Assignment 4 (10% of Course Total)

Due date: 11:59pm, Dec 3, 2024

This is an individual assignment. This assignment might be graded automatically. Make sure that your code compiles without warnings/errors and produces the required output. Also use the file names and structures indicated as requested. Deviation from that might result in 0 mark.

Your code MUST compile and run reasonably efficiently in the CSIL machines (see the **Before You Submit** section for details). It is possible that even with warnings your code would compile. But this still indicates there is something wrong with you code and you have to fix them, or marks will be deducted.

Your code MUST be readable and have reasonable documentation (comments) explaining what it does. Use your own judgement, for example, no need to explain i += 2 is increasing i by 2, but explain how variables are used to achieve something, what a certain loop is doing, and the purpose of each #include.

Description

There is only 1 question in this assignment. However, there are several files you need to submit. Write your answer in the corresponding file as instructed along with your student information. While you still can include any libraries that are covered in class, read the sections below to see how C++-compatible or C++-specific versions should be used. You can also write your own helper functions. **Only one of these files should contain the main function**.

Question 1 [16 marks]

In this question you are going to extend the program you made in Assignment 2&3 by **providing more functionalities**. You are also again going to write **your own main function** so the program runs. In addition, you are going to **implement everything in C++**.

Create a program that reads all the superhero information from a file and provide an interface for the user to query superhero entries*. Your program must support the following functionalities as options:

- **Option 1: to load a superheroes file** – ask the user to input the name of the file containing superhero information and load the entries from that file (report # of entries). Note that the file can be non-existent (if so the program should print the error and keep running by printing all the options again), but if it exists you can assume the format inside that file is valid and consistent, with each line having at most 300 characters. It is possible for the user to load a different file by choosing this option again, which will replace the previously loaded entries. You can assume the filename has at most 50 characters and no space.
- **Option 2**: **to list entries sorted by height** – list the superheroes from shortest to tallest. Within entries with the same height (if exist), they should be ordered by name (as determined by strcmp).
- **Option 3: to list entries sorted by name** – list the superheroes sorted by name (as determined by strcmp). Within entries with the same name (if exist), they should be ordered by height.
- **Option 4: to lookup a superhero** – ask the user for a superpower for at most 50 characters (space included), then report all entries with superpower having the input as a substring. There can be more than one entry. The lookup is case-sensitive (i.e., “fly” and “Fly” are not the same).
    - If one or more entries are found, print all the information. Any order is acceptable.
    - If no entry is found, print “No such superhero on record.”

© Victor Cheung, 2024

You can assume the user will always enter at most 50 characters.

- **(NEW) Option 5: to add an entry** – ask the user for all the information for a superhero (name, height, superpower, traits) and add it to the currently loaded entries. After adding, report and print "Entry added.". You can assume the user will always input something in the correct format.
    - There is no need to check for duplicates.
    - Check for invalid height values: feet that are <0. If that happens, inform the user and keep asking for a valid feet, then do the same for inches.
- **(NEW) Option 6: to save a file** – ask the user to input the name of a file to which the current entries will be saved in the same format as the sample files. It is possible for the name to be the same as the file just being loaded. If so, it will be overwritten. Report # entries saved when done.
- **Option 7: to terminate the program** – thank the user and end the program.

Options 1-4&7 are basically the same as Assignment 3. Yet, there are also some differences. In particular, since a **vector** is now used to store the superhero pointer entries, some functions that were defined in superherolib previously are now moved to better organize functions according to class definitions. The compare functions are also done differently. Pay attention to the provided .hpp files for details.

Your program must meet these requirements:

- Include the provided header file (.hpp file) and use the functions defined in the corresponding implementation file (.cpp file) in your driver file (where main is), do not redefine those functions.
- Use the vector template in C++ (see https://www.programiz.com/cpp-programming/vectors) in combination of the Superhero struct defined in a4_superherolib to store and handle the entries. This allows different numbers of superhero entries and lets you practice using templates.
- Although C++ supports most of the operations in C, **any operations we covered in the lecture replacing C must be used. This includes: console I/O must be done by cin/cout (see iostream), file I/O must be done by fin/fout (see fstream), text must be done by the string class, and memory management must be done by new/delete.**
- There must be no memory leaks (e.g., your program requests some memory but does not release them all before it terminates). In CSIL you can use the Valgrind tool as described to check for that.
- Start with a fancy banner. There is no specific requirement besides it must include your name, 9-digit SFU ID, and your SFU email address. Let your creativity shine, just nothing offensive.
- If a functionality (e.g., list, lookup, add) is requested by the user but no file has been loaded, the program should print an error message telling the user that no superheroes file have been loaded and prompt the user to do so.
- **Use the built-in stable_sort in C++** (see https://cplusplus.com/reference/algorithm/sort/) to do the sorting for Options 2&3.

