

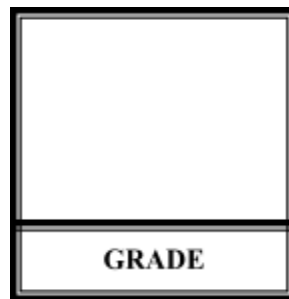


FEU Institute of Technology
COLLEGE OF ENGINEERING • COLLEGE OF COMPUTER STUDIES

College of Computer Studies

DATA STRUCTURES AND ALGORITHMS
(CCS0015L)

BookFlow: A Book Borrowing System



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I. INTRODUCTION

The system that the programmers created is a Book Borrowing System. The system implements the use of various Data Structures and Algorithms discussed in the course. The specific system was chosen to provide a solution for inefficient, slow, and unreliable manual recording that libraries rely on. The programmers aim to create a Book Borrowing System that is efficient and accurate by implementing various Data Structures and Algorithms such as: Linked Lists, Vectors, Pointers, File-Handling, and several others, which would ensure an efficient and reliable data collection, processing, and presentation. These functions were implemented by using Abstract Data Types (ADTs) and Standard Template Libraries to ensure a proper Abstraction and Encapsulation of the implementation details.

II. DESCRIPTION OF THE PROJECT

The Book Borrowing System is a digital platform that allows users to borrow, return, and search for books within the library's catalog. The system records all user transactions and book availability in real-time, ensuring that records are always up to date.

III. OBJECTIVES

The main objective of this project is to develop an efficient and user-friendly Book Borrowing Catalog System that improves how library resources are managed and accessed. Specifically, the system aims to:

1. Replace manual recording with a digital catalog to minimize human error and reduce time spent on logging transactions.
2. Implement key data structures and algorithms (such as arrays, linked lists, stack, and trees) to manage book and user records effectively.
3. Enable real-time tracking of book availability, borrowing status, and return history.
4. Allow users to search and browse the catalog using efficient search algorithms.
5. Provide administrative functions for managing the catalog, such as adding or removing books and viewing borrowing history.
6. Enhance user experience by providing a fast, reliable, and organized interface for borrowing and returning books.
7. Easier access to books data

IV. SIGNIFICANCE OF THE STUDY

The Book Borrowing System would resolve the issues of the traditional manual recording methods commonly used in older library systems. The system created would ensure a quick and accurate retrieval, processing, and presentation of data, which is beneficial for individuals who often use the library to borrow, return, or search for books. Specifically, the beneficiaries of the system are the following:

1. **Librarians.** The ease of use that the book borrowing system provides is beneficial for librarians as it allows an efficient and accurate access to data that is necessary to keep track of the books that are borrowed and returned by library users.
2. **Students and Library Users.** The system would be beneficial for individuals, mainly students, who often use the library to search, borrow, and return books. Due to the efficiency and simplicity that the system provides, the users would be able to conserve more time and effort.
3. **Institution and Other Libraries.** The system would be beneficial for the institution and other libraries as the system allows for an accurate tracking of the individuals who borrow a book. This is important to ensure that the books are preserved and properly returned each time it is borrowed.

V. PROJECT DETAILS

Table of Functions

Function Name	Scope (Local / Global)	Purpose
database_file()	Local	It initializes the book list file if not found
LoadFromFile()	Local	Loads books from txt file (library_data.txt) into a linked list
SaveToFile()	Local	Saves the linked list of books back to the txt file
Menu()	Local	Displays the main menu options
ShowBook()	Local	Displays all books and their details

BorrowBook()	Local	Handles borrowing of books with ID check and ban check
ReturnBook()	Local	Handles returning of books and issues penalty for late return
SearchBook()	Local	Searches the linked list for a book by its ID using sequential search
history()	Local	Displays borrow history from file
checkName()	Local	Validates that the borrower name
getCurrentDate()	Local	Returns the current date in MM/DD/YYYY format
Alis()	Local	Handles the programs exit confirmation
sortingData()	Local	Sorts the books by the availability status using bubble sort, borrowed first then available
date_time()	Local	display the current date and exact time
isBanned()	Local	Open “Banned_data.txt” file in read, check if the file is properly opened, and check if there is a matching ID number and save it to file.

