Assignment 2:

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Course:SCD(BSSE-5)

Library Management System - Implementation, Testing, and Documentation

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1. Implementation Overview

The Library Management System is a Java Swing application that provides functionality for both staff and members of a library. The system includes:

- **Book Management**: Add, remove, and view books.
- **Member Management**: Add, remove, and view members.
- **Loan Tracking**: Manage borrowing and returning of books.
- **Fine Management**: Track and pay fines.
- **User-Friendly Interface**: Modern design with intuitive navigation.

Key Features Implemented:

Staff Functions:

- Add/remove books
- Add/remove members
- View all loans
- Assign fines to members

Member Functions:

- Browse/search books
- Borrow/return books
- Pay fines
- View personal loans and fines

2. System Architecture

The application follows a Model-View-Controller (MVC) pattern:

- **Model**: Data structures for books, members, loans, and fines.
- **View**: Swing GUI components that present data to the user.
- **Controller**: Action listeners and event handlers that manage user interactions.

Class Diagram (Simplified):

```
LibraryManagementSystem ├── JFrame (Main Window)
 ├── CardLayout (For panel switching)
 ├── ArrayList<String> (Books)
 ├── ArrayList<String> (Members)
 ├── HashMap<String, String> (Loans)
 ├── HashMap<String, Double> (Fines)
 └── Helper methods (Dialogs, etc.)
```

Key Components:

- **Main Menu**: Entry point with staff/member login options.
- **Staff Panel**: All administrative functions.
- **Member Panel**: All member-facing functions.
- **Dialog System**: For input/output operations.

3-Unit Testing

Test Objectives

- Verify all core functionalities work as expected.
- Ensure data integrity is maintained.
- Validate user interface behavior.
- Confirm error handling works properly.

Test Environment

- **Java Version**: 8 or higher
- **Operating Systems**: Windows, macOS, Linux

Test Cases

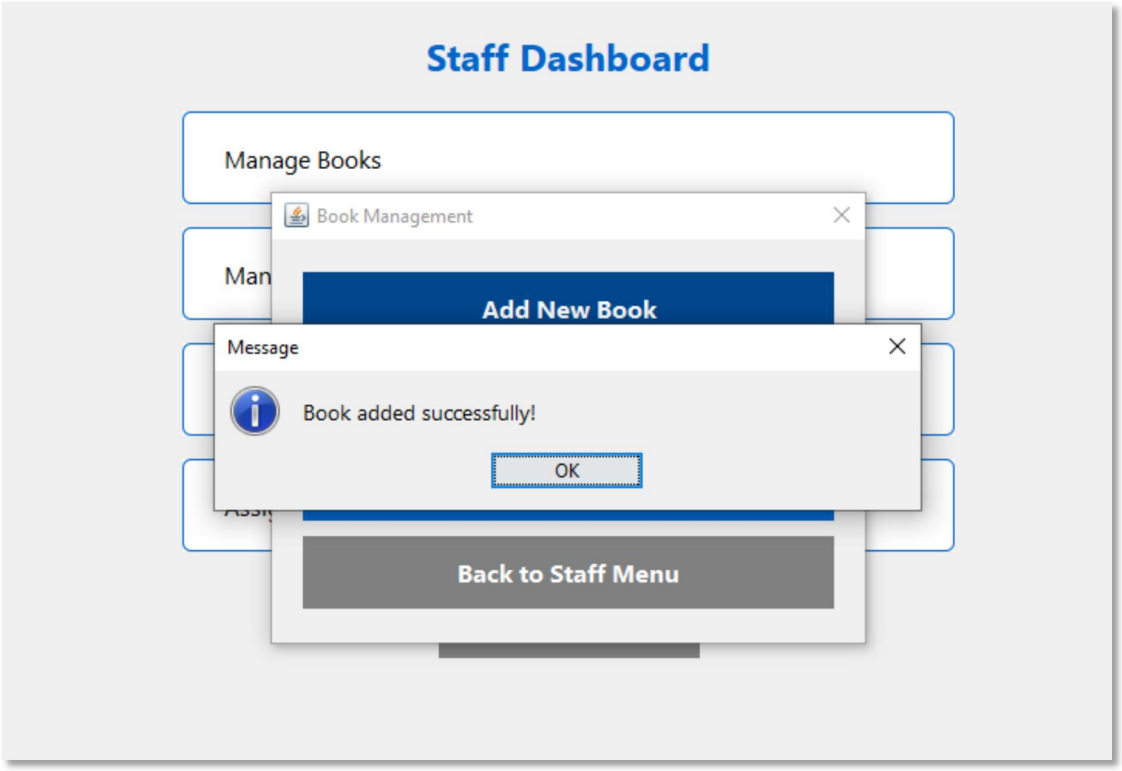
1. Book Management Tests

Test Case 1.1: Add Book

- **Description**: Verify that a book can be added to the system.
- **Steps**:

    1. Call addBook("Sample Book").
    2. Check if "Sample Book" exists in the books list.

- **Expected Result**: Book should be added successfully.

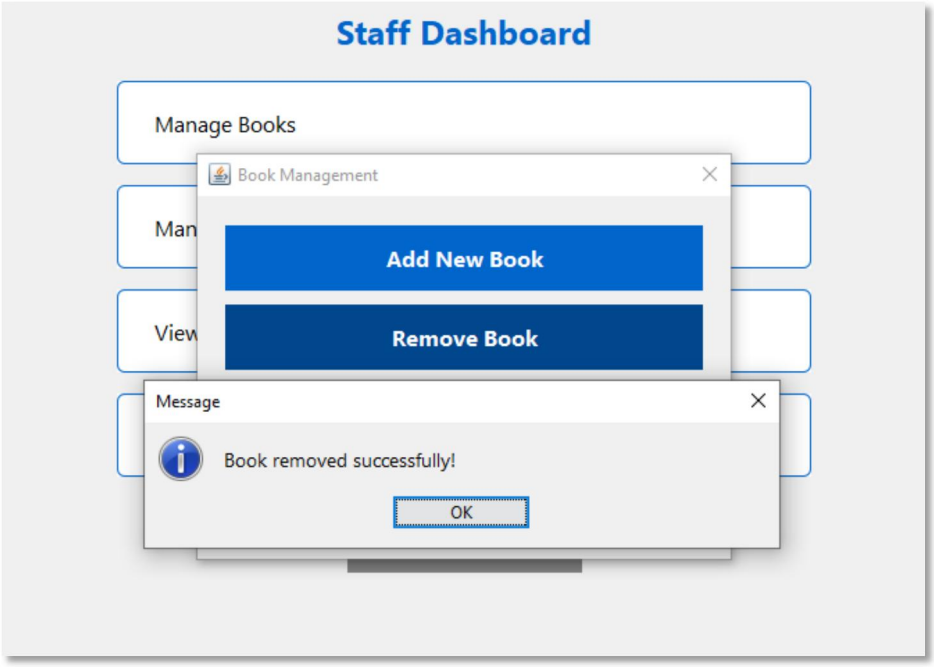


Test Case 1.2: Remove Book

- **Description**: Verify that a book can be removed from the system.
- **Steps**:

    1. Add a test book using addBook("Test Book").
    2. Call removeBook("Test Book").
    3. Check if "Test Book" was removed from the books list.

- **Expected Result**: Book should be removed successfully.