And here are some hints for you to write your code:

- The program interface is essentially a do-while loop where in each iteration it asks for an option and determines what to do, with a repeating conditional of the terminating option has not been inputted. It is a common approach for menu-based interfaces.
    - Getting the user to input a valid input is exactly the same, with the repeating conditional being the input invalid (e.g., 0>userInput).

- The built-in stable_sort from C++ (defined in <algorithm>) can sort items in different kinds of container classes as long as they provide access to the items using an "iterator", which is a common design pattern in Object-Oriented Programming. Refer to our lecture examples and the reference link above for details. Also pay attention to how the compare function pointer works.
- The way things are being read from the console and file is simplified with cin and fin. Besides the >> operator, there is a getline function for strings. Use it like this: getline(cin, stringVariable), or this after an int is read: getline(cin >> ws, stringVariable). You are encouraged to explore why.

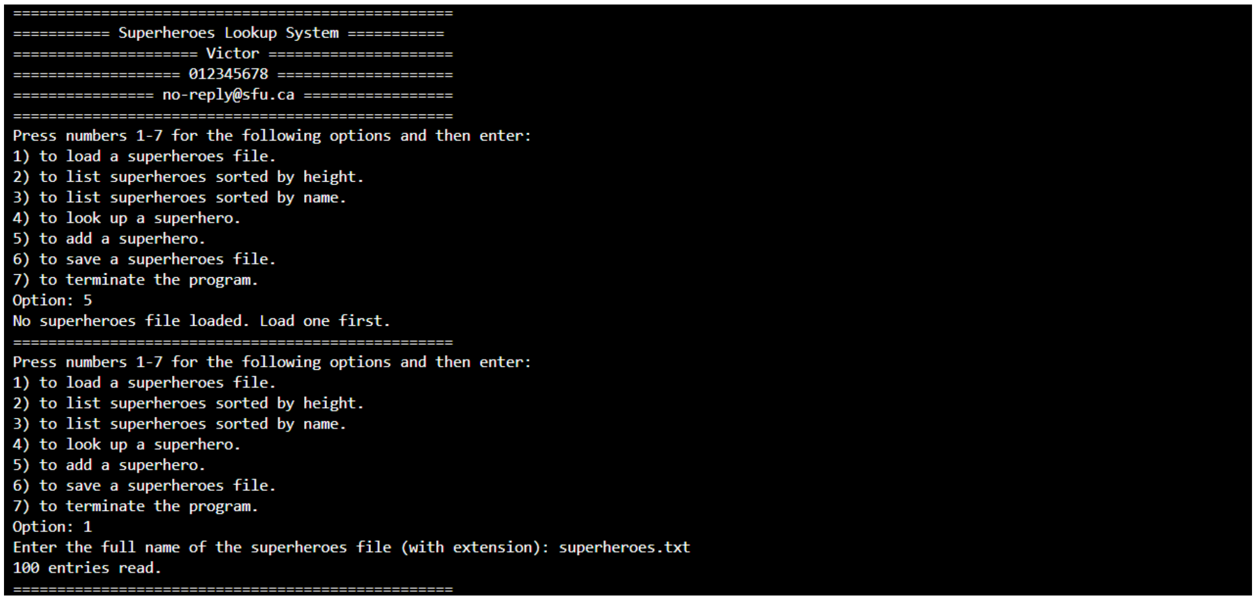
*The entries are randomly generated using ChatGPT with a specific format and then lightly modified. Hence, the content might not make sense and have very similar wording patterns – no need to worry.

Include the function definitions corresponding to a4_superherolib.hpp (and your helper functions, if any) in a source file named as **a4_superherolib.cpp**. Do the same for **a4_superheroList**. Both the .hpp files are provided to help you get started. They are adequate to complete this assignment, but if you want you can add/remove functions as appropriate – as long as they fulfill all the requirements stated above.

