will require a **swap** function in the LinkedList class as well.

Create a function called **algorithmAnalysis** that will use a timer to time how long it takes to run the algorithm on a linked list of movies and print out the times. Several movie text files will be provided for you in order for you to test your program.

FILES THAT SHOULD BE INCLUDED IN YOUR SUBMISSION

- crockett_movie_data_24.txt
- crockett_movie_data_112.txt
- crockett_movie_data_1112.txt
- crockett_movie_data_2112.txt
- crockett_movie_data_5024.txt
- crockett_movie_data_10112.txt
- Driver.cpp
- LinkedList.h
- Makefile
- Movie.cpp
- Movie.h
- Movies.cpp
- Movies.h
- runProgram.bat
- TEST_CASE_112.txt
- TEST_CASE_1112.txt
- TEST_CASE_2112.txt
- TEST_CASE_5024.txt
- Text.cpp
- Text.h
- Timer.cpp
- Timer.h

PROGRAM SPECIFICATIONS

TIMER CLASS

Whenever you see "start timer" and "stop timer" and "print out total time" in the directions in this document, that means you will be using the Timer class provided for you.

You will need to **`#include "Timer.h"`** to use this class.

When you want to use a timer in your program, you will first need to create variables of data type `time_t`.

```
time_t start;

time_t end;
```

The getTime() function will get the current time and return it as a `time_t` data type. You will use this function to get the start time and the end time.

The totalTime() function accepts two `time_t` variables (start & end) and then returns the difference as a `double` (which is the number of seconds between the start & end time.

DRIVER.CPP

Modify the menu so that there is an addition option. The option should be inserted after "Print all movies" and before "Delete All movies…" and will be your new #7. Then the user will choose between 1 and 8.

If the user chooses #7, then you should call the **algorithmAnalysis** function, which is a member function of the Movies class.

MOVIES CLASS

Create the functions described below. All of the following functions except for **algorithmEfficiency**() should be made private.

- **linearSearch** – This function should search for a particular movie title to see if it is in the list. It should return -1 if the Movie title could not be found. Use the **linear search algorithm** to implement this function.

- **binarySearch -** This function should search for a particular movie title to see if it is in the list. It should return -1 if the Movie title could not be found. Use the **binary search algorithm** to implement this function.

- **bubbleSort** – This function should sort the LinkedList of Movies in ascending order by Movie title. This function will call a function called swap in the linkedList class to swap values in the linked list when necessary. Use the **bubble sort algorithm** to implement this function.

- **insertionSort** - This function should sort the LinkedList of Movies in ascending order by Movie title. This function will call a function called swap in the linkedList class to swap values in the linked list when necessary. Use the **insertion sort algorithm** to implement this function.

- **insertionSortDescending** – This function should be the same as insertionSort except it will sort the LinkedList of Movies in **descending** order by Movie title instead of ascending order.

- **selectionSort** - This function should sort the LinkedList of Movies in ascending order by Movie title. This function will call a function called swap in the linkedList class to swap values in the linked list when necessary. Use the **selection sort algorithm** to implement this function.

- **mergeSort** & **merge** – These two functions work together to implement the merge sort algorithm, which should sort the LinkedList of Movies in ascending order by Movie title. The mergeSort function is a recursive function which calls the merge function. The merge function dynamically allocates a new linked list of Movie pointers to use as the merged linked list. At some point in the merge function you will need to replace a node….you will do this by deleting the node (deleteNode) at a particular position and then inserting a new node (insertNode function) at a particular position.

quickSort & **partition** – These two functions work together to implement the quick sort algorithm, which should sort the LinkedList of Movies in ascending order by Movie title. The quicksort function is a recursive function which calls the partition function. The partition function will use a pivot string (c-string). The partition function will call a function called swap in the linkedList class to swap values in the linked list when necessary.