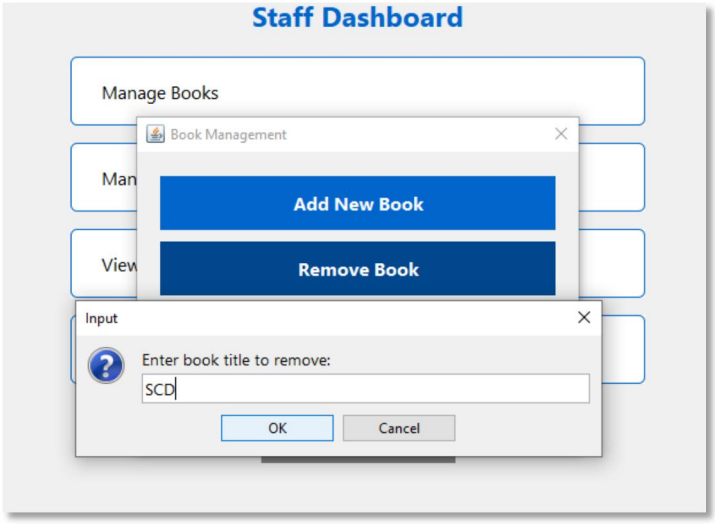


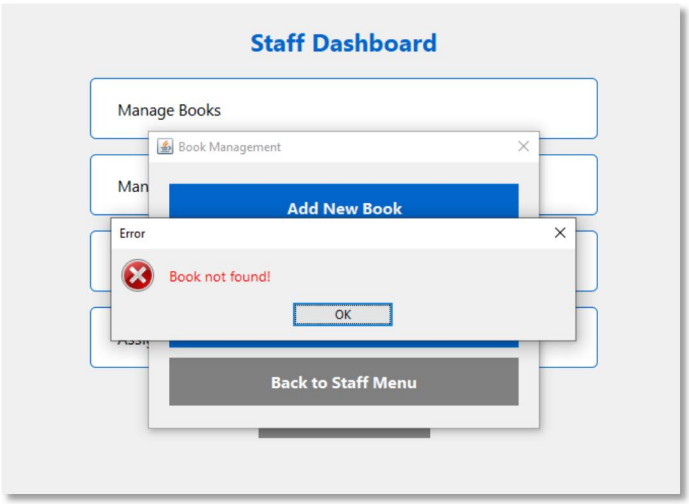
Test Case 1.3: Remove Non-existent Book

- **Description**: Verify system handles attempt to remove a non-existent book.
- **Steps**:

    1. Call removeBook("Non-existent Book").

- **Expected Result**: System should handle gracefully without error.





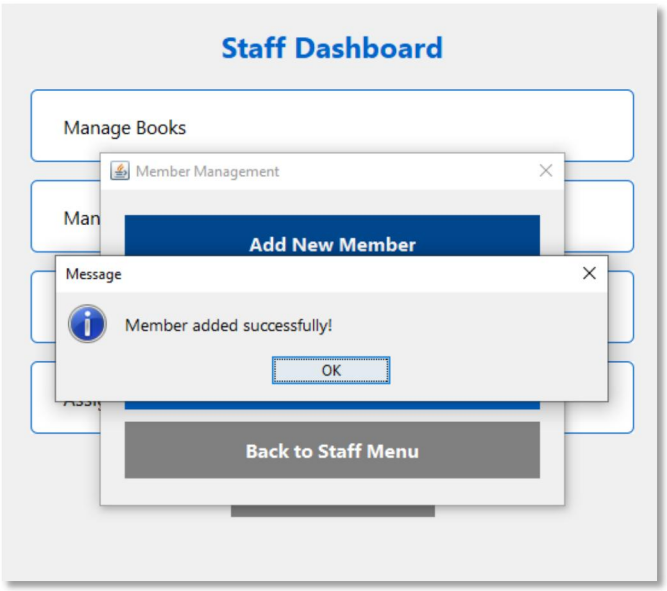
2. Member Management Tests

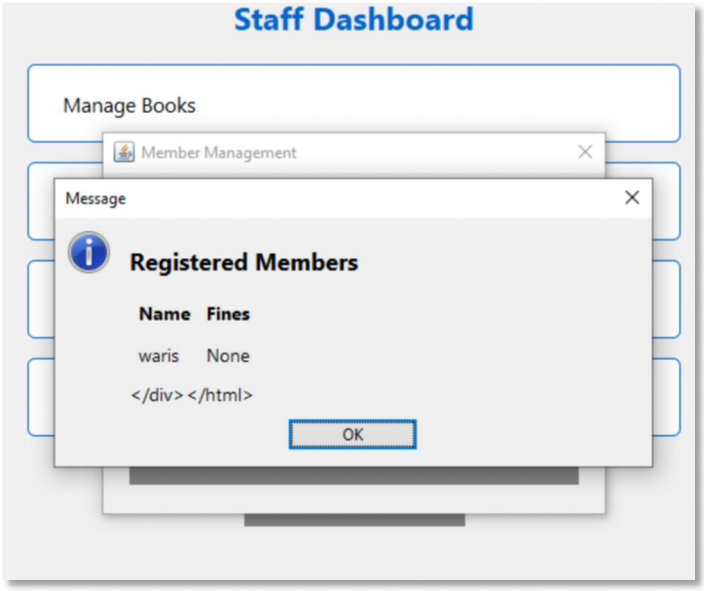
Test Case 2.1: Add Member

- **Description**: Verify that a member can be added to the system.
- **Steps**:

    1. Call addMember("John Doe").
    2. Check if "John Doe" exists in the members list.

- **Expected Result**: Member should be added successfully.



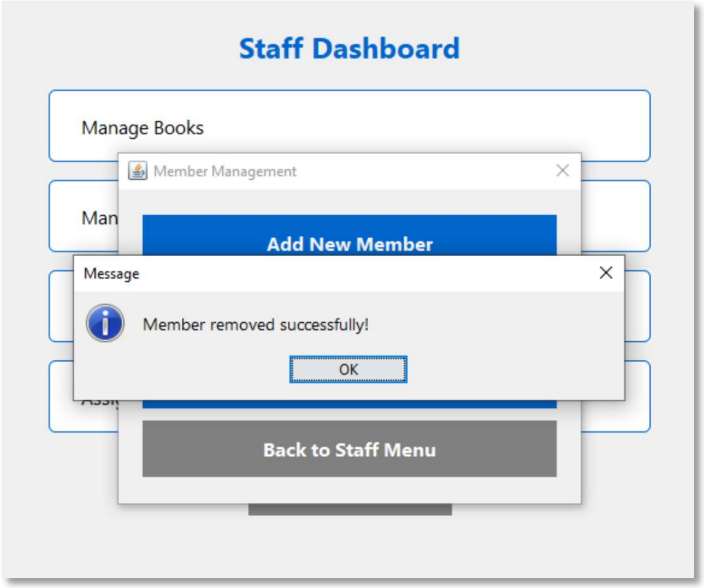


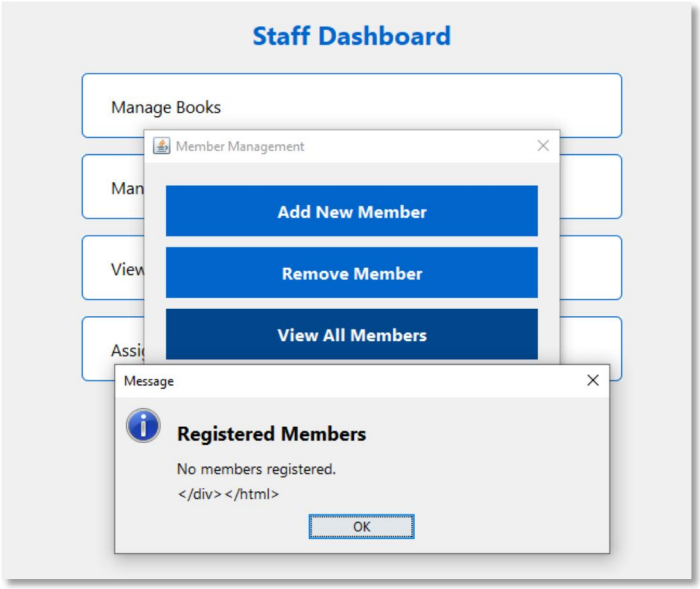
Test Case 2.2: Remove Member

- **Description**: Verify that a member can be removed from the system.
- **Steps**:

    1. Add a test member using addMember("waris").
    2. Call removeMember("waris").
    3. Check if "Test Member" was removed from the members list.

