CMSC 202 Fall 2024

Project 2 – UMBC Library

Assignment: Project 2 – UMBC Library

Due Date: Thursday, October 10th at 8:59pm on GL

Value: 80 points

1. Overview

In this project, you will:

- Practice basic C++ syntax including branching structures,
- Write classes and instantiate those classes using a constructor,
- Use arrays to hold objects,
- Use simple file input,
- Practice breaking projects into multiple files, and
- Using a makefile to compile a project.

2. Background

In this project, students will be introduced to the fundamental concepts of **classes** and **objects** in C++ by building a simplified **Online Library System**. This project focuses on applying object-oriented programming (OOP) principles to model real-world entities, such as books, library members, and waitlists, while developing a better understanding of class design, member variables, member functions, and interaction between objects.

For our implementation of the system, we will be designing some basic functionality including: listing all available books, searching for a book by the title, adding a book to the waitlist, and displaying the waitlist.

3. Assignment Description

There are two classes that are used in this project. Take a few minutes to review the header files provided (**`Book.h, and Library.h`**) as well as the project driver (**`proj2.cpp`**). Your job will be to implement the corresponding .cpp files (**`Book.cpp and Library.cpp`**) based on the provided files. The

first class, **`Book`**, should be very easy to implement. Just copy each of the functions from the header file and implement them in the .cpp file. Then you can run the make function for just **`Book.o`** which would just be "**`make Book.o`**". This will allow you to implement each of the functions incrementally. After you have run **`Book.o`**, you can start to work on **`Library.cpp`**.

For **`Library.cpp`**, you will need to read in a list of books and the information related to those items from a file and load them into the existing array. The list of books is static, and you can assume that the size is stored in a constant (**`NUM_BOOKS`**). There are a number of constants provided in both **`Book.h`** and **`Library.h`** and you should be using all of them. Make sure to test each of the arrays to make sure they are properly loaded.

Once the file is loaded, you can start to work on the menus and then the display, search, add, and waitlist display functionality.

4. Requirements:

This is a list of the requirements of this application. For this project, you will be provided with header files to start you in the right direction. For you to earn all the points, however, you will need to meet all the defined requirements.

- You must follow the coding standard as defined in the CMSC 202 coding standards (found on Blackboard under course policies). This includes comments as required.
- The project must be turned in on time by the deadline listed above.
- The project must be completed in C++. You may not use any commands, libraries, or data structures that we have not learned in class. Libraries we have learned include **`<iostream>`**, **`<fstream>`**, **`<iomanip>`**, **`<vector>`**, **`<cmath>`**, **`<ctime>`**, **`<cstdlib>`**, and **`<string>`**. You may not use vectors – everything must be implemented in arrays. You should only use **`namespace std`**.
- Do not use pointers for this project.
- No For..Each loops and no **`auto`**.
- Do not use EOF to load the file but rather use a while loop and multiple getline commands. Here is an example: https://www.digitalocean.com/community/tutorials/getline-in-c-plus-plus

Do not use stringstream. Hint: What are the data parts of each book? What is the order? You are allowed to use **`stoi`** to convert strings to integers and **`stod`** to convert strings to doubles. Here is an example: https://geeksprogramming.com/stoi-function/

- You **must** use the provided files, **`Book.h, Library.h`**, **`makefile`**, **`proj2_books.txt,`** and **`proj2.cpp`**, to create the application. Do not add or change any constant, variables, or functions in these files. Do not add any files. Do not add member variables or member functions to any class.
- To copy all of the starting files, navigate to your project 2 folder and type:

```
cp /afs/umbc.edu/users/j/d/jdixon/pub/cs202/proj2/* .
```

- All user input must be validated. For example, if a menu allows for 1, 2, or 3 to be entered and the user enters a 4, it will re-prompt the user. However, the user is expected to always enter the correct data type. i.e. If the user is asked to enter an integer, they will. If they are asked to enter a character, they will. **You do not need to worry about checking for correct data types.**
- There is one input file for this project named, "**`proj2_books.txt`**". The file name is passed in **`proj2.cpp`**. Look at the code in **`proj2.cpp`** for additional details. The files are already provided in Prof. Dixon's course folder on GL.
- Have a main menu that asks if the user wants to:

1. Display All Books
    - Displays each of the books in the catalog showing exactly 10 at a time. At the bottom of each list of 10 items, the user is prompted to either enter N/n (for next) or Q/q (for quit). If they enter Q or q, the display ends and returns the user back to the main menu. Otherwise, it shows the next list of 10 books until you reach the end of the list. If there are less than 10 books left to display, displays just the last number of books (test using a smaller input file of just 5 books).
    - The books are numbered starting at one

