

## CMP\_SC 3050 SP2024

### ASSIGNMENT 2: IMPLEMENT HEAP SORT

#### DESCRIPTION

You are to implement Heap Sort as a function similar to the Standard C Library's `qsort` function. This is similar to the way you implemented Insertion Sort in A1.

You are given a `main()` program, a Makefile, a library, and some starter code for your sorting function. All you need to do is complete the actual code for the function `heapsort()` in the provided `sort.c` file. However, I would suggest that you break `heapsort()` down by writing worker functions as well, similar to the pseudocode provided in class.

#### HOW TO GET STARTED

The starter code is publicly available on GitHub. You can clone it using git via the following command:

```
git clone https://github.com/JimRies1966/cs3050sp2024A2.git
```

I recommend you clone this code somewhere under your home directory on `tc.rnet.missouri.edu`. You are welcome to clone this and work on your code on any platform you like. However, you should be aware that submissions will **only** be evaluated by the TAs on `tc.rnet.missouri.edu`. If, for example, something works on your machine but doesn't compile on `tc.rnet.missouri.edu`, you will get a zero.

Once you have cloned things down, you should `cd` to the newly cloned directory and type "make". This will build the code and leave you with an executable file called "mysort". The `mysort` program should work for quick sort. However, you must implement heap sort (out of the box, this sort will do nothing).

#### NOTES

- You should not need to change any of the files except `sort.c`. When you have completed the assignment, submit only `sort.c` on Canvas. The TAs will clone fresh starter code down and copy in your `sort.c` in order to evaluate it.
- Notice that the function you are writing is already prototyped in `sort.h` and an empty stub is available in `sort.c`.
- If you want to swap the positions of two items in your data structure, you **must** use the provided `Swap()` function to do this. This is similar to your use of this function in the previous assignment.
- If you want to assign one item to another (not swap them), you **must** use the `Copy()` function from `cs3050.h`. This will work whether your item is an int, a float, a struct, or whatever.

- Notice that the tests try each function with a two int arrays and an array of structures (Customers). The Customer array is to be sorted first by lastname, firstname and then it is sorted again by age. The large int array does not show output (only counts of the compares and such) because it has approximately 10 million items in the array.
- You don't need to worry about writing a Compare() function, as an appropriate one will be passed to you during testing. If you find it hard to think about how Compare() works, you might look at the Standard C Library function strcmp(). That function compares two strings and is an example of a Compare() function. A specific Compare() function must be used to allow the sort functions to compare elements of specific types (i.e., strcmp() knows how to compare strings, but you would need something else to compare ints, floats, structs, etc.).
- You can certainly add your own functions to sort.c to break the problem down more. There should not be a need to add prototypes to sort.h.

## SAMPLE OUTPUT

```
jimr@jimrsurfacepro9:~/CS3050/SP2024/assignments/A2$ ./mysort
```

Heap Sort:

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\*\*\*\*\* Small int array:

-> 9 items: 23 -1 15 700 10 1 2 3 -99

-> 9 items: -99 -1 1 2 3 10 15 23 700

\*\* Comparisons = 43, Swaps = 25 \*\*

\*\*\*\*\* Small Customer array:

-> 10 items: Jim Ries (56), Larry Ries (54), Robert Bisby (56), Cisco Ries (13),  
Albert Pujols (42), Adam Wainwright (40), Yadier Molina (39), David Polly (56), Bill  
Moser (54), Neil Blanck (53),

-> 10 items: Robert Bisby (56), Neil Blanck (53), Yadier Molina (39), Bill Moser  
(54), David Polly (56), Albert Pujols (42), Cisco Ries (13), Jim Ries (56), Larry  
Ries (54), Adam Wainwright (40),

\*\* Comparisons = 54, Swaps = 33 \*\*

-> 10 items: Cisco Ries (13), Yadier Molina (39), Adam Wainwright (40), Albert Pujols  
(42), Neil Blanck (53), Bill Moser (54), Larry Ries (54), Jim Ries (56), David Polly  
(56), Robert Bisby (56),

\*\* Comparisons = 54, Swaps = 33 \*\*

\*\*\*\*\* Very Large Int array:

-> 10485760 items:

461373440

-> 10485760 items:

\*\* Comparisons = 469803914, Swaps = 238932644 \*\*

Quick Sort:

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\*\*\*\*\* Small int array:

-> 9 items: 23 -1 15 700 10 1 2 3 -99

-> 9 items: -99 -1 1 2 3 10 15 23 700

\*\* Comparisons = 19, Swaps = 0 \*\*

\*\*\*\*\* Small Customer array:

-> 10 items: Jim Ries (56), Larry Ries (54), Robert Bisby (56), Cisco Ries (13),  
Albert Pujols (42), Adam Wainwright (40), Yadier Molina (39), David Polly (56), Bill  
Moser (54), Neil Blanck (53),

-> 10 items: Robert Bisby (56), Neil Blanck (53), Yadier Molina (39), Bill Moser  
(54), David Polly (56), Albert Pujols (42), Cisco Ries (13), Jim Ries (56), Larry  
Ries (54), Adam Wainwright (40),

\*\* Comparisons = 23, Swaps = 0 \*\*

-> 10 items: Cisco Ries (13), Yadier Molina (39), Adam Wainwright (40), Albert Pujols  
(42), Neil Blanck (53), Bill Moser (54), Larry Ries (54), Robert Bisby (56), David  
Polly (56), Jim Ries (56),

\*\* Comparisons = 23, Swaps = 0 \*\*

\*\*\*\*\* Very Large Int array:

-> 10485760 items:

115343360

-> 10485760 items:

\*\* Comparisons = 124780544, Swaps = 0 \*\*