Include your main function (and your helper functions, if any) in another source file named as **a4_superheroLookupSystem.cpp**. We call this the driver file because this is where the program starts.

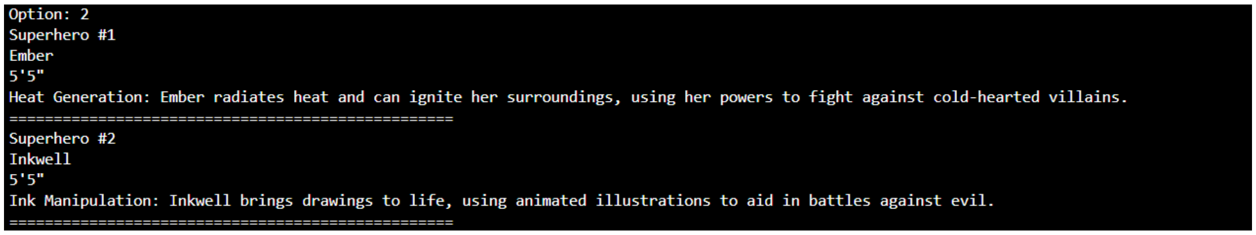
To determine where to place a helper function, think about its purpose. If it provides functionality with the Superhero structs (e.g., create/clear Superheroes, compare Superheroes), it is a library function; if it provides functionality of the program (e.g., print a fancy banner), it is a program function; and if it provides functionality that directly accesses private members of the SuperheroList, it should be a member function of SuperheroList. Incorrectly placing these functions will lead to mark deductions in the Coding Style.

Here are some sample input and output (you can assume user input is always valid, except Option 5):



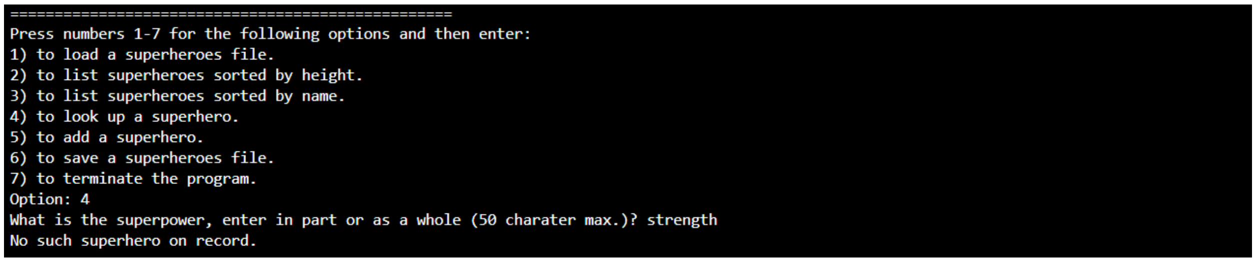
```
==================================================
=========== Superheroes Lookup System ==========
===================== Victor =====================
=================== 012345678 ====================
================ no-reply@sfu.ca =================
==================================================
Press numbers 1-7 for the following options and then enter:
1) to load a superheroes file.
2) to list superheroes sorted by height.
3) to list superheroes sorted by name.
4) to look up a superhero.
5) to add a superhero.
6) to save a superheroes file.
7) to terminate the program.
Option: 5
No superheroes file loaded. Load one first.
==================================================
Press numbers 1-7 for the following options and then enter:
1) to load a superheroes file.
2) to list superheroes sorted by height.
3) to list superheroes sorted by name.
4) to look up a superhero.
5) to add a superhero.
6) to save a superheroes file.
7) to terminate the program.
Option: 1
Enter the full name of the superheroes file (with extension): superheroes.txt
100 entries read.
==================================================
```

Figure 1. Choosing an option without opening any file then opening an existing file.



