CS 210 – Fundamentals of Programming I  
Fall 2006 – Programming Project 2, Part A  
30 points  
Out: November 16  
Due: November 28 (Tuesday after Thanksgiving break)  

Part A of this first programming project consists of writing the analysis and design for the following problem that meets the given design criteria. **The work must be entirely your own**, except for any help you may get from the instructor. Hand in a clean, readable copy of your analysis and design.  

Part B will be assigned on November 21. The implementation portion of the project will be due no later than the time of the final exam, Friday, December 8, 2:45pm. There will some additional implementation requirements not specified here. Also, there will be an extra credit opportunity in the implementation phase.  

**Problem Statement**  
A library is a collection of books that may be checked out by library patrons. A library needs to keep track of the books in its collection and which ones are currently checked out. (To simplify this problem, we will not keep track of non-book items, which patron checked out the book, or what the due dates are.) In addition, librarians need to be able to answer questions like "What books have Harry Potter as a character?"  

We would like a program that keeps track of books in a library. For each book, the library should keep track of the author of the book, the title of the book, the genre of the book, a list of main characters in the book, the number of copies of the book a library has, and whether any of the copies are checked out. The library would also like to keep statistics on the total number of copies currently rented out, and the total number of all the books it currently has in its collection.  

The program should be menu-driven and allow the user to do the following actions repeatedly:  

- initialize the library's collection of books  
- add one or more copies of a particular book to the collection  
- check out a particular book by giving its author and title  
- return a particular book by giving its author and title  
- print out the information on a particular book by giving its author and title  
- print out a list of all the books in the library's collection  
- print out a list of books with the same author  
- print out a list of books of the same genre
• print out a list of books having a particular character
• print out the total number of all books (not all the titles) in the library collection
• print out the total number of books (not all the titles) that are currently checked out

The list printouts should include the title, the number of copies the library has, and the number of copies currently checked out for each matching book. See the sample program run for examples of some of these actions.

If a book already exists in the collection when a user tries to add it, the program should only add the number of additional copies for that book. Otherwise it should add a new entry for the book to the collection. The program should print an error message if any of the following happen: the user tries to check out or return a book that does not exist in the library's collection, a user tries to check out a book when there are no copies available, or a user tries to return a book when the library currently has all its copies. Initialization consists of asking the user for the number of books to be entered and the data for those books. It should cause the collection to become exactly those books entered. (I.e., any books previously in the collection are lost.)

**Design Criteria**

This program must be designed using a Library class to represent the library. Recall that the analysis and design of a class consists of the specification of the attributes and the analysis and designs of all member functions. The Library class should contain all of the information necessary to do the library actions given above. In particular, it should contain at least a collection of Book objects. Additional attributes may be needed or useful. There should only be one (default) constructor that creates an empty Library object (i.e., one with an empty collection of books.) The initialization action should be implemented as a member function (not as an explicit value constructor). The Book class developed in Programming Assignment 7 should be used to model the data for a single, distinct book. I.e., you should use Book objects and their operations as needed. You should not add any operations to the Book class or change any of the operations.

In addition, there will be an analysis and design of the main program. The main program analysis should consist of one Library object, and its design should use Library member functions to execute the actions of the library. As usual, significant subproblems should be solved using functions.

To make keyboard input easier, you should assume all of the string inputs (i.e., author, title, genre, and names) are one "word" and use the regular input operation. Multi-word titles and names will be input with underscores between the words, e.g., Harry_Potter, or without spaces, e.g., HarryPotter.
Example Program Run

Welcome to the CS 210 Library!

Please choose from the following actions:

A. Initialize the collection.
B. Add a new book to the collection.
C. Check out a book.
D. Return a book.
E. Print out information about a book
F. Print out a list of all books
G. Print out a list of books with the same author
H. Print out a list of books of the same genre
I. Print out a list of books with the same character
J. Print out the total number of books in library collection
K. Print out the total number of currently checked out books
Q. Quit the program.