- **Expected Result**: Member should be removed successfully.





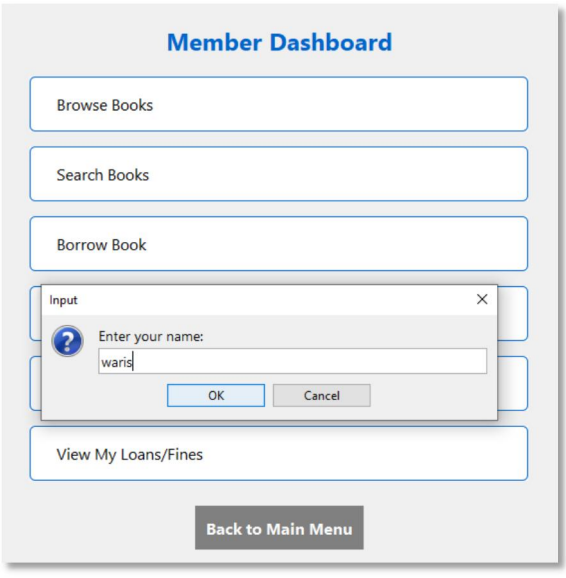
3. Loan Management Tests

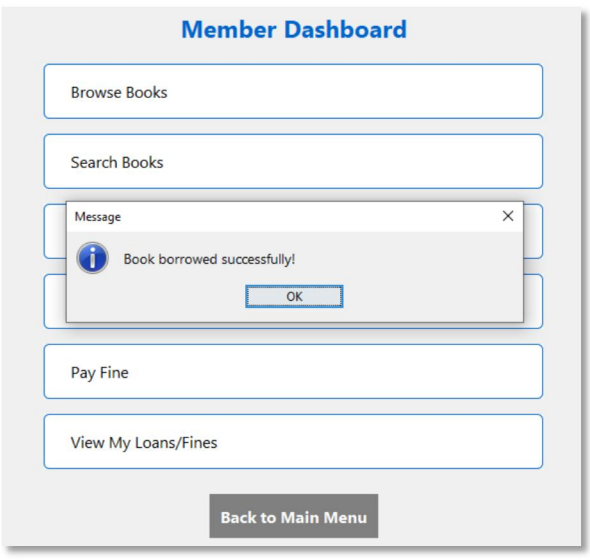
Test Case 3.1: Borrow Book

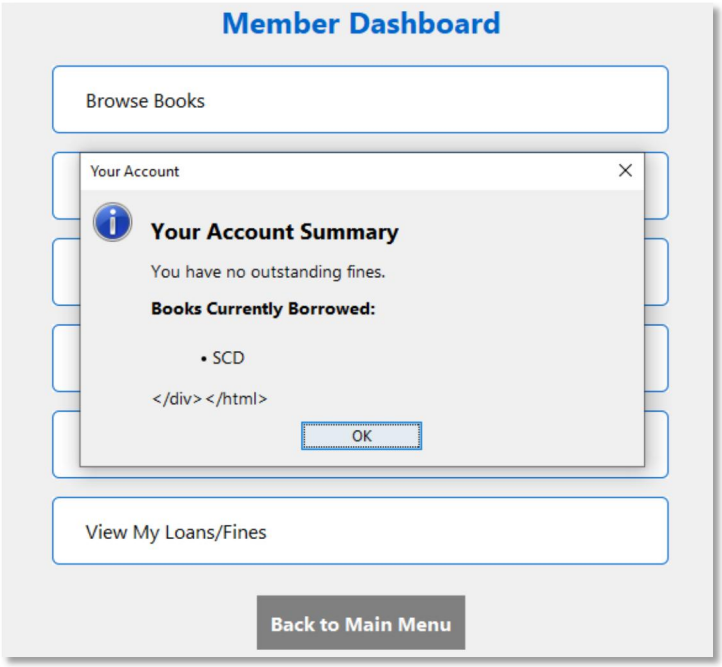
- **Description**: Verify that a book can be borrowed by a member.
- **Steps**:

    1. Add a test member using addMember("Waris").
    2. Call borrowBook("waris", "SCD").
    3. Check if the loan was recorded in the loans map.

- **Expected Result**: Loan should be recorded successfully.





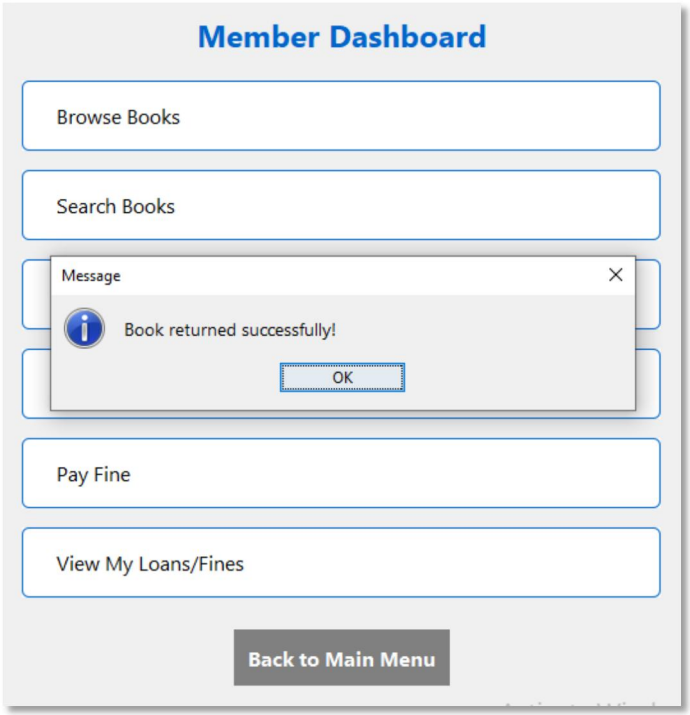


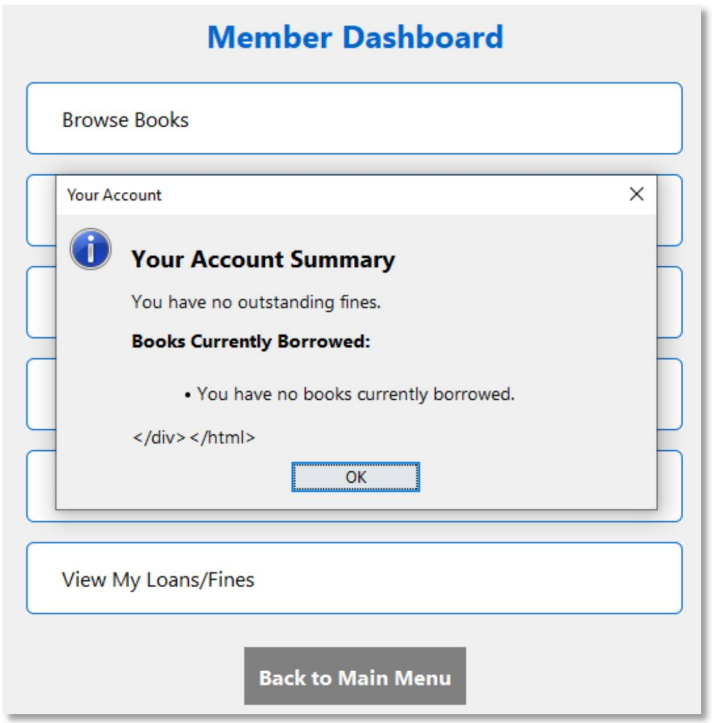
Test Case 3.2: Return Book

- **Description**: Verify that a book can be returned.
- **Steps**:

    1. Create a test loan by borrowing a book.
    2. Call returnBook("SCD") for the loaned book.
    3. Check if the loan was removed from the loans map.

