

CAB301 ALGORITHMS AND COMPLEXITY
Assignment 3

Development of a Community Library Movie DVDs Management Software

Group 22

Team Member	Student Number
Dulce Acevedo	N10370021
Anthony Nguyen	N10625119
Rodo Nguyen	N10603280

Table of contents

Table of contents	2
1. Introduction	3
2. Design and Analysis of an algorithm	4
2.1 Pseudocode (Task B)	4
2.2 Theoretical Analysis	4
2.3 Empirical Analysis	5
3. Software Test Plan and Test Results	7
3.1 Test Plan	7
3.2 Test Results	8
3.2.1 Main Menu	8
a) Staff Login Menu	9
b) Member Login Menu	11
3.2.2 Staff Menu	13
Menu Option 0	14
Menu Option 1	14
Menu Option 2	19
Menu Option 3	21
Menu Option 4	24
Menu Option 5	25
Menu Option 6	26
3.2.3 Member Menu	28
Menu Option 0	29
Menu Option 1	30
Menu Option 2	31
Menu Option 3	32
Menu Option 4	34
Menu Option 5	35
Menu Option 6	36

1. Introduction

The goal of this project is to develop of a community library movie DVDs management software. This consists of designing effective algorithms to manage the library's members, movies, and DVDs, and creating a console-based user interface to easily interact with.

In addition, an algorithm that gets the three greatest items from an array is requested. So, we have designed, analysed its efficiency by using empirical analysis approach and implemented it in the software as well.

The project has been split into three different parts, part one is about creating our objects for members, a way to store our members in a collection and methods to be able to interact with the member collection such as adding, removing, and listing information about a member in the member collection.

In part two, we created movie objects, movie collections and methods to be able to interact with the movie collection while using previous methods from part one.

And in part three, we combine both parts into a usable GUI and add further logics to the existing code to make a complete movie DVDs management software.

2. Design and Analysis of an algorithm

2.1 Pseudocode (Task B)

```
ALGORITHM ThreeLargestElements(A[0...n-1])  
// Input: Array A[0..n-1] of n integers that are greater than or equal to 0  
// T: an array used to store three largest elements  
// Returns the array T containing the three largest elements in array A  
// in descending order  
  
T = {-1, -1, -1}  
for i ← 0 to n - 1 do  
    if i > T[0]  
        T[2] = T[1]  
        T[1] = T[0]  
        T[0] = i  
    else if i > T[1]  
        T[2] = T[1]  
        T[1] = i  
    else if i > T[2]  
        T[2] = i  
return T
```

2.2 Theoretical Analysis

The parameter characterising the size of the problem is determined by the length n of array A . The basic operation is the comparison between an element in A with an element in T . A basic operation occurs in three places in the algorithm: $i > T[0]$, $i > T[1]$, $i > T[2]$. A different number of basic operations will occur depending on the elements of the array and its position.

In the worst-case scenario, the elements in array A are in descending order and they are all greater than or equal to 0. In this case, the first iteration will go through only the first basic operation. The second iteration will go through the first 2 basic operations. The rest of the iterations will reach all 3 basic operations. Thus, we have:

$$\begin{aligned} C_{\text{worst}}(n) &= \left(\sum_{i=0}^{n-1} 3 \right) - 3 \\ &= \left(3 \sum_{i=0}^{n-1} 1 \right) - 3 \\ &= 3(n - 1 - 0 + 1) - 3 \\ &= 3n - 3 \\ &\in O(n) \end{aligned}$$

The efficiency of this algorithm is $O(n)$.

2.3 Empirical Analysis

An empirical analysis is performed with the purpose of finding the time efficiency of the algorithm by analysing its worst case and checking the accuracy of our initial theoretical assertion about the efficiency.

The basic operation identified is the comparison between an element in A with an element in T. A basic operation occurs in three places in the algorithm: $i > T[0]$, $i > T[1]$, $i > T[2]$. A different number of basic operations will occur depending on the elements of the array and its position.

The efficiency metric used is the number of times the algorithm's basic operation is executed. Thus, the program increases 'count' by 1 every time the identified basic operation is executed.