- **algorithmAnalysis**- This is the "driver" function that will call all of these other functions to test the efficiency of each one. Here is the pseudocode for this function below:

1. Start timer
   Call linearSearch sending a temporary Text* with a c-string named "Llama" to it. (I don't care if It finds this string or not)
   Stop timer
   Print out total time for this algorithm

2. Start timer
   Call binarySearch() sending a temporary Text* with a c-string named "Llama" to it.
   Stop timer
   Print out total time for this algorithm

3. Call insertionSortDescending() to put linked list in opposite order.
   Start timer
   Call bubbleSort()
   Stop timer
   Print out total time for this algorithm

4. Call insertionSortDescending() to put linked list in opposite order.
   Start timer
   Call selectionSort()
   Stop timer
   Print out total time for this algorithm

5. Call insertionSortDescending() to put linked list in opposite order.
   Start timer
   Call insertionSort()
   Stop timer
   Print out total time for this algorithm

6. Start timer
   Call insertionSortDescending()
   Stop timer
   Print out total time for this algorithm

7. Start timer
   Call mergeSort() sending 0 and the length of the linked list (# of nodes) minus 1 to the function
   Stop timer
   Print out total time for this algorithm

8. Start timer
   Call quickSort() sending 0 and the length of the linked list (# of nodes) minus 1 to the function
   Stop timer
   Print out total time for this algorithm

LINKEDLIST CLASS

Add a function to the LinkedList template class (LinkedList.h) called swap. This function should accept two integers which represent two node positions that need to be swapped.

This function should swap the VALUES in the two nodes. You do not have to swap the whole node, just swap the values.

READABILITY OF OUTPUT & CODE DOCUMENTATION

- Make sure that your output looks similar to my sample output (below). When I run your program, it shouldn't make me want to scream. It should be extremely readable and user-friendly.
- For this program, don't worry about comments except put your NAME at the top of all files that you modify so that the "Author" says April Crockett, modified by _____ (your name)

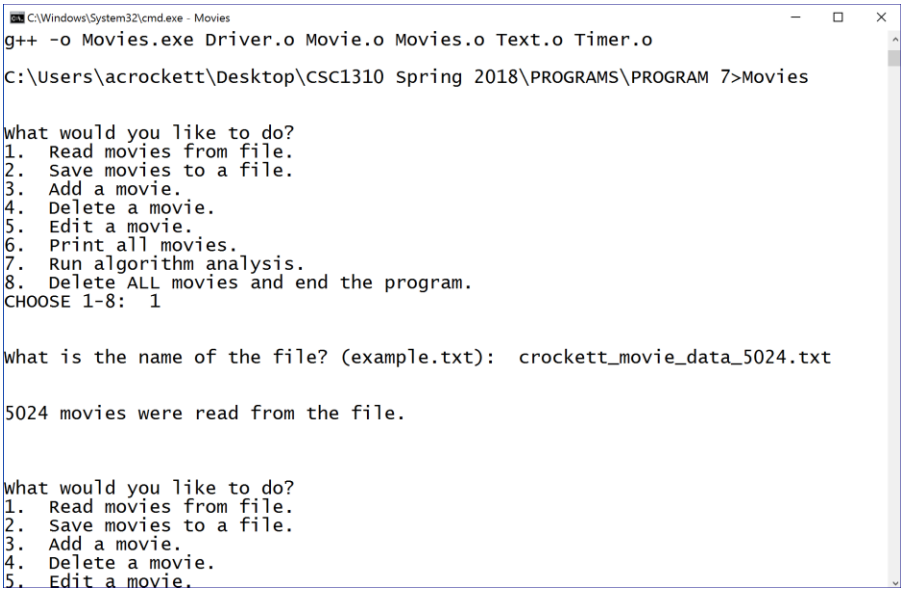
WHAT TO TURN IN

Zip ALL the files required to compile & run the program, in a single zipped file named whatever you want. Then, upload this zip file to the assignment folder in ilearn. I will remove one point if you turn in unzipped files**. Programs that do not include all the files listed in the "FILES" section on the first page of this document will not be graded**.