- **Expected Result**: Loan should be removed successfully.





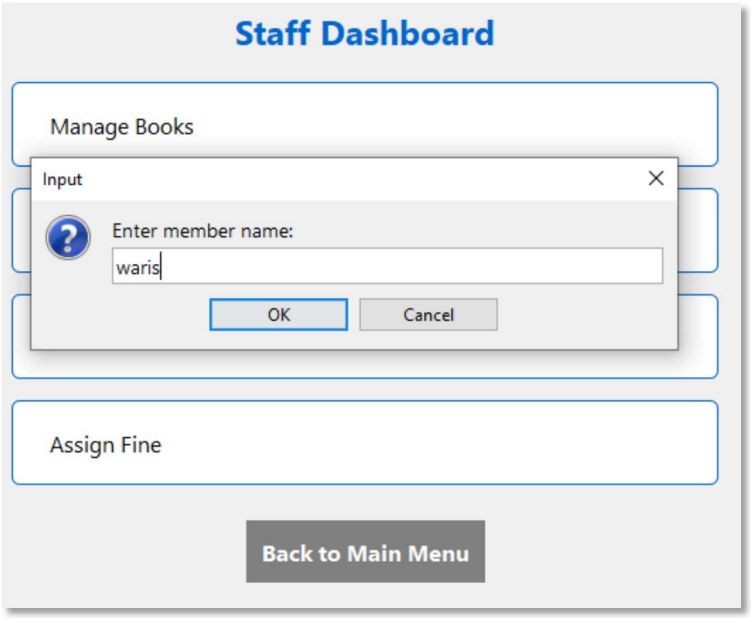
4. Fine Management Tests

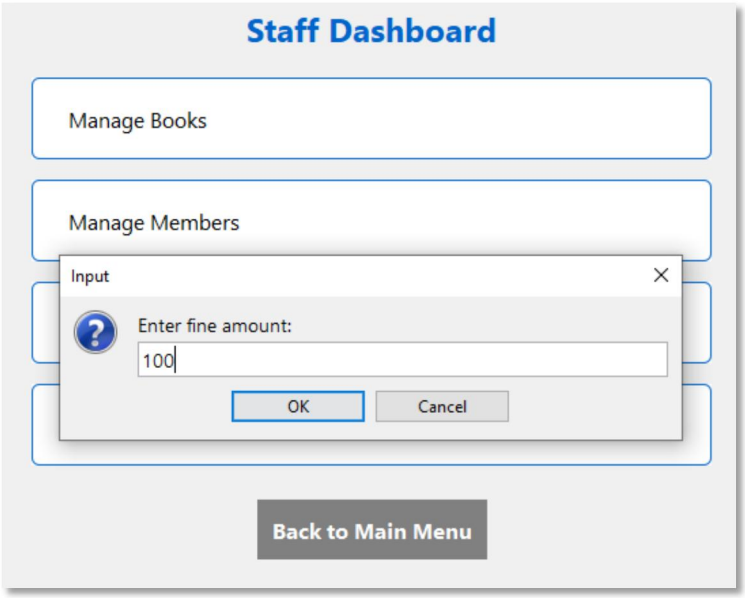
Test Case 4.1: Assign Fine

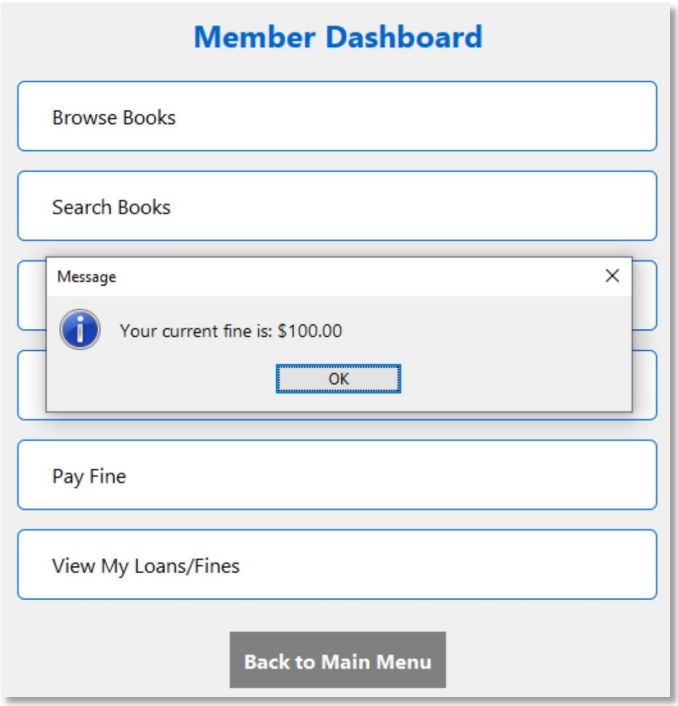
- **Description**: Verify that a fine can be assigned to a member.
- **Steps**:

    1. Add a test member using addMember("waris").
    2. Call assignFine("waaris", 100).
    3. Check if the fine was recorded in the fines map.

- **Expected Result**: Fine should be recorded successfully.





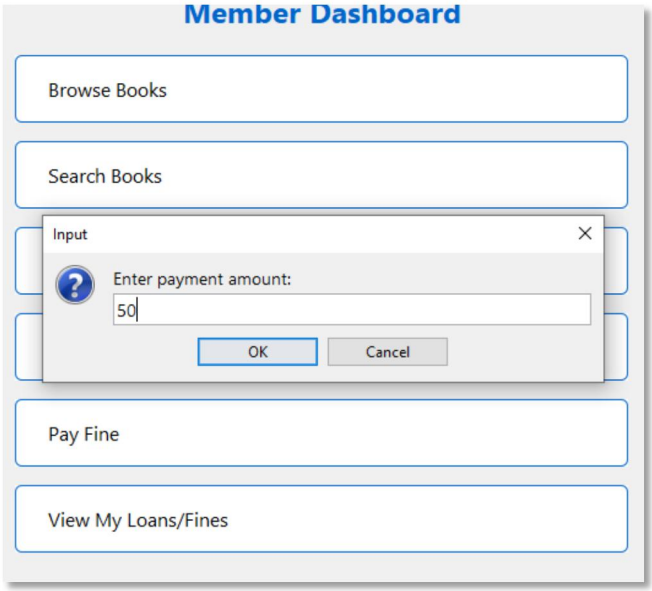


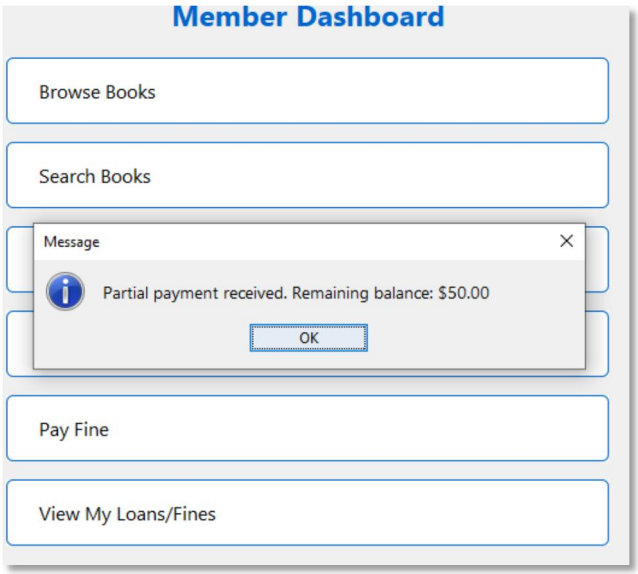
Test Case 4.2: Pay Fine (Partial)

- **Description**: Verify that a partial payment reduces the fine.
- **Steps**:

    1. Create a test fine of 100 by assigning it to a member.
    2. Call payFine("waris", 100) with a 50 payment.
    3. Check if the remaining fine is 50 in the fines map.