2. Search Catalog for Book Title
    - Allows user to enter a title or partial title and the program returns all books with that title or partial title. For example, if you search for “Red Queen” the program will just return one book but if you search for just “Queen” the program will return 6 books
    - The books are numbered based on their location in the array (plus one) so that you can search for a book to add to your wait list.
3. Add Book to Waitlist
    - Asks the user to enter a number of a book to add to waitlist. If the user enters a -1, the program displays all books with their numbering.
    - Waitlist limited to 5 books maximum.
4. Display Waitlist
    - Displays all books on waitlist numbered starting at one.
5. Exit

5. Recommendations

You must use the provided header files (**`Book.h`** and **`Library.h`**) additionally, we provided you with the **`makefile`**, **`proj2_books.txt`**, **`proj2_sample1.txt`** and the **`proj2.cpp`**.

Here are some general implementation recommendations (do not follow these verbatim – these are GENERAL suggestions):

- Read each of the header files in detail. Read through the project document in detail. Use paper to take notes. Each header file has tons of comments.
- Design the solution (part is already designed, so make sure you understand how it works) on PAPER.
- Read through the provided **`Book.h`**. Think about how you can use the starting file **`proj2_books.txt`** to populate an array of Books.

- Once **`Book.cpp`** is written, start on **`Library.cpp`** – start with loading in the Books from the **`proj2_books.txt`** file. You will need to use getline command with the delimiter parameter.
- After the file is successfully loaded (and displayed) work on the main menu.
- The **`DisplayBooks`** function is a little bit challenging as it requires nested loops. It should display 10 books at a time. If there are less than 10 books left to display (960 – 965), the program should just display the five remaining books. You can create a different input file with just 5 books to test this.
- **`SearchCatalog()`** requires that the user enters a string to search the title through all books in the catalog. The program will return all books with either a full or partial match of the entered string. The entered string is case-sensitive. For example, a search of “queen” will return nothing. A search of “Queen” will return 6 books. A search of “Red Queen” will return 1 book. Hint: Use **`.find()`** in the string library to match strings.
- **`AddBook`** allows the user to add a book to their waitlist. The waitlist can hold up to 5 books. The user will enter the number of the book where the number 1 equates to the book in position 0 of the array. For example, if the user enters 1, then it adds Batman: Year One to the waitlist. If the user enters a -1 then it displays the books as above in **`DisplayBooks`**. The **`AddBook`** function does not allow duplicate books on the waitlist.
- **`BookExist(Book)`** is a helper function that checks to see if a book already exists on the waitlist. If it does, it returns true, else false.
- **`DisplayWaitlist`** displays the books on the waitlist numbered starting at one.

6. Sample Input and Output

The input file for this project includes a data file that has 965 books listed. The file, **`proj2_books.txt`** is the text file used in this project. The data is year, title, author(s), and score (rating).

You can type "**`make run`**" and it should use a built-in macro in the provided makefile.

In the sample output below, user input is colored blue for clarity. After compiling and running proj2, the output would look like this:

```
[jdixon@linux1 proj2]$ make run
./proj2 proj2_books.txt
Welcome to UMBC Library
Catalog populated with 965 books.
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
```

If you were to display all the books, it would look like this (this is just the first 10 of 965 books):

```
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
1
  1. Batman: Year One (1987) by Frank Miller, David Mazzucchelli,
Richmond Lewis, Dennis O'Neil with a score of 4.23
  2. Go Set a Watchman (2015) by Harper Lee with a score of 3.31
  3. When You Are Engulfed in Flames (2008) by David Sedaris with a
score of 4.04
  4. Daughter of Smoke & Bone (2011) by Laini Taylor with a score of
4.04
  5. Red Queen (2015) by Victoria Aveyard with a score of 4.08
  6. The Power of Habit (2011) by Charles Duhigg with a score of 4.03
```

```
  7. Midnight in the Garden of Good and Evil (1994) by John Berendt
with a score of 3.9
  8. Hopeless (2012) by Colleen Hoover with a score of 4.34
  9. A Little Princess (1905) by Frances Hodgson Burnett, Nancy Bond
with a score of 4.2
 10. The Truth About Forever (2004) by Sarah Dessen with a score of
4.13
N for Next, Q to quit
Q
```