The input is a randomly generated array of descending integers, none of which is less than 0. The sizes of the array are 1000, 2000, 3000, ..., 20000; so, there are 20 runs in total. The experiment involves running a program in C#. Below is the function to generate our array:

```
1 reference
public static int[] GenerateRandomArray(int size)
{
    int[] A = new int[size];

    int seed = (int)DateTime.Now.Ticks;
    Random rnd = new Random(seed);

    for (int i = 0; i < A.Length; i++)
        A[i] = rnd.Next(Int32.MaxValue);

    Array.Sort(A);
    Array.Reverse(A);
    return A;
}
```

The results of our test are:

Size	Basic operation count
1000	2997
2000	5997
3000	8997
4000	11997
5000	14997
6000	17997
7000	20997
8000	23997
9000	26997
10000	29997
11000	32997
12000	35997
13000	38997

14000	41997
15000	44997
16000	47997
17000	50997
18000	53997
19000	56997
20000	59997

Let the efficiency function $t(n) = cg(n)$, where c is a constant and $g(n)$ is a simple function. Firstly, we calculate the ratio of $t(2n)$ and $t(n)$ using the above experimental results:

$$\frac{t(8000)}{t(4000)} = \frac{23997}{11997} \approx 2 \quad (1)$$

Therefore, we have:

$$g(n) = n$$

Because $\frac{t(2n)}{t(n)} = \frac{c2n}{cn} = 2$, which is exactly what we have in (1)

So, the efficiency function $t(n) = cn$ belongs to $O(n)$. This shows that our initial assertion about the algorithm efficiency in section 2.2 Theoretical Analysis is accurate.

3. Software Test Plan and Test Results

3.1 Test Plan

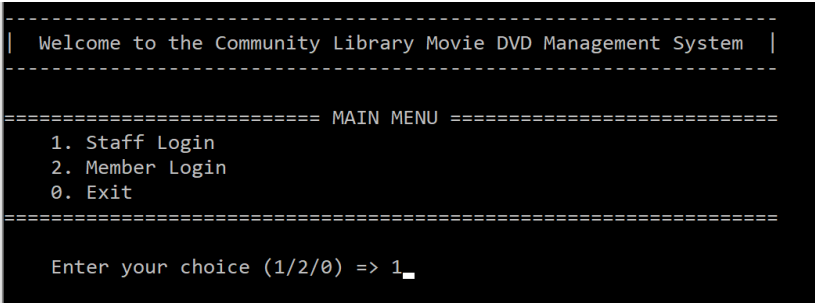
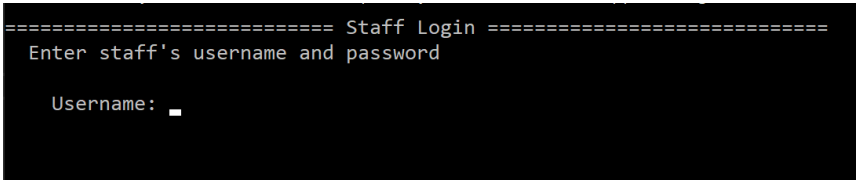
Menu	Menu Option	Functionality to Test
Main Menu		<ul style="list-style-type: none">Choose an action
Staff Login Sub-Menu		<ul style="list-style-type: none">Login as staff
Member Login Sub-Menu		<ul style="list-style-type: none">Login as member
Staff Menu		<ul style="list-style-type: none">Choose an action
	0	<ul style="list-style-type: none">Return to the main menu
	1	<ul style="list-style-type: none">Add a new movie if a new DVD movie is not in the system.Add DVDs to a movie that already exists
	2	<ul style="list-style-type: none">Remove a number of DVD copies from a movie that is less than the number of copies available.Delete the movie from the system if all the copies are deleted.
	3	<ul style="list-style-type: none">Register a new member
	4	<ul style="list-style-type: none">Remove a registered member from the system
	5	<ul style="list-style-type: none">Display a member's contact phone number, given the member's name
	6	<ul style="list-style-type: none">Display all members who are currently renting a particular movie
Member Menu		<ul style="list-style-type: none">Choose an action
	0	<ul style="list-style-type: none">Return to the main menu
	1	<ul style="list-style-type: none">Display information about all movie DVDs in the library in alphabetical order, including the number of the movie DVDs currently available.
	2	<ul style="list-style-type: none">Display all the information about a movie, given the movie's title
	3	<ul style="list-style-type: none">Borrow a movie DVD
	4	<ul style="list-style-type: none">Return a movie DVD
	5	<ul style="list-style-type: none">Display List current movies that are currently borrowed by the registered member
	6	<ul style="list-style-type: none">Display the top three (3) most frequently borrowed movies by members in the descending order of their frequency. The display