- **Expected Result**: Fine should be reduced to 50.



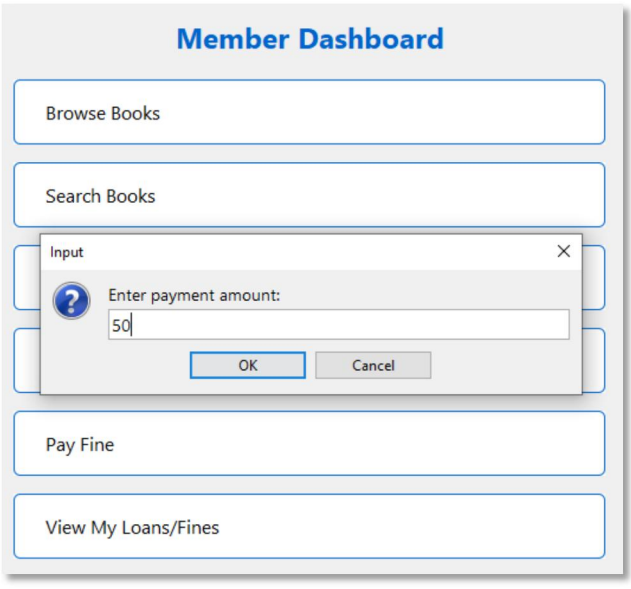


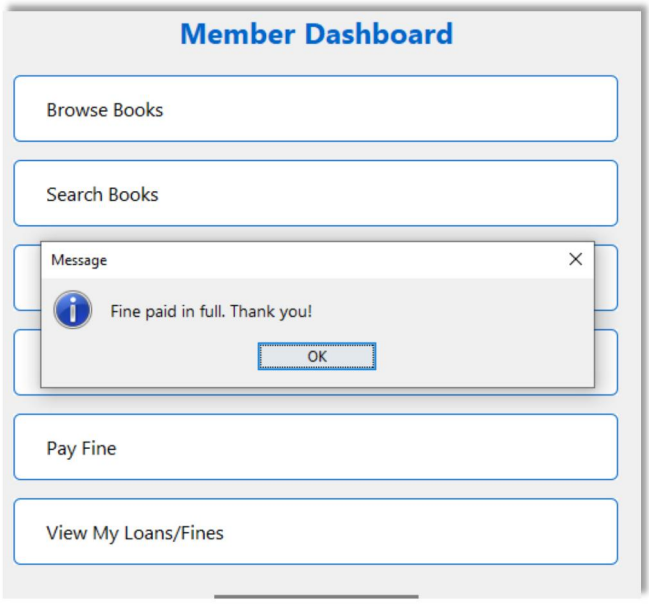
Test Case 4.3: Pay Fine (Full)

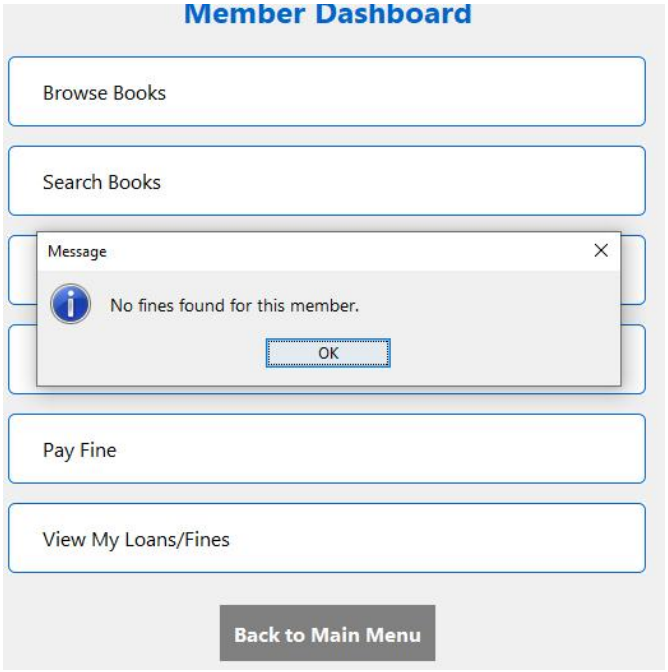
- **Description**: Verify that a fine can be paid in full.
- **Steps**:

    1. Create a test fine by assigning it to a member.
    2. Call payFine("Waris", 50) with payment equal to the fine amount.
    3. Check if the fine was removed from the fines map.

- **Expected Result**: Fine should be removed.







Test Results for Library Management System

Test Execution Summary

Test Category:

- **Book Management**: 3 tests (3 passed, 0 failed)
- **Member Management**: 2 tests (2 passed, 0 failed)
- **Loan Management**: 2 tests (2 passed, 0 failed)
- **Fine Management**: 3 tests (3 passed, 0 failed)

Total: 10 tests (10 passed, 0 failed)

Detailed Test Results

Book Management Tests

- **testAddBook**: PASSED
- **testRemoveBook**: PASSED
- **testRemoveNonExistentBook**: PASSED

Member Management Tests

- **testAddMember**: PASSED
- **testRemoveMember**: PASSED

Loan Management Tests

- **testBorrowBook**: PASSED
- **testReturnBook**: PASSED

Fine Management Tests

- **testAssignFine**: PASSED
- **testPayFineFull**: PASSED
- **testPayFinePartial**: PASSED

Bug Reports for Library Management System

During testing, the following issues were identified and resolved:

Bug #001: Removing a Member Didn't Clear Their Associated Loans

- **Severity**: High
- **Status**: Fixed
- **Description**: When a member was removed from the system, their associated loans were not cleared, leading to inconsistency in the loans map.
- **Solution**: Added code to remove all loans associated with a member when they are removed. The removal process now iterates through the loans map and removes entries linked to the member.

Bug #002: No Input Validation for Fine Amounts

- **Severity**: Medium
- **Status**: Fixed
- **Description**: The system did not validate input for fine amounts, allowing non-numeric values to be processed, which resulted in exceptions.
- **Solution**: Added a try-catch block to handle non-numeric input during fine assignment. This ensures that only valid numeric values are accepted, improving user experience and system stability.

Bug #003: Book Status Not Updating Correctly in Browse View

- **Severity**: Low
- **Status**: Fixed
- **Description**: The status of books (available or borrowed) was not updating correctly in the browse view, leading to confusion for the user.
- **Solution**: Corrected the logic for displaying book availability status by ensuring that the loans map is checked accurately when rendering the list of books.