If the user entered Q then 2, Search Catalog for Book Title, then the user would be asked to enter a string. There are three examples here of when the user enters “queen” then “Queen” then “Red Queen”:

```
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
2
What title would you like to search for?
queen
No books with that title found.
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
2
What title would you like to search for?
Queen
  5. Red Queen (2015) by Victoria Aveyard with a score of 4.08
216. The White Queen (2009) by Philippa Gregory with a score of 3.9
337. The Queen of the Damned (1988) by Anne Rice with a score of 3.86
677. Queen of Shadows (2015) by Sarah J. Maas with a score of 4.6
```

```
878. The Queen's Fool (2003) by Philippa Gregory with a score of 3.83
913. The Iron Queen (2011) by Julie Kagawa with a score of 4.24
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
2
What title would you like to search for?
Red Queen
  5. Red Queen (2015) by Victoria Aveyard with a score of 4.08
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
```

If the user would choose 3, Add Book to Waitlist the output would look like this:

```
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
3
Which book would you like to add? (-1 for list)
-1
  1. Batman: Year One (1987) by Frank Miller, David Mazzucchelli, Richmond
Lewis, Dennis O'Neil with a score of 4.23
  2. Go Set a Watchman (2015) by Harper Lee with a score of 3.31
  3. When You Are Engulfed in Flames (2008) by David Sedaris with a score of
4.04
  4. Daughter of Smoke & Bone (2011) by Laini Taylor with a score of 4.04
  5. Red Queen (2015) by Victoria Aveyard with a score of 4.08
```

```
  6. The Power of Habit (2011) by Charles Duhigg with a score of 4.03
  7. Midnight in the Garden of Good and Evil (1994) by John Berendt with a
score of 3.9
  8. Hopeless (2012) by Colleen Hoover with a score of 4.34
  9. A Little Princess (1905) by Frances Hodgson Burnett, Nancy Bond with a
score of 4.2
 10. The Truth About Forever (2004) by Sarah Dessen with a score of 4.13
N for Next, Q to quit
q
Which book would you like to add? (-1 for list)
7
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
4
```

If you were to choose to display waitlist it would look like this:

```
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
4
**Current Waitlist**
1. Midnight in the Garden of Good and Evil (1994) by John Berendt with a
score of 3.9
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
```

Here are some example runs where additional input validation is being shown and where the user is entering invalid numbers:

```
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
1
  1. Batman: Year One (1987) by Frank Miller, David Mazzucchelli, Richmond Lewis, Dennis O'Neil with a score of 4.23
  2. Go Set a Watchman (2015) by Harper Lee with a score of 3.31
  3. When You Are Engulfed in Flames (2008) by David Sedaris with a score of 4.04
  4. Daughter of Smoke & Bone (2011) by Laini Taylor with a score of 4.04
  5. Red Queen (2015) by Victoria Aveyard with a score of 4.08
  6. The Power of Habit (2011) by Charles Duhigg with a score of 4.03
  7. Midnight in the Garden of Good and Evil (1994) by John Berendt with a score of 3.9
  8. Hopeless (2012) by Colleen Hoover with a score of 4.34
  9. A Little Princess (1905) by Frances Hodgson Burnett, Nancy Bond with a score of 4.2
 10. The Truth About Forever (2004) by Sarah Dessen with a score of 4.13
N for Next, Q to quit
n
 11. The horse and his boy (1954) by C.S. Lewis with a score of 3.9
 12. Last Sacrifice  (2010) by Richelle Mead with a score of 4.42
 13. Little House on the Prairie (1935) by Laura Ingalls Wilder, Garth Williams with a score of 4.18
 14. The Velveteen Rabbit (1922) by Margery Williams Bianco, William Nicholson with a score of 4.29
 15. Zen and the Art of Motorcycle Maintenance (1974) by Robert M. Pirsig with a score of 3.76
 16. The War of the Worlds (1897) by H.G. Wells, Arthur C. Clarke with a score of 3.8
 17. Pretty Little Liars (2006) by Sara Shepard with a score of 3.9
 18. Corduroy (1948) by Don Freeman with a score of 4.28
 19. The Omnivore's Dilemma (2006) by Michael Pollan with a score of 4.17
```

```
 20. Life After Life (2013) by Kate Atkinson with a score of 3.74
N for Next, Q to quit
q
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
2
What title would you like to search for?
asdfn
No books with that title found.
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
3
Which book would you like to add? (-1 for list)
-2
Invalid number
Which book would you like to add? (-1 for list)
0
Invalid number
Which book would you like to add? (-1 for list)
966
Invalid number
Which book would you like to add? (-1 for list)
965
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
```

```
5. Quit
4
**Current Waitlist**
1. Midnight in the Garden of Good and Evil (1994) by John Berendt with a score of 3.9
2. Night Road (2011) by Kristin Hannah with a score of 4.17
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
3
Which book would you like to add? (-1 for list)
7
Midnight in the Garden of Good and Evil already on waitlist.
Which book would you like to add? (-1 for list)
965
Night Road already on waitlist.
Which book would you like to add? (-1 for list)
1
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
4
**Current Waitlist**
1. Midnight in the Garden of Good and Evil (1994) by John Berendt with a score of 3.9
2. Night Road (2011) by Kristin Hannah with a score of 4.17
3. Batman: Year One (1987) by Frank Miller, David Mazzucchelli, Richmond Lewis, Dennis O'Neil with a score of 4.23
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
```

```
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
3
Which book would you like to add? (-1 for list)
2
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
4
**Current Waitlist**
1. Midnight in the Garden of Good and Evil (1994) by John Berendt with a score of 3.9
2. Night Road (2011) by Kristin Hannah with a score of 4.17
3. Batman: Year One (1987) by Frank Miller, David Mazzucchelli, Richmond Lewis, Dennis O'Neil with a score of 4.23
4. Go Set a Watchman (2015) by Harper Lee with a score of 3.31
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
3
Which book would you like to add? (-1 for list)
4
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
3
No additional books can be added to the wait list.
```

```
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
4
**Current Waitlist**
1. Midnight in the Garden of Good and Evil (1994) by John Berendt with a score of 3.9
2. Night Road (2011) by Kristin Hannah with a score of 4.17
3. Batman: Year One (1987) by Frank Miller, David Mazzucchelli, Richmond Lewis, Dennis O'Neil with a score of 4.23
4. Go Set a Watchman (2015) by Harper Lee with a score of 3.31
5. Daughter of Smoke & Bone (2011) by Laini Taylor with a score of 4.04
What would you like to do?
1. Display All Books
2. Search Catalog for Book Title
3. Add Book to Waitlist
4. Display Waitlist
5. Quit
5
Thank you for using the UMBC Library
```