		should include the title of the movie and frequency (the number of times that the movie has been borrowed by registered members by now)
--	--	---

3.2 Test Results

3.2.1 Main Menu

Functionality Under Test: Choose Action

Test	Enter a valid input
Test Data	<ul style="list-style-type: none"> Input: 1 (the same for 0 and 2)  <pre> Welcome to the Community Library Movie DVD Management System ----- ===== MAIN MENU ===== 1. Staff Login 2. Member Login 0. Exit ===== Enter your choice (1/2/0) => 1_ </pre>
Expected Result	The Staff Login Menu appears
Actual Result	 <pre> ===== Staff Login ===== Enter staff's username and password Username: _ </pre>
Test Passed	

Test	Enter an invalid input (an integer)
Test Data	<ul style="list-style-type: none"> Input: 4
Expected Result	No action is selected. Warning Message is displayed. Refresh the menu.

Actual Result	<pre> ----- Invalid choice (4): Your choice must be an integer from 0 to 2! ----- Welcome to the Community Library Movie DVD Management System ----- ===== MAIN MENU ===== 1. Staff Login 2. Member Login 0. Exit ===== Enter your choice (1/2/0) => </pre>
Test Passed	

Test	Enter an invalid input (string)
Test Data	<ul style="list-style-type: none"> Input: "\n"
Expected Result	No action is selected. Warning Message is displayed. Refresh the menu.
Actual Result	<pre> ----- Invalid choice (\n): Your choice must be an integer from 0 to 2! ----- Welcome to the Community Library Movie DVD Management System ----- ===== MAIN MENU ===== 1. Staff Login 2. Member Login 0. Exit ===== Enter your choice (1/2/0) => </pre>
Test Passed	

a) Staff Login Menu

Functionality Under Test: Login as staff

Test	Enter correct Password and Username
Test Data	<ul style="list-style-type: none"> Username: staff Password: today123 <pre> ===== Staff Login ===== Enter staff's username and password Username: staff Password: today123 </pre>

Expected Result	The Staff Menu appears
Actual Result	<pre> ===== Staff Menu ===== 1. Add new DVDs of a new movie to the system 2. Remove DVDs of a movie from the system 3. Register a new member with the system 4. Remove a registered member from the system 5. Display a member's contact phone number, given the member's name 6. Display all members who are currently renting a particular movie 0. Return to the main menu ===== Enter your choice (1/2/3/4/5/6/0) => _ </pre>
Test Passed	

Test	Enter wrong Password
Test Data	<ul style="list-style-type: none"> • Username: staff • Password: today <pre> ===== Staff Login ===== Enter staff's username and password Username: staff Password: today </pre>
Expected Result	Login is unsuccessful. A warning message is displayed. The login form is refreshed.
Actual Result	<pre> ----- Incorrect login details! Please try again. ----- ===== Staff Login ===== Enter staff's username and password Username: staff Password: today </pre>
Test Passed	

Test	Unsuccessful Login: Wrong Username
Test Data	<ul style="list-style-type: none"> • Username: STAFF • Password: today
Expected Result	Login is unsuccessful. A warning message is displayed. The login form is refreshed.

