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");
}
```

```
36
37  Book::Book(int bookID, std::string bookName, std::string author)
38  {
39      this->bookID = bookID;
40      this->bookName = bookName;
41      this->author = author;
42  }
43
44  void Book::BookInformation()
45  {
46      std::cout << "Book ID: " << bookID
47                << "\nTitle: " << bookName
48                << "\nAuthor: " << author
49                << "\nIssued: " << (isIssued ? "Yes" : "No") << '\n';
50  }
51
52  User::User(std::string userName, int password)
53  {
54      this->userName = userName;
55      this->password = password;
56  }
57
58  Student::Student(int userID, std::string userName, int password) : User(userName, pas
59  {
60      this->userID = userID;
61  }
62
63  Administrator::Administrator(std::string userName, int password) : User(userName, pas
64  {
65  }
66
67  void FileManager::SaveBooks(const std::vector<std::shared_ptr<Book>> &books, const st
68  {
69      std::ofstream outFile(filename, std::ios::binary);
70      if (!outFile)
71      {
72          std::cerr << "Error opening file for saving.\n";
73          return;
74      }
75
76      size_t count = books.size();
77      outFile.write(reinterpret_cast<const char *>(&count), sizeof(count));
78
79      for (const auto &book : books)
80      {
81          book->Save(outFile);
82      }
83
```

```
84      if (!outFile)
85      {
86          std::cerr << "Error writing to file!\n";
87      }
88  }
89
90  void FileManager::LoadBooks(std::vector<std::shared_ptr<Book>> &books, const std::str
91  {
92      std::ifstream inFile(filename, std::ios::binary);
93      if (!inFile)
94      {
95          std::cerr << "Error opening file for loading book data.\n";
96          return;
97      }
98      size_t count;
99      inFile.read(reinterpret_cast<char *>(&count), sizeof(count));
100     books.clear();
101     for (size_t i = 0; i < count; ++i)
102     {
103         auto book = std::make_shared<Book>(inFile);
104         books.push_back(book);
105     }
106     if (!inFile)
107     {
108         std::cerr << "Error reading from book data file.!\n";
109     }
110 }
111
112 void FileManager::SaveUsers(const std::vector<std::shared_ptr<User>> &users, const st
113 {
114     std::ofstream outFile(filename, std::ios::binary);
115     if (!outFile)
116     {
117         std::cerr << "Error opening file for saving users.\n";
118         return;
119     }
120
121     size_t count = users.size();
122     outFile.write(reinterpret_cast<const char *>(&count), sizeof(count));
123
124     for (const auto &user : users)
125     {
126         if (auto student = std::dynamic_pointer_cast<Student>(user))
127         {
128             student->SaveStudent(outFile);
129         }
130     }
131
```

```
132     if (!outFile)
133     {
134         std::cerr << "Error writing to user data file!\n";
135     }
136 }
137 
138 void FileManager::LoadUsers(std::vector<std::shared_ptr<User>> &users, const std::str
139 {
140     std::ifstream inFile(filename, std::ios::binary);
141     if (!inFile)
142     {
143         std::cerr << "Error opening file for loading users.\n";
144         return;
145     }
146 
147     size_t count;
148     inFile.read(reinterpret_cast<char *>(&count), sizeof(count));
149 
150     users.clear();
151     for (size_t i = 0; i < count; ++i)
152     {
153         auto student = std::make_shared<Student>(inFile);
154         users.push_back(student);
155     }
156 
157     if (!inFile)
158     {
159         std::cerr << "Error reading from user data file!\n";
160     }
161 }
162 
163 Student::Student(std::ifstream &inFile) : User("", 0)
164 {
165     size_t nameSize;
166     inFile.read(reinterpret_cast<char *>(&nameSize), sizeof(nameSize));
167     userName.resize(nameSize);
168     inFile.read(&userName[0], nameSize);
169 
170     inFile.read(reinterpret_cast<char *>(&password), sizeof(password));
171 
172     inFile.read(reinterpret_cast<char *>(&userID), sizeof(userID));
173     //
174 }
175 
176 Book::Book(std::ifstream &inFile)
177 {
178     inFile.read(reinterpret_cast<char *>(&bookID), sizeof(bookID));
179 
```