Your choice: A

How many books do you wish to enter? 4
For each book, please enter the author, the title, the genre, the number of characters, the characters' names, and number of copies separated by spaces or newlines.

Book 1: Rowling Harry_Potter:Goblet_of_Fire Fantasy 3 HarryPotter RonWeasley HermioneGranger 1

Book 2: Rowling Harry_Potter:Half-Blood_Prince Fantasy 3 HarryPotter RonWeasley HermioneGranger 3

Book 3: Brown DaVinci_Code,_The Mystery 2 RobertLangdon SophieNeveu 5

Book 4: Hawking Brief_History_of_Time,_A Non-Fiction 0 1

Please choose from the following actions:

A. Initialize the collection.
B. Add a new book to the collection.
C. Check out a book.
D. Return a book.
E. Print out information about a book
F. Print out a list of all books
G. Print out a list of books with the same author
H. Print out a list of books of the same genre
I. Print out a list of books with the same character
J. Print out the total number of books in library collection
K. Print out the total number of currently checked out books

Q. Quit the program.

Your choice: C

Please enter an author: Brown
Please enter a title: Da_Vinci_Code,_The

Da_Vinci_Code,_The by Brown has been checked out

Please choose from the following actions:

A. Initialize the collection.
B. Add a new book to the collection.
C. Check out a book.
D. Return a book.
E. Print out information about a book
F. Print out a list of all books
G. Print out a list of books with the same author
H. Print out a list of books of the same genre
I. Print out a list of books with the same character
J. Print out the total number of books in library collection
K. Print out the total number of currently checked out books

Q. Quit the program.

Your choice: F

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th># copies</th>
<th># checked out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rowling</td>
<td>Harry_Potter:Goblet_of_Fire</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Rowling</td>
<td>Harry_Potter:Half-Blood_Prince</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Brown</td>
<td>Da_Vinci_Code,_The</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Hawking</td>
<td>Brief_History_of_Time,_A</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Please choose from the following actions:

A. Initialize the collection.
B. Add a new book to the collection.
C. Check out a book.
D. Return a book.
E. Print out information about a book
F. Print out a list of all books
G. Print out a list of books with the same author
H. Print out a list of books of the same genre
I. Print out a list of books with the same character
J. Print out the total number of books in library collection
K. Print out the total number of currently checked out books

Q. Quit the program.

Your choice: G

Please enter an author: Rowling
The following books are by Rowling:

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th># copies</th>
<th># checked out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rowling</td>
<td>Harry_Potter:Goblet_of_Fire</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Rowling</td>
<td>Harry_Potter:Half-Blood_Prince</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Please choose from the following actions:

A. Initialize the collection.
B. Add a new book to the collection.
C. Check out a book.
D. Return a book.
E. Print out information about a book
F. Print out a list of all books
G. Print out a list of books with the same author
H. Print out a list of books of the same genre
I. Print out a list of books with the same character
J. Print out the total number of books in library collection
K. Print out the total number of currently checked out books

Q. Quit the program.

Your choice: J

There is/are 10 total book(s) in the collection.

Please choose from the following actions:

A. Initialize the collection.
B. Add a new book to the collection.
C. Check out a book.
D. Return a book.
E. Print out information about a book
F. Print out a list of all books
G. Print out a list of books with the same author
H. Print out a list of books of the same genre
I. Print out a list of books with the same character
J. Print out the total number of books in library collection
K. Print out the total number of currently checked out books

11/15/2006
Q. Quit the program.

Your choice: K

There is/are 1 book(s) checked out.

Please choose from the following actions:

A. Initialize the collection.
B. Add a new book to the collection.
C. Check out a book.
D. Return a book.
E. Print out information about a book
F. Print out a list of all books
G. Print out a list of books with the same author
H. Print out a list of books of the same genre
I. Print out a list of books with the same character
J. Print out the total number of books in library collection
K. Print out the total number of currently checked out books

Q. Quit the program.

Your choice: Q

Thank you for using the CS 210 Library!