There is a longer run of the program available as **`proj2_sample1.txt`** with the other files.

7. Compiling and Running

We have provided you with a sample **`makefile`** which should help you compile all of the classes and the program itself.

Once you have compiled using the provided **`makefile`**, enter the command **`make run`** or **`./proj2`** to run your program. If your executable is not proj2, you will lose points. It should look like the sample output provided above.

8. Completing your Project

When you have completed your project, you can copy it into the submission folder. You can copy your files into the submission folder as many times as you like (before the due date). We will only grade what is in your submission folder.

For this project, you should submit the following files to the **`proj2`** subdirectory:

`Book.cpp, Book.h`

`Library.cpp, Library.h`

`proj2.cpp`

You do not need to submit the **`makefile`**.

As you should have already set up your symbolic link for this class, you can just copy your files listed above to the submission folder. You can also make a rule in your makefile to copy all of the files using make submit if you would like (although it is not provided).

A. cd to your project 2 folder. An example might be

```
cd ~/202/projects/proj2
```

B.
```
cp Book.h Book.cpp Library.h Library.cpp
proj2.cpp  ~/cs202proj/proj2
```

You can check to make sure that your files were successfully copied over to the submission directory by entering the command:

```
ls ~/cs202proj/proj2
```

Additionally, I have included a **`make submit`** command that you can run in your project 2 directory assuming your symbolic link is successfully implemented as described in lab 1. It will copy the five required files to your submission directory. Double check using the ls command above to double check that your files have been successfully submitted prior to the due date.

Make sure that the required files are submitted by the deadline. If the copy command provided does not work, it is your responsibility to figure out what is wrong and that all required files have been submitted.

You can check that your program compiles and runs in the `proj2` directory, but please clean up any `.o` and executable files. Again, do not develop your code in this directory and you should not have the only copy of your program here. Uploading of any `.gch` files will result in a severe penalty.

IMPORTANT: If you want to submit the project late (after the due date), you will need to copy your files to the appropriate late folder. If you can no longer copy the files into the proj2 folder, it is because the due date has passed. You should be able to see your proj2 files but you can no longer edit or copy the files in to your proj2 folder. (They will be read only)

- If it is 0-24 hours late, copy your files to **`~/cs202proj/proj2-late1`**
- If it is 24-48 hours late, copy your files to **`~/cs202proj/proj2-late2`**
- If it is after 48 hours late, it is too late to be submitted.