Library Management System

TECHNICAL REPORT

SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
Bachelor of Technology
in Computer Science and Engineering

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Chapter 1

main.cpp

```cpp
#include <iostream>
#include "library.h"

int main()
{

    library lib;
    std::cout << "Welcome to Library management System! ";
    char choice;
    std::cout << "Registered Already? (y/n)";
    std::cin >> choice;
    toupper(choice);
    if (choice == 'y')
    {
        Menu::Login(lib);
    }
    else if (choice == 'n')
    {
        Menu::Registration(lib);
        Menu::Login(lib);
    }
    return 0;
}
```

Chapter 2

Library.h

```
1
2  #ifndef LIBRARY_H
3  #define LIBRARY_H
4  #include <fstream>
5  #include <iostream>
6  #include <string>
7  #include <vector>
8  #include <memory>
9  class Book;
10 class User;
11 class library;
12
13 class Book {
14     bool isIssued;
15     std::string bookName;
16     std::string author;
17     int bookID;
18
19 public:
20     std::shared_ptr<User> bookBorrower;
21     Book(int bookID, std::string bookName, std::string author);
22
23     Book(std::ifstream &inFile);
24
25     void Save(std::ofstream &outFile);
26
27     void BookInformation();
28
29     int getBookID() {
30         return bookID;
31     }
32
33     bool isBookIssued() const { return isIssued; }
34     void setIssued(bool status) { isIssued = status; }
35 };
```

```
36
37  class User {
38  protected:
39      std::string userName;
40      int password;
41
42      User(std::string userName, int password);
43
44  public:
45      virtual ~User() = default;
46
47      std::string getUserName() const { return userName; }
48      int getPassword() const { return password; }
49  };
50
51  class Student : public User {
52      int userID; //Roll no
53      //TODO Save which book has been borrowed.
54      std::shared_ptr<Book> borrowedBook;
55      int borrowedBookID;
56
57  public:
58      void SaveStudent(std::ofstream &outFile);
59
60      Student(int userID, std::string userName, int password);
61
62      void DisplayIssuedBook();
63
64      std::shared_ptr<Book> getBorrowedBook() const { return borrowedBook; }
65
66      void setBorrowedBook(std::shared_ptr<Book> borrowedBook) {
67          this->borrowedBook = borrowedBook;
68      }
69
70      bool hasIssuedBook() {
71          return borrowedBook != nullptr;
72      }
73
74      Student(std::ifstream &inFile);
75
76      void studentInformation();
77  };
78
79  class FileManager {
80  public:
81      static void SaveBooks(const std::vector<std::shared_ptr<Book> > &books, const std
82
83      static void LoadBooks(std::vector<std::shared_ptr<Book> > &books, const std::stri
```

```
84
85      static void SaveUsers(const std::vector<std::shared_ptr<User> > &users, const std
86
87      static void LoadUsers(std::vector<std::shared_ptr<User> > &users, const std::stri
88  };
89
90  class Administrator : public User {
91  public:
92      Administrator(std::string userName, int password);
93  };
94
95  class library {
96      std::shared_ptr<Administrator> administrator;
97      std::vector<std::shared_ptr<User> > users;
98      std::vector<std::shared_ptr<Book> > books;
99
100 public:
101     library();
102
103     ~library();
104
105     void RegisterStudent(int userID, std::string userName, int password);
106
107     void LoginUser(bool isAdmin);
108
109     void issueBook(std::shared_ptr<Student> student);
110
111     void addBook();
112
113     void displayBooks();
114
115     void searchBook();
116
117     void displayIssuedBooksForStudent();
118
119     void displaystudents();
120
121     void returnBook(std::shared_ptr<Student> student);
122
123     void AddDummyStudentsToBinaryFile();
124
125     void AddDummyBooksToBinaryFile();
126 };
127
128 class Menu {
129 public:
130     static void Registration(library &lib);
131
```

```
132     static void Login(library &lib);
133
134     static void StudentDashboard(library &lib, std::shared_ptr<Student> activeStudent
135
136     static void AdministratorDashboard(library &lib);
137 };
138
139 #endif // LIBRARY_H
140
```