Table of Classes

Class Name	Scope (Public /Private)	Purpose
BOOK	Public	Main class for managing books, borrowers, borrowing, and returns

Table of Data Structures/ADT

Identifier Name	Type of Data Structure/ ADT Operations	Purpose
bookList	dequeue<books>	Temporary book list initialization before file loading
head	books* (linked list	Head pointer to dynamically loaded book records
borrowHistory	stack<string>	Keeps track of latest borrow/return events (LIFO)
books	struct	Stores information of individual book records
borrower	struct	Temporarily stores

Table of Algorithms

Algorithm Name	In what part of the program was it applied	Purpose
Sequential Search	SearchBook(), isBanned()	Find the specific book using a book ID and check if the borrower is banned.
Stack	history(), BorrowBook(), ReturnBook()	Saves the record of latest borrowed books, and deletes if returned.
Bubble Sort	sortingData()	Sorts the books via availability status.
Book Availability Check	BorrowBook, ReturnBook	Checks if a book is available or borrowed before processing action.

Late Return Detection	ReturnBook()	Compares return time with borrow time (7 days) to trigger ban, in our system 1 day is equivalent to 1.
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Division of Labor

Function Name	Author/Developer	Date Completed
database_file()	Arada, Aaron Randolph	July 12, 2025
LoadFromFile()	Legara, Dashtin Kyle	July 12, 2025
SaveToFile()	Arada, Aaron Randolph	July 12, 2025
Menu()	Marfil, Ezekiel O.	July 12, 2025
main()	Boo, James Gabriel	July 12, 2025
ShowBook()	Januya, Joaquin Elizandro B.	July 12, 2025
BorrowBook()	Marfil, Ezekiel O.	July 12, 2025
ReturnBook()	Marfil, Ezekiel O.	July 14, 2025
findBookById()	Boo, James Gabriel	July 14, 2025
history()	Arada, Aaron Randolph	July 14, 2025
checkName()	Legara, Dashtin Kyle	July 15, 2025
getCurrentDate()	Boo, James Gabriel	July 15, 2025
Alis()	Boo, James Gabriel	July 17, 2025
getCurrentDateTime()	Marfil, Ezekiel O.	July 17, 2025
sortingData()	Januya, Joaquin Elizandro B.	July 17, 2025
date_time()	Januya, Joaquin Elizandro B.	July 17, 2025
isBanned()	Legara, Dashtin Kyle	July 17, 2025

VI. DATA ITEMS SPECIFICATION

Data Item	Input/Output	Data Type	Length	Decimal	Formula used	Allowed Value
book_id	Input/Output	string	4	-	-	B001-B020
b.book_title	Output	string	-	-	-	-
b.book_author	Output	string	-	-	-	-
b.book_availability	Output	string	-	-	-	-
currentDate	Output	string	10	-	date_time()	-
name	Input	string	-	-	-	alphabetical
b.borrower_name	Input	string	-	-	-	alphabetical
b.borrower_ID	Input	int	9	-	-	numeric
line	Output	string	-	-	-	-
b.BookID	Input/Output	string	4	-	-	B001-B020
bookBorrowed	Output	string	-	-	-	-
needsswapped	-	-	-	-	-	-
b.confirm	Input	char	1	-	-	Y, N
b.again	Input	char	1	-	-	Y, N
wow	-	bool	-	-	-	-
borrowHistory	Output	stack<string>	-	-	-	-
id	Output	string	4	-	-	-
title	Output	string	-	-	-	-
author	Output	string	-	-	-	-

status	Output	string	-	-	-	-
se	Input	string	4	-	-	B001-B020
current dt	Output	time t	10	-	time(0)	-
save_time	Output	time_t	10	-	sizeof(time_t)	-
inputBookID	input	string	4	-	-	alphanumeric
found	-	bool	-	-	-	-
validDate	-	bool	-	-	-	-
r.borrower_name	Input	string	-	-	-	alphabetical
r.borrower ID	Input	int	9	-	-	alphanumeric
bookID	Input	string	4	-	-	B001-B020
r.confirm	Input	char	1	-	-	Y, N
r.again	Input	char	1	-	-	Y, N
e.again	Input	char	1	-	-	Y,N
option	Input	int	1	-	-	1-6
obj	-	BOOK	-	-	-	-