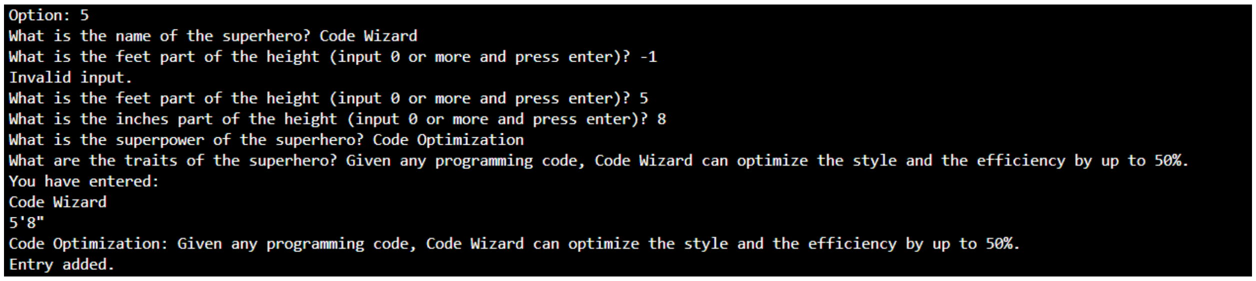
```
Option: 2
Superhero #1
Ember
5'5"
Heat Generation: Ember radiates heat and can ignite her surroundings, using her powers to fight against cold-hearted villains.
================================================
Superhero #2
Inkwell
5'5"
Ink Manipulation: Inkwell brings drawings to life, using animated illustrations to aid in battles against evil.
================================================
```

Figure 2. Listing superheroes sorted by height, note how they are also sorted by name (only showing the first 2 here for space).



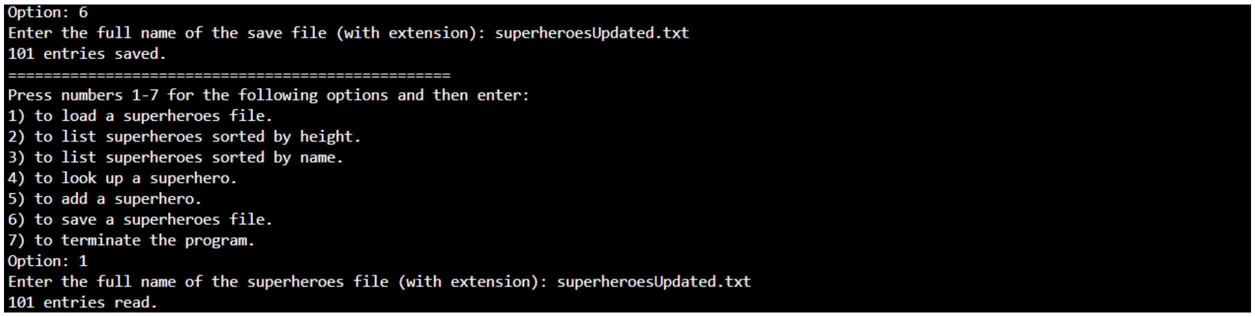
```
================================================
Press numbers 1-7 for the following options and then enter:
1) to load a superheroes file.
2) to list superheroes sorted by height.
3) to list superheroes sorted by name.
4) to look up a superhero.
5) to add a superhero.
6) to save a superheroes file.
7) to terminate the program.
Option: 4
What is the superpower, enter in part or as a whole (50 charater max.)? strength
No such superhero on record.
```

Figure 3. Looking up for "strength" which has no result (but with "Strength" there will be one – Iron Guardian).



```
Option: 5
What is the name of the superhero? Code Wizard
What is the feet part of the height (input 0 or more and press enter)? -1
Invalid input.
What is the feet part of the height (input 0 or more and press enter)? 5
What is the inches part of the height (input 0 or more and press enter)? 8
What is the superpower of the superhero? Code Optimization
What are the traits of the superhero? Given any programming code, Code Wizard can optimize the style and the efficiency by up to 50%.
You have entered:
Code Wizard
5'8"
Code Optimization: Given any programming code, Code Wizard can optimize the style and the efficiency by up to 50%.
Entry added.
```

Figure 4. Adding a superhero to the list (it'll be Superhero #16 when choosing Option 3 next).



```
Option: 6
Enter the full name of the save file (with extension): superheroesUpdated.txt
101 entries saved.
================================================
Press numbers 1-7 for the following options and then enter:
1) to load a superheroes file.
2) to list superheroes sorted by height.
3) to list superheroes sorted by name.
4) to look up a superhero.
5) to add a superhero.
6) to save a superheroes file.
7) to terminate the program.
Option: 1
Enter the full name of the superheroes file (with extension): superheroesUpdated.txt
101 entries read.
```

Figure 5. Saving the entries to a file (100 entries were loaded at start, adding 1 makes it 101) and loading it back.

Coding Style [4 marks]

Your program should be properly indented, have clear and meaningful variable names (e.g., no single-letter variable names except loop iterators) and enough white space and comments to make it easy to read. Named constants should be used where appropriate. Each line of code should not exceed 80 characters. White space should be used in a consistent manner. Remember to include your information.