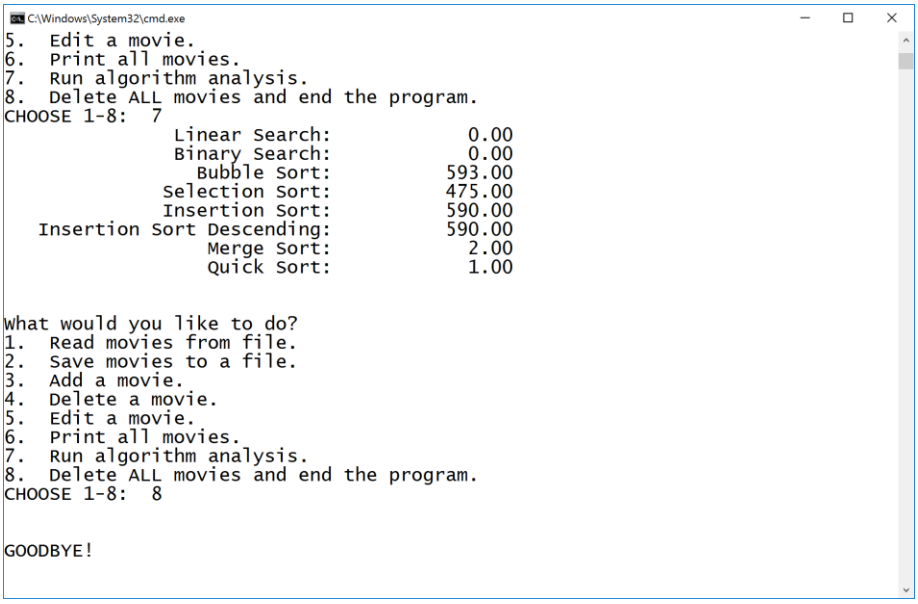
SAMPLE OUTPUT

Your sample output will very likely have different numbers of seconds for how long your algorithms take to run. This is because your computer's speed varies from my computer's speed. You should, however, notice the same pattern of time efficiency as you see in my sample output.

5024 MOVIES IN LINKED LIST:



```
C:\Windows\System32\cmd.exe - Movies
g++ -o Movies.exe Driver.o Movie.o Movies.o Text.o Timer.o

C:\Users\acrockett\Desktop\CSC1310 Spring 2018\PROGRAMS\PROGRAM 7>Movies


What would you like to do?
1.  Read movies from file.
2.  Save movies to a file.
3.  Add a movie.
4.  Delete a movie.
5.  Edit a movie.
6.  Print all movies.
7.  Run algorithm analysis.
8.  Delete ALL movies and end the program.
CHOOSE 1-8:  1


What is the name of the file? (example.txt):  crockett_movie_data_5024.txt


5024 movies were read from the file.



What would you like to do?
1.  Read movies from file.
2.  Save movies to a file.
3.  Add a movie.
4.  Delete a movie.
5.  Edit a movie.
```



```
C:\Windows\System32\cmd.exe
5.  Edit a movie.
6.  Print all movies.
7.  Run algorithm analysis.
8.  Delete ALL movies and end the program.
CHOOSE 1-8:  7
               Linear Search:            0.00
               Binary Search:            0.00
                 Bubble Sort:          593.00
              Selection Sort:          475.00
              Insertion Sort:          590.00
   Insertion Sort Descending:          590.00
                  Merge Sort:            2.00
                  Quick Sort:            1.00


What would you like to do?
1.  Read movies from file.
2.  Save movies to a file.
3.  Add a movie.
4.  Delete a movie.
5.  Edit a movie.
6.  Print all movies.
7.  Run algorithm analysis.
8.  Delete ALL movies and end the program.
CHOOSE 1-8:  8


GOODBYE!
```

24 MOVIES IN LINKED LIST:

```
What is the name of the file? (example.txt):  crockett_movie_data_24.txt

24 movies were read from the file.


What would you like to do?
1.  Read movies from file.
2.  Save movies to a file.
3.  Add a movie.
4.  Delete a movie.
5.  Edit a movie.
6.  Print all movies.
7.  Run algorithm analysis.
8.  Delete ALL movies and end the program.
CHOOSE 1-8:  7
               Linear Search:            0.00
               Binary Search:            0.00
                 Bubble Sort:            0.00
              Selection Sort:            0.00
              Insertion Sort:            0.00
   Insertion Sort Descending:            0.00
                  Merge Sort:            0.00
                  Quick Sort:            0.00
```