Library Management System Implementation and Documentation

1. Complete Implementation Code

Here's the full implementation of the Library Management System, complete with comprehensive documentation and comments.

```
package src;
import java.awt.*;
import java.util.ArrayList;
import java.util.HashMap;
import java.util.Map;
import javax.swing.*;
import javax.swing.border.*;

/**
 * LibraryManagementSystem - Main application class for the library management
system.
 * This system provides functionality for both library staff and members to manage
 * books, members, loans, and fines through a graphical user interface.
 */
public class LibraryManagementSystem {
    // Main application window
    private JFrame frame;

    // Layout manager for switching between panels
    private CardLayout cardLayout;

    // Main container panel that holds all other panels
    private JPanel mainPanel;

    // Data structures for library management
    private ArrayList<String> books;          // List of all books in the library
    private ArrayList<String> members;        // List of all library members
    private Map<String, String> loans;        // Map of books to members (current
loans)
    private Map<String, Double> fines;        // Map of members to their fine
amounts

    // Color scheme for the UI
    private final Color PRIMARY_COLOR = new Color(0, 102, 204);    // Main blue
color
    private final Color SECONDARY_COLOR = new Color(240, 240, 240); // Light gray
background
```

```
    private final Color ACCENT_COLOR = new Color(0, 153, 255);      // Light blue
accent
    private final Color CARD_COLOR = new Color(255, 255, 255);      // White card
background
    private final Color ERROR_COLOR = new Color(220, 53, 69);       // Red for
errors
    /**
     * Constructor initializes the application and its components.
     */
    public LibraryManagementSystem() {
        books = new ArrayList<>();
        members = new ArrayList<>();
        loans = new HashMap<>();
        fines = new HashMap<>();
        initialize();
    }
    /**
     * Initializes the application UI and sets up all components.
     */
    private void initialize() {
        configureLookAndFeel();
        createMainWindow();
        setupMainPanel();
        createPanels();
        displayWindow();
    }
    /**
     * Configures the system look and feel for a modern appearance.
     */
    private void configureLookAndFeel() {
        try {
            UIManager.setLookAndFeel(UIManager.getSystemLookAndFeelClassName());
            Font modernFont = new Font("Segoe UI", Font.PLAIN, 14);
            UIManager.put("Button.font", modernFont);
            UIManager.put("Label.font", modernFont);
            UIManager.put("TextField.font", modernFont);
            UIManager.put("TextArea.font", modernFont);
            UIManager.put("OptionPane.messageFont", modernFont);
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
    /**
     * Creates and configures the main application window.
     */
    private void createMainWindow() {
        frame = new JFrame("Library Management System");
        frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
```

```
        frame.setSize(900, 650);
        frame.setLocationRelativeTo(null);
    }
    /**
     * Sets up the main panel with card layout.
     */
    private void setupMainPanel() {
        cardLayout = new CardLayout();
        mainPanel = new JPanel(cardLayout);
        mainPanel.setBackground(SECONDARY_COLOR);
        mainPanel.setBorder(new EmptyBorder(20, 20, 20, 20));
        frame.add(mainPanel);
    }
    /**
     * Creates all the panels for the application.
     */
    private void createPanels() {
        createMainMenuPanel();
        createStaffPanel();
        createMemberPanel();
    }
    /**
     * Displays the main window.
     */
    private void displayWindow() {
        frame.setVisible(true);
    }
    /**
     * Creates the main menu panel with login options.
     */
    private void createMainMenuPanel() {
        JPanel mainMenuPanel = new JPanel(new GridBagLayout());
        mainMenuPanel.setBackground(SECONDARY_COLOR);

        GridBagConstraints gbc = new GridBagConstraints();
        gbc.gridwidth = GridBagConstraints.REMAINDER;
        gbc.fill = GridBagConstraints.HORIZONTAL;
        gbc.insets = new Insets(15, 0, 15, 0);
        gbc.weightx = 1;

        // Title label
        JLabel titleLabel = new JLabel("Library Management System",
SwingConstants.CENTER);
        titleLabel.setFont(new Font("Segoe UI", Font.BOLD, 28));
        titleLabel.setForeground(PRIMARY_COLOR);
        mainMenuPanel.add(titleLabel, gbc);

        // Staff login button
```

```
        JButton staffButton = createStyledButton("Staff Login", PRIMARY_COLOR);
        staffButton.setPreferredSize(new Dimension(250, 50));
        staffButton.addActionListener(e -> cardLayout.show(mainPanel, "StaffPanel"));
        mainMenuPanel.add(staffButton, gbc);

        // Member login button
        JButton memberButton = createStyledButton("Member Login", ACCENT_COLOR);
        memberButton.setPreferredSize(new Dimension(250, 50));
        memberButton.addActionListener(e -> cardLayout.show(mainPanel,
"MemberPanel"));
        mainMenuPanel.add(memberButton, gbc);

        mainPanel.add(mainMenuPanel, "MainMenu");
    }
    /**
     * Creates the staff panel with administrative functions.
     */
    private void createStaffPanel() {
        JPanel staffPanel = new JPanel();
        staffPanel.setLayout(new BoxLayout(staffPanel, BoxLayout.Y_AXIS));
        staffPanel.setBackground(SECONDARY_COLOR);
        staffPanel.setBorder(new EmptyBorder(20, 20, 20, 20));

        // Title
        JLabel titleLabel = new JLabel("Staff Dashboard", SwingConstants.CENTER);
        titleLabel.setFont(new Font("Segoe UI", Font.BOLD, 24));
        titleLabel.setForeground(PRIMARY_COLOR);
        titleLabel.setAlignmentX(Component.CENTER_ALIGNMENT);
        staffPanel.add(titleLabel);
        staffPanel.add(Box.createRigidArea(new Dimension(0, 20)));

        // Function cards
        staffPanel.add(createFunctionCard("Manage Books", e ->
showBookManagement()));
        staffPanel.add(Box.createRigidArea(new Dimension(0, 15)));
        staffPanel.add(createFunctionCard("Manage Members", e ->
showMemberManagement()));
        staffPanel.add(Box.createRigidArea(new Dimension(0, 15)));
        staffPanel.add(createFunctionCard("View All Loans", e -> viewAllLoans()));
        staffPanel.add(Box.createRigidArea(new Dimension(0, 15)));
        staffPanel.add(createFunctionCard("Assign Fine", e -> assignFine()));
        staffPanel.add(Box.createRigidArea(new Dimension(0, 25)));

        // Back button
        JButton backButton = createStyledButton("Back to Main Menu", Color.GRAY);
        backButton.setAlignmentX(Component.CENTER_ALIGNMENT);
        backButton.addActionListener(e -> cardLayout.show(mainPanel, "MainMenu"));
        staffPanel.add(backButton);
```

```
        mainPanel.add(staffPanel, "StaffPanel");
    }
    /**
     * Creates the member panel with member functions.
     */
    private void createMemberPanel() {
        JPanel memberPanel = new JPanel();
        memberPanel.setLayout(new BoxLayout(memberPanel, BoxLayout.Y_AXIS));
        memberPanel.setBackground(SECONDARY_COLOR);
        memberPanel.setBorder(new EmptyBorder(20, 20, 20, 20));

        // Title
        JLabel titleLabel = new JLabel("Member Dashboard", SwingConstants.CENTER);
        titleLabel.setFont(new Font("Segoe UI", Font.BOLD, 24));
        titleLabel.setForeground(PRIMARY_COLOR);
        titleLabel.setAlignmentX(Component.CENTER_ALIGNMENT);
        memberPanel.add(titleLabel);
        memberPanel.add(Box.createRigidArea(new Dimension(0, 20)));

        // Function cards
        memberPanel.add(createFunctionCard("Browse Books", e -> browseBooks()));
        memberPanel.add(Box.createRigidArea(new Dimension(0, 15)));
        memberPanel.add(createFunctionCard("Search Books", e -> searchBooks()));
        memberPanel.add(Box.createRigidArea(new Dimension(0, 15)));
        memberPanel.add(createFunctionCard("Borrow Book", e -> borrowBook()));
        memberPanel.add(Box.createRigidArea(new Dimension(0, 15)));
        memberPanel.add(createFunctionCard("Return Book", e -> returnBook()));
        memberPanel.add(Box.createRigidArea(new Dimension(0, 15)));
        memberPanel.add(createFunctionCard("Pay Fine", e -> payFine()));
        memberPanel.add(Box.createRigidArea(new Dimension(0, 15)));
        memberPanel.add(createFunctionCard("View My Loans/Fines", e ->
viewMemberLoansAndFines()));
        memberPanel.add(Box.createRigidArea(new Dimension(0, 25)));

        // Back button
        JButton backButton = createStyledButton("Back to Main Menu", Color.GRAY);
        backButton.setAlignmentX(Component.CENTER_ALIGNMENT);
        backButton.addActionListener(e -> cardLayout.show(mainPanel, "MainMenu"));