```
    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";
}
```

```
228
229 void library::LoginUser(bool isAdmin)
230 {
231     std::string userName;
232     int password;
233     std::cout << "Enter Username: ";
234     std::cin.ignore();
235     getline(std::cin, userName);
236     std::cout << "Enter Password: ";
237     std::cin >> password;
238
239     if (!isAdmin)
240     {
241         for (const auto &user : users)
242         {
243             if (dynamic_cast<Student *>(user.get()))
244             {
245                 if (user->getUserName() == userName && user->getPassword() == passwor
246                 {
247                     std::cout << "Student login successful!\n";
248                     Menu::StudentDashboard(*this, std::dynamic_pointer_cast<Student>(
249                     return;
250                 }
251             }
252         }
253     }
254     else
255     {
256         if (administrator->getUserName() == userName && administrator->getPassword()
257         {
258             std::cout << "Admin login successful!\n";
259             Menu::AdministratorDashboard(*this);
260             return;
261         }
262     }
263     std::cout << "Invalid credentials!\n";
264 }
265
266 void library::issueBook(std::shared_ptr<Student> student)
267 {
268     int bookID;
269     std::cout << "Enter Book ID to issue: ";
270     std::cin >> bookID;
271     if (!student->hasIssuedBook())
272     {
273         for (auto &book : books)
274         {
275             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";
```

```
324     for (const auto &book : books)
325     {
326         book->BookInformation();
327     }
328 }
329 
330 void library::displaystudents()
331 {
332     for (const auto &user : users)
333     {
334         std::dynamic_pointer_cast<Student>(user)->studentInformation();
335     }
336 }
337 
338 void Student::studentInformation()
339 {
340     std::cout << "Student ID: " << userID
341               << "\nName: " << userName
342               << "\nPassword: " << password << std::endl;
343 }
344 
345 void Student::SaveStudent(std::ofstream &outFile)
346 {
347 
348     size_t nameSize = userName.size();
349     outFile.write(reinterpret_cast<const char *>(&nameSize), sizeof(nameSize));
350     outFile.write(userName.c_str(), nameSize);
351     outFile.write(reinterpret_cast<const char *>(&password), sizeof(password));
352 
353     outFile.write(reinterpret_cast<const char *>(&userID), sizeof(userID));
354 }
355 // unused
356 void library::searchBook()
357 {
358     int bookID;
359     std::cout << "Enter Book ID to search: ";
360     std::cin >> bookID;
361 
362     for (const auto &book : books)
363     {
364         if (book->isBookIssued())
365         {
366             book->BookInformation();
367             return;
368         }
369     }
370 
371     std::cout << "Book not found.\n";
```

```
372 }
373
374 void library::displayIssuedBooksForStudent()
375 {
376     std::string studentName;
377     std::cout << "Enter your username: ";
378     getline(std::cin, studentName);
379
380     for (const auto &user : users)
381     {
382         if (auto student = std::dynamic_pointer_cast<Student>(user))
383         {
384             if (student->getUserName() == studentName)
385             {
386                 student->DisplayIssuedBook();
387                 return;
388             }
389         }
390     }
391     std::cout << "Student not found or no books issued.\n";
392 }
393
394 // Menu Class Definitions
395 void Menu::Registration(library &lib)
396 {
397     std::cout << "Registration Menu\n1. Register as Student\n2. Exit\n";
398     int choice;
399     std::cin >> choice;
400
401     if (choice == 1)
402     {
403         int userID, password;
404         std::string userName;
405         std::cout << "Enter User ID: ";
406         std::cin >> userID;
407         std::cin.ignore();
408         std::cout << "Enter Username: ";
409
410         getline(std::cin, userName);
411         std::cout << "Enter Password: ";
412         std::cin >> password;
413         std::cin.ignore();
414         lib.RegisterStudent(userID, userName, password);
415     }
416 }
417
418 void Menu::Login(library &lib)
419 {
```