Chapter 3

library.cpp

```cpp
#include "library.h"
#include "string"
#include <iostream>

void library::AddDummyBooksToBinaryFile()
{
    books.push_back(std::make_shared<Book>(101, "C++ Programming", "Bjarne Stroustrup
    books.push_back(std::make_shared<Book>(102, "Introduction to Algorithms", "Thomas
    books.push_back(std::make_shared<Book>(103, "Clean Code", "Robert C. Martin"));
    books.push_back(std::make_shared<Book>(104, "The Pragmatic Programmer", "Andrew H
    books.push_back(std::make_shared<Book>(105, "Design Patterns", "Erich Gamma"));
}

// TODO Add input validation for username (Capitalization ignore).
void library::AddDummyStudentsToBinaryFile()
{
    // Add some dummy students
    users.push_back(std::make_shared<Student>(101, "Alice", 1234));
    users.push_back(std::make_shared<Student>(102, "Bob", 5678));
    users.push_back(std::make_shared<Student>(103, "Charlie", 91011));
}

library::library()
{
    administrator = std::make_shared<Administrator>("Diljot", 1234);
    FileManager::LoadBooks(books, "./books.dat");
    FileManager::LoadUsers(users, "./students.dat");
}

library::~library()
{
    FileManager::SaveBooks(books, "./books.dat");
    FileManager::SaveUsers(users, "./students.dat");
}
```

```
Book::Book(int bookID, std::string bookName, std::string author)
{
    this->bookID = bookID;
    this->bookName = bookName;
    this->author = author;
}

void Book::BookInformation()
{
    std::cout << "Book ID: " << bookID
              << "\nTitle: " << bookName
              << "\nAuthor: " << author
              << "\nIssued: " << (isIssued ? "Yes" : "No") << '\n';
}

User::User(std::string userName, int password)
{
    this->userName = userName;
    this->password = password;
}

Student::Student(int userID, std::string userName, int password) : User(userName, pas
{
    this->userID = userID;
}

Administrator::Administrator(std::string userName, int password) : User(userName, pas
{
}

void FileManager::SaveBooks(const std::vector<std::shared_ptr<Book>> &books, const st
{
    std::ofstream outFile(filename, std::ios::binary);
    if (!outFile)
    {
        std::cerr << "Error opening file for saving.\n";
        return;
    }

    size_t count = books.size();
    outFile.write(reinterpret_cast<const char *>(&count), sizeof(count));

    for (const auto &book : books)
    {
        book->Save(outFile);
    }
```

```
    if (!outFile)
    {
        std::cerr << "Error writing to file!\n";
    }
}

void FileManager::LoadBooks(std::vector<std::shared_ptr<Book>> &books, const std::str
{
    std::ifstream inFile(filename, std::ios::binary);
    if (!inFile)
    {
        std::cerr << "Error opening file for loading book data.\n";
        return;
    }
    size_t count;
    inFile.read(reinterpret_cast<char *>(&count), sizeof(count));
    books.clear();
    for (size_t i = 0; i < count; ++i)
    {
        auto book = std::make_shared<Book>(inFile);
        books.push_back(book);
    }
    if (!inFile)
    {
        std::cerr << "Error reading from book data file.!\n";
    }
}

void FileManager::SaveUsers(const std::vector<std::shared_ptr<User>> &users, const st
{
    std::ofstream outFile(filename, std::ios::binary);
    if (!outFile)
    {
        std::cerr << "Error opening file for saving users.\n";
        return;
    }

    size_t count = users.size();
    outFile.write(reinterpret_cast<const char *>(&count), sizeof(count));

    for (const auto &user : users)
    {
        if (auto student = std::dynamic_pointer_cast<Student>(user))
        {
            student->SaveStudent(outFile);
        }
    }
```

```
    if (!outFile)
    {
        std::cerr << "Error writing to user data file!\n";
    }
}

void FileManager::LoadUsers(std::vector<std::shared_ptr<User>> &users, const std::str
{
    std::ifstream inFile(filename, std::ios::binary);
    if (!inFile)
    {
        std::cerr << "Error opening file for loading users.\n";
        return;
    }

    size_t count;
    inFile.read(reinterpret_cast<char *>(&count), sizeof(count));

    users.clear();
    for (size_t i = 0; i < count; ++i)
    {
        auto student = std::make_shared<Student>(inFile);
        users.push_back(student);