Keep your code concise and efficient. If your code is unnecessarily long or inefficient (e.g., hard-code for all possible cases, extraneous function calls), we might deduct marks. To help you to get into the habit of good coding style, we will read your code and marks will be deducted if your code is not styled properly.

Before You Submit

Before submitting your assignment, make sure you have test-run your code in our CSIL machines using the steps covered in class: **open your assignment folder in VS Code, use the gcc command with options in the terminal to compile your code, and run the executable**. We will use these steps when marking your submission and will deduct marks if your code does not compile/run – to maintain fairness we do not accept reasons like “but it worked on my computer” or “but it ran just fine in my IDE”.

The Makefile provided in this assignment is used by a command in the CSIL machines called “make” to quickly compile your code. It is especially useful if you have multiple source files. To use it, type the following command in the prompt (make sure you are in the directory with all the files of Assignment 3):

```
$ make test1
```

The example above illustrates how Question 1 is compiled into an executable called “test1” when using the Makefile. Replace the “test1” with “test2”, “test3”, …etc. for other questions. You can then run the executable by typing **./test1** to test your code for Question 1. If you make changes to your code, use the make command again. You can also use **make all** if you want to compile all your code at once.

The header files are there to make the compilation work. Take a look at them for information about how each function should work. You might have to modify them and you will have to submit them this time.

Submission

Submit **only the 5 source files** (a4_superherolib.hpp, a4_superherolib.cpp, a4_superheroList.hpp a4_superheroList.cpp, a4_superheroLookupSystem.cpp) to CourSys. Refer to the corresponding Canvas assignment entry for details.

Assignment late penalty: 10% per calendar day (each 0 to 24 hour period past due), max 2 days late.

Academic Honesty

It is expected that within this course, the highest standards of academic integrity will be maintained, in keeping with SFU’s Policy S10.01, “Code of Academic Integrity and Good Conduct.” In this class, collaboration is encouraged for in-class exercises and the team components of the assignments, as well as task preparation for group discussions. However, individual work should be completed by the person who submits it. Any work that is independent work of the submitter should be clearly cited to make its source clear. All referenced work in reports and presentations must be appropriately cited, to include websites, as well as figures and graphs in presentations. If there are any questions whatsoever, feel free to contact the course instructor about any possible grey areas.

Some examples of unacceptable behavior:

- Handing in assignments/exercises that are not 100% your own work (in design, implementation, wording, etc.), without a clear/visible citation of the source.
- Using another student's work as a template or reference for completing your own work.
- Sharing your work with or making your work available on any platform for anyone who would benefit from it (e.g., other students in the course).
- Using any unpermitted resources during an exam.
- Looking at, or attempting to look at, another student's answer during an exam.
- Submitting work that has been submitted before, for any course at any institution.

All instances of academic dishonesty will be dealt with severely and according to SFU policy. This means that Student Services will be notified, and they will record the dishonesty in the student's file. Students are strongly encouraged to review SFU's Code of Academic Integrity and Good Conduct (S10.01) available online at: http://www.sfu.ca/policies/gazette/student/s10-01.html.

Use of ChatGPT or Other AI Tools

As mentioned in the class, we are aware of them. I see them as helpers/tutors from which you can look for inspiration. However, these tools are not reliable and they tend to be overly confident about their answers, sometimes even incorrect. It is also very easy to grow a reliance to them and put yourself at risk of not actually learning anything and even committing academic dishonesty. Other issues include:

- When it comes to uncertainty, you won't know how to determine what is correct.
- If you need to modify or fine tune your answer, you won't know what to do.
- You will not be able to learn the materials and thus will not ne able to apply what you learn in situations where no external help is available, for example, during exams and interviews.

Bottomline is, if you ask these tools to give you an answer and you use the answer as yours, you are committing academic dishonesty by claiming work that is not done by you as yours. You can, however, ask general questions like "how do I write a for-loop?", "explain mergesort to me" and use the answers to help you come up with your own answers – make sure you have cited it at the top of your code/essay as comments by stating what tool you used what questions you asked, and how you used the answers. Type everything yourself.

Note that different instructors might have different policies regarding the use of these tools. Check with them before you proceed with assignments from other courses.

© Victor Cheung, 2024