VII. SCREEN OUTPUT

This should include the screen outputs of the features of the project along with detailed explanations.

```

=====
                        MENU
=====
||      [1] - Show Books      ||
||      [2] - Search Book    ||
||      [3] - Borrow Book    ||
||      [4] - Return Book    ||
||      [5] - View History   ||
||      [6] - Exit           ||
=====
Input your Choice (1-6) : █

```

Figure 1. Menu for BookFlow

Figure 1 shows the menu for BookFlow that include the following:

1. **Show Books**
2. **Search Book**

3. **Borrow Book**
4. **Return Book**
5. **View History**
6. **Exit**

```
=====
                        MENU
=====
||      [1] - Show Books      ||
||      [2] - Search Book    ||
||      [3] - Borrow Book    ||
||      [4] - Return Book    ||
||      [5] - View History   ||
||      [6] - Exit           ||
=====

Input your Choice (1-6) : 1

=====
                        BOOK LIST
=====
Book ID  Title                Author                Availability
-----
B002    To Kill a Mockingbird  Harper Lee           Borrowed
B003    The Great Gatsby       F. Scott Fitzgerald Borrowed
B004    Pride and Prejudice     Jane Austen          Borrowed
B010    Snow Crash              Neal Stephenson       Borrowed
B014    Fluent Python           Luciano Ramalho        Borrowed
B001    1984                     George Orwell         Available
B005    The Hobbit                 J.R.R. Tolkien        Available
B006    Dune                      Frank Herbert         Available
B007    Ender's Game               Orson Scott Card      Available
B008    Foundation                 Isaac Asimov          Available
B009    Necromancer                 William Gibson        Available
B011    Programming Pearls         Jon Bentley           Available
B012    C++ Primer                  Stanley B. Lippman     Available
B013    Effective Modern C++       Scott Meyers           Available
B015    Effective Java              Joshua Bloch           Available
B016    A Game of Thrones           George R.R. Martin    Available
B017    The name of the Wind         Patrick Rothfuss       Available
B018    Pedagogy of the Oppressed   Paulo Freire           Available
B019    MPL                        Doggie Saber           Available
B020    The 48 Laws of Power        Robert Greene          Available
=====
```

Figure 2 presents the option 1 (showbooks) output

Displays all the book titles with their corresponding authors, id's, and availability.

```
=====
                        MENU
=====
||      [1] - Show Books      ||
||      [2] - Search Book    ||
||      [3] - Borrow Book    ||
||      [4] - Return Book    ||
||      [5] - View History   ||
||      [6] - Exit           ||
=====

Input your Choice (1-6) : 2

=====
                        Search Book
=====
Enter Book ID (B001-B020): B019
=====

Book Found | B019 | MPL BY Doggie Saber ----- Available

=====

Do you want to search another book (Y/N)?n
```