    }

    if (!inFile)
    {
        std::cerr << "Error reading from user data file!\n";
    }
}

Student::Student(std::ifstream &inFile) : User("", 0)
{
    size_t nameSize;
    inFile.read(reinterpret_cast<char *>(&nameSize), sizeof(nameSize));
    userName.resize(nameSize);
    inFile.read(&userName[0], nameSize);

    inFile.read(reinterpret_cast<char *>(&password), sizeof(password));

    inFile.read(reinterpret_cast<char *>(&userID), sizeof(userID));
    //
}

Book::Book(std::ifstream &inFile)
{
    inFile.read(reinterpret_cast<char *>(&bookID), sizeof(bookID));
```

```
    size_t nameSize;
    inFile.read(reinterpret_cast<char *>(&nameSize), sizeof(nameSize));
    bookName.resize(nameSize);
    inFile.read(&bookName[0], nameSize);

    size_t authorSize;
    inFile.read(reinterpret_cast<char *>(&authorSize), sizeof(authorSize));
    author.resize(authorSize);
    inFile.read(&author[0], authorSize);

    inFile.read(reinterpret_cast<char *>(&isIssued), sizeof(isIssued));
}

void Book::Save(std::ofstream &outFile)
{

    outFile.write(reinterpret_cast<const char *>(&bookID), sizeof(bookID));

    size_t nameSize = bookName.size();
    outFile.write(reinterpret_cast<const char *>(&nameSize), sizeof(nameSize));
    outFile.write(bookName.c_str(), nameSize);

    size_t authorSize = author.size();
    outFile.write(reinterpret_cast<const char *>(&authorSize), sizeof(authorSize));
    outFile.write(author.c_str(), authorSize);

    outFile.write(reinterpret_cast<const char *>(&isIssued), sizeof(isIssued));
}

void Student::DisplayIssuedBook()
{
    if (borrowedBook)
    {
        std::cout << "Issued Book Details:\n";
        borrowedBook->BookInformation();
    }
    else
    {
        std::cout << "No book has been issued to you.\n";
    }
}

void library::RegisterStudent(int userID, const std::string userName, int password)
{
    auto student = std::make_shared<Student>(userID, userName, password);
    users.push_back(student);
    std::cout << "Student registered successfully.\n";
}
```

```
void library::LoginUser(bool isAdmin)
{
    std::string userName;
    int password;
    std::cout << "Enter Username: ";
    std::cin.ignore();
    getline(std::cin, userName);
    std::cout << "Enter Password: ";
    std::cin >> password;

    if (!isAdmin)
    {
        for (const auto &user : users)
        {
            if (dynamic_cast<Student *>(user.get()))
            {
                if (user->getUserName() == userName && user->getPassword() == passwor
                {
                    std::cout << "Student login successful!\n";
                    Menu::StudentDashboard(*this, std::dynamic_pointer_cast<Student>(
                    return;
                }
            }
        }
    }
    else
    {
        if (administrator->getUserName() == userName && administrator->getPassword()
        {
            std::cout << "Admin login successful!\n";
            Menu::AdministratorDashboard(*this);
            return;
        }
    }
    std::cout << "Invalid credentials!\n";
}

void library::issueBook(std::shared_ptr<Student> student)
{
    int bookID;
    std::cout << "Enter Book ID to issue: ";
    std::cin >> bookID;
    if (!student->hasIssuedBook())
    {
        for (auto &book : books)
        {
            if (book->getBookID() == bookID && !(book->isBookIssued()))
```

```
            {
                book->setIssued(true);
                student->setBorrowedBook(book);
                std::cout << "Book issued successfully.\n";
                return;
            }
        }
    }

    std::cout << "Book not available.\n";
}

void library::returnBook(std::shared_ptr<Student> student)
{
    if (student->hasIssuedBook())
    {
        student->getBorrowedBook()->setIssued(true);
        student->setBorrowedBook(nullptr);
        std::cout << "Book returned successfully.\n";
    }
    else
    {
        std::cout << "You don't have any issued books..\n";
    }
}

void library::addBook()
{
    int bookID;
    std::string bookName, author;

    std::cout << "Enter Book ID: ";
    std::cin >> bookID;
    std::cin.ignore();
    std::cout << "Enter Book Name: ";