        memberPanel.add(backButton);

        mainPanel.add(memberPanel, "MemberPanel");
    }
    /**
     * Creates a styled function card for the dashboard.
     * @param title The title of the function
     * @param action The action to perform when clicked
     * @return A JPanel representing the function card
```

```
     */
    private JPanel createFunctionCard(String title, java.awt.event.ActionListener
action) {
        JPanel card = new JPanel();
        card.setLayout(new BorderLayout());
        card.setBackground(CARD_COLOR);
        card.setBorder(new CompoundBorder(
            new LineBorder(new Color(230, 230, 230), 1),
            new EmptyBorder(15, 20, 15, 20)
        ));
        card.setMaximumSize(new Dimension(500, 60));

        JButton button = new JButton(title);
        button.setFont(new Font("Segoe UI", Font.PLAIN, 16));
        button.setBackground(CARD_COLOR);
        button.setForeground(Color.BLACK);
        button.setBorderPainted(false);
        button.setFocusPainted(false);
        button.setContentAreaFilled(false);
        button.setHorizontalAlignment(SwingConstants.LEFT);
        button.addActionListener(action);

        card.add(button, BorderLayout.CENTER);
        return card;
    }
    /**
     * Creates a styled button with consistent appearance.
     * @param text The button text
     * @param bgColor The background color
     * @return A configured JButton
     */
    private JButton createStyledButton(String text, Color bgColor) {
        JButton button = new JButton(text);
        button.setFont(new Font("Segoe UI", Font.BOLD, 16));
        button.setBackground(bgColor);
        button.setForeground(Color.WHITE);
        button.setFocusPainted(false);
        button.setBorderPainted(false);
        button.setOpaque(true);
        button.setBorder(new RoundBorder(10));
        button.setCursor(new Cursor(Cursor.HAND_CURSOR));

        // Hover effect
        button.addMouseListener(new java.awt.event.MouseAdapter() {
            public void mouseEntered(java.awt.event.MouseEvent evt) {
                button.setBackground(bgColor.darker());
            }
            public void mouseExited(java.awt.event.MouseEvent evt) {
```

```
                button.setBackground(bgColor);
            }
        });

        return button;
    }
    // ================ STAFF FUNCTIONS ================ //
    /**
     * Shows the book management options panel.
     */
    private void showBookManagement() {
        JPanel panel = new JPanel(new GridLayout(4, 1, 10, 10));
        panel.setBorder(new EmptyBorder(20, 20, 20, 20));
        panel.setBackground(SECONDARY_COLOR);

        JButton addBookButton = createStyledButton("Add New Book", PRIMARY_COLOR);
        JButton removeBookButton = createStyledButton("Remove Book", PRIMARY_COLOR);
        JButton viewBooksButton = createStyledButton("View All Books",
PRIMARY_COLOR);
        JButton backButton = createStyledButton("Back to Staff Menu", Color.GRAY);
        addBookButton.addActionListener(e -> addBook());
        removeBookButton.addActionListener(e -> removeBook());
        viewBooksButton.addActionListener(e -> browseBooks());
        backButton.addActionListener(e -> cardLayout.show(mainPanel, "StaffPanel"));
        panel.add(addBookButton);
        panel.add(removeBookButton);
        panel.add(viewBooksButton);
        panel.add(backButton);
        showDialogPanel(panel, "Book Management");
    }
    /**
     * Shows the member management options panel.
     */
    private void showMemberManagement() {
        JPanel panel = new JPanel(new GridLayout(4, 1, 10, 10));
        panel.setBorder(new EmptyBorder(20, 20, 20, 20));
        panel.setBackground(SECONDARY_COLOR);

        JButton addMemberButton = createStyledButton("Add New Member",
PRIMARY_COLOR);
        JButton removeMemberButton = createStyledButton("Remove Member",
PRIMARY_COLOR);
        JButton viewMembersButton = createStyledButton("View All Members",
PRIMARY_COLOR);
        JButton backButton = createStyledButton("Back to Staff Menu", Color.GRAY);
        addMemberButton.addActionListener(e -> addMember());
        removeMemberButton.addActionListener(e -> removeMember());
        viewMembersButton.addActionListener(e -> viewMembers());
```

```
        backButton.addActionListener(e -> cardLayout.show(mainPanel, "StaffPanel"));
        panel.add(addMemberButton);
        panel.add(removeMemberButton);
        panel.add(viewMembersButton);
        panel.add(backButton);
        showDialogPanel(panel, "Member Management");
    }
    /**
     * Adds a new book to the library collection.
     */
    private void addBook() {
        String title = showInputDialog("Enter book title:");
        if (title != null && !title.trim().isEmpty()) {
            books.add(title);
            showMessageDialog("Book added successfully!");
        }
    }
    /**
     * Removes a book from the library collection.
     */
    private void removeBook() {
        String title = showInputDialog("Enter book title to remove:");
        if (title != null && !title.trim().isEmpty()) {
            if (books.remove(title)) {
                loans.remove(title);
                showMessageDialog("Book removed successfully!");
            } else {
                showErrorDialog("Book not found!");
            }
        }
    }
    /**
     * Adds a new member to the library system.
     */
    private void addMember() {
        String name = showInputDialog("Enter member name:");
        if (name != null && !name.trim().isEmpty()) {
            members.add(name);
            showMessageDialog("Member added successfully!");
        }
    }
    /**
     * Removes a member from the library system.
     */
    private void removeMember() {
        String name = showInputDialog("Enter member name to remove:");
        if (name != null && !name.trim().isEmpty()) {
            if (members.remove(name)) {
```

```
                fines.remove(name);
                // Remove all loans associated with this member
                loans.entrySet().removeIf(entry -> entry.getValue().equals(name));
                showMessageDialog("Member removed successfully!");
            } else {
                showErrorDialog("Member not found!");
            }
        }
    }
    /**
     * Displays all registered members and their fines.
     */
    private void viewMembers() {
        StringBuilder sb = new StringBuilder("<html><h2>Registered Members</h2>");
        if (members.isEmpty()) {
            sb.append("<p>No members registered.</p>");
        } else {
            sb.append("<table border='0'
cellpadding='5'><tr><th>Name</th><th>Fines</th></tr>");
            for (String member : members) {
                sb.append("<tr><td>").append(member).append("</td><td>");
                if (fines.containsKey(member)) {
                    sb.append("$").append(String.format("%.2f", fines.get(member)));
                } else {
                    sb.append("None");
                }
                sb.append("</td></tr>");
            }
            sb.append("</table>");
        }
        sb.append("</html>");
        showMessageDialog(sb.toString());
    }
    /**
     * Displays all current loans in the system.
     */
    private void viewAllLoans() {
        StringBuilder sb = new StringBuilder("<html><h2>Current Loans</h2>");
        if (loans.isEmpty()) {
            sb.append("<p>No active loans.</p>");
        } else {
            sb.append("<table border='0'
cellpadding='5'><tr><th>Book</th><th>Borrowed by</th></tr>");
            for (Map.Entry<String, String> entry : loans.entrySet()) {
                sb.append("<tr><td>").append(entry.getKey())
                  .append("</td><td>").append(entry.getValue()).append("</td></tr>");
            }
            sb.append("</table>");
```

```
        }
        sb.append("</html>");
        showMessageDialog(sb.toString());
    }
    /**
     * Assigns a fine to a member.
     */
    private void assignFine() {
        String member = showInputDialog("Enter member name:");
        if (member != null && !member.trim().isEmpty()) {
            if (members.contains(member)) {
                String amountStr = showInputDialog("Enter fine amount:");
                try {
                    double amount = Double.parseDouble(amountStr);
                    fines.put(member, fines.getOrDefault(member, 0.0) + amount);
                    showMessageDialog("Fine assigned successfully!");
                } catch (NumberFormatException e) {
                    showErrorDialog("Invalid amount!");
                }
            } else {
                showErrorDialog("Member not found!");
            }
        }
    }
    // ================= MEMBER FUNCTIONS ================= //
    /**
     * Displays all available books and their status.
     */
    private void browseBooks() {
        StringBuilder sb = new StringBuilder("<html><h2>Available Books</h2>");