Figure 3 presents the option 2 (search book) output

It will ask the user to input a Book ID, then checks the database for a matching Book ID. If a match is found, the system will display the book information. If no match is found, the system will output “Book not found.”

```
|| [6] - Exit ||
=====
Input your Choice (1-6) : 3
=====
BORROW BOOK
=====
Name: Ezekiel
ID number (9 digits): 202410600
=====
BOOK LIST
=====
Book ID Title Author Availability
-----
0002 To Kill a Mockingbird Harper Lee Borrowed
0003 The Great Gatsby F. Scott Fitzgerald Borrowed
0004 Pride and Prejudice Jane Austen Borrowed
0010 Snow Crash Neal Stephenson Borrowed
0014 Fluent Python Luciano Ramalho Borrowed
0001 1984 George Orwell Available
0005 The Hobbit J.R.R. Tolkien Available
0006 Dune Frank Herbert Available
0007 Ender's Game Orson Scott Card Available
0008 Foundation Isaac Asimov Available
0009 Necromancer William Gibson Available
0011 Programming Pearls Jon Bentley Available
0012 C++ Primer Stanley B. Lippman Available
0013 Effective Modern C++ Scott Meyers Available
0015 Effective Java Joshua Bloch Available
0016 A Game of Thrones George R.R. Martin Available
0017 The name of the Wind Patrick Rothfuss Available
0018 Pedagogy of the Oppressed Paulo Freire Available
0019 MPL Doggie Saber Available
0020 The 48 Laws of Power Robert Greene Available
=====
ID of Book (e.g., 0001 - 0020): 0019
Borrowing Terms & Conditions

Failure to return within 7 days

will result to permanent ban

Confirm borrowing (Y/N)? Y
Book borrowed successfully!
Return the Book within 7 days.
Date Borrowed:
Sat Jul 19 21:59:49 2025

Borrow another book (Y/N)? N
```

Figure 4 presents the option 3 (borrow book) output

It will ask the user to input their name, a 9-digit ID number, and the Book ID of the book they want to borrow. The system will notify the user to return the book within 7 days to avoid being banned, then it will ask for confirmation.

```
=====
                        MENU
=====
||      [1] - Show Books      ||
||      [2] - Search Book    ||
||      [3] - Borrow Book    ||
||      [4] - Return Book    ||
||      [5] - View History   ||
||      [6] - Exit           ||
=====

Input your Choice (1-6) : 4
=====
                        RETURN BOOK
=====
Name: Ezekiel
ID number (9 digits): 202410600
ID of Book (800*): 8019

Confirm return (Y/N)? Y

Borrowed on: 07/19/2025 21:59
Minutes passed (simulated days): 1.58333
Book returned successfully!

Return another book (Y/N)? n
=====
                        MENU
=====
||      [1] - Show Books      ||
||      [2] - Search Book    ||
||      [3] - Borrow Book    ||
||      [4] - Return Book    ||
||      [5] - View History   ||
||      [6] - Exit           ||
=====

Input your Choice (1-6) : █
```

Figure 5 presents the option 4 (return book) output

It will ask the user to input their name, a 9-digit ID number, and the Book ID of the book they want to return. Then it checks whether the return is late. If it is, the user's ID will be banned from using the system.

```
=====
                        MENU
=====
||      [1] - Show Books      ||
||      [2] - Search Book    ||
||      [3] - Borrow Book    ||
||      [4] - Return Book    ||
||      [5] - View History    ||
||      [6] - Exit           ||
=====

Input your Choice (1-6) : 5

===== Borrow History (Latest on Top) =====
ID: 321321321 | "Pride and Prejudice" | Date: 07/16/2025 16:39
Due Date: 70/23/2025
-----
ID: 321321321 | "To Kill a Mockingbird" | Date: 07/16/2025 16:36
Due Date: 70/23/2025
-----
ID: 123123123 | "The Great Gatsby" | Date: 07/16/2025 16:19
Due Date: 70/23/2025
-----
ID: 123123123 | "Snow Crash" | Date: 07/16/2025 16:18
Due Date: 70/23/2025
-----
ID: 123123123 | "Fluent Python" | Date: 07/16/2025 16:11
Due Date: 70/23/2025
=====
```

Figure 6 presents the option 5 (view history) output

This will display the borrowing history, showing each book by its ID, along with the student ID of the borrower and the corresponding return date.

```
=====
                        MENU
=====
||      [1] - Show Books      ||
||      [2] - Search Book    ||
||      [3] - Borrow Book    ||
||      [4] - Return Book    ||
||      [5] - View History    ||
||      [6] - Exit           ||
=====

Input your Choice (1-6) : 6

Exiting Program
Are you sure? (Y/N): Y
Thank you for using the library management system :)
Exiting...
PS C:\Users\Ezekiel\Desktop\finals comprog lib> |
```

Figure 7 presents the option 6 (exit) output

It will ask the user for confirmation to exit the system.

VIII. SOURCE CODE

Upload both .cpp and .txt of your code.