    getline(std::cin, bookName);
    std::cout << "Enter Author Name: ";
    getline(std::cin, author);

    auto newBook = std::make_shared<Book>(bookID, bookName, author);
    books.push_back(newBook);

    std::cout << "Book added successfully.\n";
}

void library::displayBooks()
{
    std::cout << "Books in the library:\n";
```

```
    for (const auto &book : books)
    {
        book->BookInformation();
    }
}

void library::displaystudents()
{
    for (const auto &user : users)
    {
        std::dynamic_pointer_cast<Student>(user)->studentInformation();
    }
}

void Student::studentInformation()
{
    std::cout << "Student ID: " << userID
              << "\nName: " << userName
              << "\nPassword: " << password << std::endl;
}

void Student::SaveStudent(std::ofstream &outFile)
{

    size_t nameSize = userName.size();
    outFile.write(reinterpret_cast<const char *>(&nameSize), sizeof(nameSize));
    outFile.write(userName.c_str(), nameSize);
    outFile.write(reinterpret_cast<const char *>(&password), sizeof(password));

    outFile.write(reinterpret_cast<const char *>(&userID), sizeof(userID));
}
// unused
void library::searchBook()
{
    int bookID;
    std::cout << "Enter Book ID to search: ";
    std::cin >> bookID;

    for (const auto &book : books)
    {
        if (book->isBookIssued())
        {
            book->BookInformation();
            return;
        }
    }

    std::cout << "Book not found.\n";
```

```
}

void library::displayIssuedBooksForStudent()
{
    std::string studentName;
    std::cout << "Enter your username: ";
    getline(std::cin, studentName);

    for (const auto &user : users)
    {
        if (auto student = std::dynamic_pointer_cast<Student>(user))
        {
            if (student->getUserName() == studentName)
            {
                student->DisplayIssuedBook();
                return;
            }
        }
    }
    std::cout << "Student not found or no books issued.\n";
}

// Menu Class Definitions
void Menu::Registration(library &lib)
{
    std::cout << "Registration Menu\n1. Register as Student\n2. Exit\n";
    int choice;
    std::cin >> choice;

    if (choice == 1)
    {
        int userID, password;
        std::string userName;
        std::cout << "Enter User ID: ";
        std::cin >> userID;
        std::cin.ignore();
        std::cout << "Enter Username: ";

        getline(std::cin, userName);
        std::cout << "Enter Password: ";
        std::cin >> password;
        std::cin.ignore();
        lib.RegisterStudent(userID, userName, password);
    }
}

void Menu::Login(library &lib)
{
```

```
    std::cout << "Login Menu\n1. Student Login\n2. Admin Login\n3. Exit\n";
    int choice;
    std::cin >> choice;
    if (choice == 1)
    {
        lib.LoginUser(false);
    }
    else if (choice == 2)
    {
        lib.LoginUser(true);
    }
}

void Menu::StudentDashboard(library &lib, std::shared_ptr<Student> activeStudent)
{
    bool running = true;
    while (running)
    {
        std::cout << "Student Dashboard\n1.Display Books\n2.Issue Book\n3.Return Book
        int choice;
        std::cin >> choice;
        switch (choice)
        {
        case 1:
            lib.displayBooks();
            break;
        case 2:
            lib.issueBook(activeStudent);
            break;
        case 3:
            lib.returnBook(activeStudent);
            break;
        case 4:
            activeStudent->DisplayIssuedBook();
            break;

        default:
            running = false;
            break;
        }
    }
}

void Menu::AdministratorDashboard(library &lib)
{
    bool running = true;
    while (running)
    {
```

```
            std::cout << "Administrator Dashboard\n1. Add Book\n2. Display Users\n3. Disp
            int choice;
            std::cin >> choice;
            switch (choice)
            {
            case 1:
                lib.addBook();
                break;
            case 2:
                lib.displaystudents();
                break;
            case 3:
                lib.displayBooks();
                break;
            default:
                running = false;
            }
        }
    }
```