112 MOVIES IN LINKED LIST:

```
What is the name of the file? (example.txt):  crockett_movie_data_112.txt

112 movies were read from the file.


What would you like to do?
1.  Read movies from file.
2.  Save movies to a file.
3.  Add a movie.
4.  Delete a movie.
5.  Edit a movie.
6.  Print all movies.
7.  Run algorithm analysis.
8.  Delete ALL movies and end the program.
CHOOSE 1-8:  7
               Linear Search:            0.00
               Binary Search:            0.00
                 Bubble Sort:            0.00
              Selection Sort:            0.00
              Insertion Sort:            0.00
   Insertion Sort Descending:            0.00
                  Merge Sort:            0.00
                  Quick Sort:            0.00
```

1112 MOVIES IN LINKED LIST:

```
What is the name of the file? (example.txt):  crockett_movie_data_1112.txt

1112 movies were read from the file.


What would you like to do?
1.  Read movies from file.
2.  Save movies to a file.
3.  Add a movie.
4.  Delete a movie.
5.  Edit a movie.
6.  Print all movies.
7.  Run algorithm analysis.
8.  Delete ALL movies and end the program.
CHOOSE 1-8:  7
               Linear Search:            0.00
               Binary Search:            0.00
                 Bubble Sort:            5.00
              Selection Sort:            5.00
              Insertion Sort:            4.00
   Insertion Sort Descending:            5.00
                  Merge Sort:            0.00
                  Quick Sort:            0.00
```

2112 MOVIES IN THE LINKED LIST:

```
What is the name of the file? (example.txt):  crockett_movie_data_2112.txt

2112 movies were read from the file.


What would you like to do?
1.  Read movies from file.
2.  Save movies to a file.
3.  Add a movie.
4.  Delete a movie.
5.  Edit a movie.
6.  Print all movies.
7.  Run algorithm analysis.
8.  Delete ALL movies and end the program.
CHOOSE 1-8:  7
               Linear Search:            0.00
               Binary Search:            0.00
                 Bubble Sort:           43.00
              Selection Sort:           32.00
              Insertion Sort:           39.00
   Insertion Sort Descending:           39.00
                   Merge Sort:            0.00
                   Quick Sort:            0.00
```

5112 MOVIES IN THE LINKED LIST:

```
5112 movies were read from the file.


What would you like to do?
1.  Read movies from file.
2.  Save movies to a file.
3.  Add a movie.
4.  Delete a movie.
5.  Edit a movie.
6.  Print all movies.
7.  Run algorithm analysis.
8.  Delete ALL movies and end the program.
CHOOSE 1-8:  7
               Linear Search:            0.00
               Binary Search:            0.00
                 Bubble Sort:          763.00
              Selection Sort:          554.00
              Insertion Sort:          724.00
   Insertion Sort Descending:          714.00
                   Merge Sort:            4.00
                   Quick Sort:            1.00
```

10112 MOVIES IN THE LINKED LIST:

Note: I won't be testing your program with 10112 movies, but I included this text file for fun.

```
What is the name of the file? (example.txt):  crockett_movie_data_10112.txt

10112 movies were read from the file.


What would you like to do?
1.  Read movies from file.
2.  Save movies to a file.
3.  Add a movie.
4.  Delete a movie.
5.  Edit a movie.
6.  Print all movies.
7.  Run algorithm analysis.
8.  Delete ALL movies and end the program.
CHOOSE 1-8:  7
               Linear Search:            0.00
               Binary Search:            0.00
                 Bubble Sort:         7096.00
              Selection Sort:         5445.00
              Insertion Sort:         6477.00
   Insertion Sort Descending:         6558.00
                   Merge Sort:           13.00
                   Quick Sort:            4.00
```