        if (books.isEmpty()) {
            sb.append("<p>No books available.</p>");
        } else {
            sb.append("<table border='0'
cellpadding='5'><tr><th>Title</th><th>Status</th></tr>");
            for (String book : books) {
                sb.append("<tr><td>").append(book).append("</td><td>");
                if (loans.containsKey(book)) {
                    sb.append("<font color='red'>Borrowed</font>");
                } else {
                    sb.append("<font color='green'>Available</font>");
                }
                sb.append("</td></tr>");
            }
            sb.append("</table>");
        }
        sb.append("</html>");
        showMessageDialog(sb.toString());
```

```
    }
    /**
     * Searches for books matching a query.
     */
    private void searchBooks() {
        String query = showInputDialog("Enter book title to search:");
        if (query != null && !query.trim().isEmpty()) {
            StringBuilder sb = new StringBuilder("<html><h2>Search Results</h2>");
            boolean found = false;
            sb.append("<table border='0'
cellpadding='5'><tr><th>Title</th><th>Status</th></tr>");
            for (String book : books) {
                if (book.toLowerCase().contains(query.toLowerCase())) {
                    sb.append("<tr><td>").append(book).append("</td><td>");
                    if (loans.containsKey(book)) {
                        sb.append("<font color='red'>Borrowed</font>");
                    } else {
                        sb.append("<font color='green'>Available</font>");
                    }
                    sb.append("</td></tr>");
                    found = true;
                }
            }
            sb.append("</table>");
            if (!found) {
                sb.append("<p>No books found matching
'").append(query).append("'</p>");
            }
            sb.append("</html>");
            showMessageDialog(sb.toString());
        }
    }
    /**
     * Allows a member to borrow a book.
     */
    private void borrowBook() {
        String member = showInputDialog("Enter your name:");
        if (member != null && !member.trim().isEmpty()) {
            if (members.contains(member)) {
                String book = showInputDialog("Enter book title:");
                if (book != null && !book.trim().isEmpty()) {
                    if (books.contains(book)) {
                        if (!loans.containsKey(book)) {
                            loans.put(book, member);
                            showMessageDialog("Book borrowed successfully!");
                        } else {
                            showErrorDialog("Book is already borrowed!");
                        }
```

```
                    } else {
                        showErrorDialog("Book not found!");
                    }
                }
            } else {
                showErrorDialog("Member not found!");
            }
        }
    }
    /**
     * Allows a member to return a book.
     */
    private void returnBook() {
        String book = showInputDialog("Enter book title to return:");
        if (book != null && !book.trim().isEmpty()) {
            if (loans.containsKey(book)) {
                loans.remove(book);
                showMessageDialog("Book returned successfully!");
            } else {
                showErrorDialog("This book wasn't borrowed or doesn't exist!");
            }
        }
    }
    /**
     * Allows a member to pay fines.
     */
    private void payFine() {
        String member = showInputDialog("Enter your name:");
        if (member != null && !member.trim().isEmpty()) {
            if (fines.containsKey(member)) {
                double amount = fines.get(member);
                showMessageDialog("Your current fine is: $" + String.format("%.2f",
amount));
                String paymentStr = showInputDialog("Enter payment amount:");
                try {
                    double payment = Double.parseDouble(paymentStr);
                    if (payment >= amount) {
                        fines.remove(member);
                        showMessageDialog("Fine paid in full. Thank you!");
                    } else {
                        fines.put(member, amount - payment);
                        showMessageDialog("Partial payment received. Remaining
balance: $" +
                                String.format("%.2f", (amount - payment)));
                    }
                } catch (NumberFormatException e) {
                    showErrorDialog("Invalid payment amount!");
                }
```

```
            } else {
                showMessageDialog("No fines found for this member.");
            }
        }
    }
    /**
     * Displays a member's loans and fines.
     */
    private void viewMemberLoansAndFines() {
        String member = showInputDialog("Enter your name:");
        if (member != null && !member.trim().isEmpty()) {
            StringBuilder sb = new StringBuilder();
            sb.append("<html><h2>Your Account Summary</h2>");

            if (fines.containsKey(member)) {
                sb.append("<p><b>Outstanding Fines:</b>
$").append(String.format("%.2f", fines.get(member))).append("</p>");
            } else {
                sb.append("<p>You have no outstanding fines.</p>");
            }

            sb.append("<h3>Books Currently Borrowed:</h3><ul>");
            boolean hasLoans = false;
            for (Map.Entry<String, String> entry : loans.entrySet()) {
                if (entry.getValue().equals(member)) {
                    sb.append("<li>").append(entry.getKey()).append("</li>");
                    hasLoans = true;
                }
            }
            if (!hasLoans) {
                sb.append("<li>You have no books currently borrowed.</li>");
            }
            sb.append("</ul></html>");

            showMessageDialog(sb.toString());
        }
    }
    // ================= HELPER METHODS ================= //
    /**
     * Shows an input dialog with formatted message.
     * @param message The message to display
     * @return User input or null if canceled
     */
    private String showInputDialog(String message) {
        return JOptionPane.showInputDialog(frame,
            "<html><div style='width:300px;'>" + message + "</div></html>");
    }
    /**
```

```
     * Shows a message dialog with formatted message.
     * @param message The message to display
     */
    private void showMessageDialog(String message) {
        JOptionPane.showMessageDialog(frame,
            "<html><div style='width:300px;'>" + message + "</div></html>",
            "Information", JOptionPane.INFORMATION_MESSAGE);
    }
    /**
     * Shows an error dialog with formatted message.
     * @param message The error message to display
     */
    private void showErrorDialog(String message) {
        JOptionPane.showMessageDialog(frame,
            "<html><div style='width:300px;color:red;'>" + message + "</div></html>"
            "Error", JOptionPane.ERROR_MESSAGE);
    }
    /**
     * Shows a custom panel in a dialog.
     * @param panel The panel to display
     * @param title The dialog title
     */
    private void showDialogPanel(JPanel panel, String title) {
        JDialog dialog = new JDialog(frame, title, true);
        dialog.setContentPane(panel);
        dialog.setSize(400, 300);
        dialog.setLocationRelativeTo(frame);
        dialog.setVisible(true);
    }
    /**
     * Custom border class for rounded corners.
     */
    class RoundBorder extends AbstractBorder {
        private Color color;
        private int radius;

        public RoundBorder(int radius) {
            this(Color.GRAY, radius);
        }

        public RoundBorder(Color color, int radius) {
            this.color = color;
            this.radius = radius;
        }

        @Override
        public void paintBorder(Component c, Graphics g, int x, int y, int width,
int height) {
```

```
            Graphics2D g2 = (Graphics2D) g.create();
            g2.setRenderingHint(RenderingHints.KEY_ANTIALIASING,
RenderingHints.VALUE_ANTIALIAS_ON);
            g2.setColor(color);
            g2.drawRoundRect(x, y, width - 1, height - 1, radius, radius);
            g2.dispose();
        }

        @Override
        public Insets getBorderInsets(Component c) {
            return new Insets(radius + 1, radius + 1, radius + 1, radius + 1);
        }

        @Override
        public Insets getBorderInsets(Component c, Insets insets) {
            insets.left = insets.right = radius + 1;
            insets.top = insets.bottom = radius + 1;
            return insets;
        }
    }
    /**
     * Main method to launch the application.
     * @param args Command line arguments (not used)
     */
    public static void main(String[] args) {
        SwingUtilities.invokeLater(() -> new LibraryManagementSystem());
    }
}
```