```
420     std::cout << "Login Menu\n1. Student Login\n2. Admin Login\n3. Exit\n";
421     int choice;
422     std::cin >> choice;
423     if (choice == 1)
424     {
425         lib.LoginUser(false);
426     }
427     else if (choice == 2)
428     {
429         lib.LoginUser(true);
430     }
431 }
432
433 void Menu::StudentDashboard(library &lib, std::shared_ptr<Student> activeStudent)
434 {
435     bool running = true;
436     while (running)
437     {
438         std::cout << "Student Dashboard\n1.Display Books\n2.Issue Book\n3.Return Book
439         int choice;
440         std::cin >> choice;
441         switch (choice)
442         {
443         case 1:
444             lib.displayBooks();
445             break;
446         case 2:
447             lib.issueBook(activeStudent);
448             break;
449         case 3:
450             lib.returnBook(activeStudent);
451             break;
452         case 4:
453             activeStudent->DisplayIssuedBook();
454             break;
455
456         default:
457             running = false;
458             break;
459         }
460     }
461 }
462
463 void Menu::AdministratorDashboard(library &lib)
464 {
465     bool running = true;
466     while (running)
467     {
```

```
468             std::cout << "Administrator Dashboard\n1. Add Book\n2. Display Users\n3. Disp
469             int choice;
470             std::cin >> choice;
471             switch (choice)
472             {
473             case 1:
474                 lib.addBook();
475                 break;
476             case 2:
477                 lib.displaystudents();
478                 break;
479             case 3:
480                 lib.displayBooks();
481                 break;
482             default:
483                 running = false;
484             }
485         }
486     }
```

Chapter 4

Outputs

```
Welcome to Library management System! Registered Already? (y/n)n
Registration Menu
1. Register as Student
2. Exit
1
Enter User ID: 2302492
Enter Username: Balkrishan
Enter Password: 1234
Student registered successfully.
Login Menu
1. Student Login
2. Admin Login
3. Exit
1
Enter Username: Balkrishan
Enter Password: 1234
Student login successful!
Student Dashboard
1.Display Books
2.Issue Book
3.Return Book
4.View Issued Books
5. Exit
```

Figure 4.1: User registers

```
1
Books in the library:
Book ID: 101
Title: C++ Programming
Author: Bjarne Stroustrup
Issued: No
Book ID: 102
Title: Introduction to Algorithms
Author: Thomas H. Cormen
Issued: No
Book ID: 103
Title: Clean Code
Author: Robert C. Martin
Issued: No
Book ID: 104
Title: The Pragmatic Programmer
Author: Andrew Hunt
Issued: No
Book ID: 105
Title: Design Patterns
Author: Erich Gamma
Issued: No
```

Figure 4.2: User views books.

```
Student Dashboard
1.Display Books
2.Issue Book
3.Return Book
4.View Issued Books
5. Exit
2
Enter Book ID to issue: 105
Book issued successfully.
Student Dashboard
1.Display Books
2.Issue Book
3.Return Book
4.View Issued Books
5. Exit
4
Issued Book Details:
Book ID: 105
Title: Design Patterns
Author: Erich Gamma
Issued: Yes
Student Dashboard
1.Display Books
2.Issue Book
3.Return Book
4.View Issued Books
5. Exit
```

Figure 4.3: User issues book

```
3
Book returned successfully.
Student Dashboard
1.Display Books
2.Issue Book
3.Return Book
4.View Issued Books
5. Exit
4
No book has been issued to you.
Student Dashboard
1.Display Books
2.Issue Book
3.Return Book
4.View Issued Books
5. Exit
5
```

Figure 4.4: User returns book

```
Welcome to Library management System! Registered Already? (y/n)y
Login Menu
1. Student Login
2. Admin Login
3. Exit
1
Enter Username: Balkrishan
Enter Password: 1234
Student login successful!
Student Dashboard
1.Display Books
2.Issue Book
3.Return Book
4.View Issued Books
5. Exit
```

Figure 4.5: User logins with same info later.

```
Welcome to Library management System! Registered Already? (y/n)y
Login Menu
1. Student Login
2. Admin Login
3. Exit
2
Enter Username: Diljot
Enter Password: 1234
Admin login successful!
Administrator Dashboard
1. Add Book
2. Display Users
3. Display Books
4. Exit
1
Enter Book ID: 123
Enter Book Name: Indian Folk Dance Survey
Enter Author Name: IAS Research
Book added successfully.
Administrator Dashboard
1. Add Book
2. Display Users
3. Display Books
4. Exit
```

Figure 4.6: Admin adds new book.