Actual Result	<pre> ===== Staff Login ===== Incorrect login details! Please try again. ===== ===== Staff Login ===== Enter staff's username and password Username: </pre>
Test Passed	

b) Member Login Menu

Functionality Under Test: Login as member

Test	Enter correct password and names of a register member
Test Data	<ul style="list-style-type: none"> First name: Anthony Last Name: Nguyen Password: 1234 <pre> ===== Member Login ===== Enter your member's first name, last name and password First name: Anthony Last name: Nguyen Password: 1234_ </pre>
Expected Result	The Member menu appears.
Actual Result	<pre> ===== Member Menu ===== 1. Browse all the movies 2. Display all the information about a movie, given the movie's title 3. Borrow a movie DVD 4. Return a movie DVD 5. List current borrowing movies 6. Display the top 3 movies rented by the members 0. Return to the main menu ===== Enter your choice (1/2/3/4/5/6/0) => </pre>
Test Passed	

Test	Enter an incorrect Password
Test Data	<ul style="list-style-type: none"> First name: Anthony Last Name: Nguyen Password: 123 <pre> ===== Member Login ===== Enter your member's first name, last name and password First name: Anthony Last name: Nguyen Password: 123 </pre>

Expected Result	Login is unsuccessful. Warning Message is displayed. The login form is refreshed.
Actual Result	<pre> ----- Incorrect login details! Please try again. ----- ===== Member Login ===== Enter your member's first name, last name and password First name: _ </pre>
Test Passed	

Test	Enter an incorrect First Name
Test Data	<ul style="list-style-type: none"> • First name: Anthonyyyy • Last Name: Nguyen • Password: 123
Expected Result	Login is unsuccessful. Warning Message is displayed. The login form is refreshed.
Actual Result	<pre> ----- Incorrect login details! Please try again. ----- ===== Member Login ===== Enter your member's first name, last name and password First name: _ </pre>
Test Passed	

Test	Enter an incorrect Last Name
Test Data	<ul style="list-style-type: none"> • First name: Anthony • Last Name: Nguyennnnnn • Password: 123
Expected Result	Login is unsuccessful. Warning Message is displayed. The login form is refreshed.
Actual Result	<pre> ----- Incorrect login details! Please try again. ----- ===== Member Login ===== Enter your member's first name, last name and password First name: _ </pre>
Test Passed	

3.2.2 Staff Menu

Functionality Under Test: Choose Action

Test	Enter a valid choice (integers from 0 to 6)
Test Data	<ul style="list-style-type: none">Choice: 1 <pre>===== Staff Menu ===== 1. Add new DVDs of a new movie to the system 2. Remove DVDs of a movie from the system 3. Register a new member with the system 4. Remove a registered member from the system 5. Display a member's contact phone number, given the member's name 6. Display all members who are currently renting a particular movie 0. Return to the main menu ===== Enter your choice (1/2/3/4/5/6/0) => 1</pre>
Expected Result	An according form appears. In this test case, “Add new DVDs” form appears
Actual Result	<pre>===== Add New Movie DVDs ===== Enter the movie title => _</pre>
Test Passed	

Test	Enter an invalid choice (an integer)
Test Data	<ul style="list-style-type: none">Choice: 7 <pre>===== Staff Menu ===== 1. Add new DVDs of a new movie to the system 2. Remove DVDs of a movie from the system 3. Register a new member with the system 4. Remove a registered member from the system 5. Display a member's contact phone number, given the member's name 6. Display all members who are currently renting a particular movie 0. Return to the main menu ===== Enter your choice (1/2/3/4/5/6/0) => 7_</pre>
Expected Result	No menu option was selected. Warning message is displayed. The form is refreshed.

Actual Result	<pre> ----- Invalid choice (7). Must be an integer from 0 to 6! ----- ===== Staff Menu ===== 1. Add new DVDs of a new movie to the system 2. Remove DVDs of a movie from the system 3. Register a new member with the system 4. Remove a registered member from the system 5. Display a member's contact phone number, given the member's name 6. Display all members who are currently renting a particular movie 0. Return to the main menu ===== Enter your choice (1/2/3/4/5/6/0) => </pre>
Test Passed	

Menu Option 0

Functionality Under Test: Return to menu

Test	Return to main menu
Test Data	<ul style="list-style-type: none"> Choice: 0 <pre> ===== Staff Menu ===== 1. Add new DVDs of a new movie to the system 2. Remove DVDs of a movie from the system 3. Register a new member with the system 4. Remove a registered member from the system 5. Display a member's contact phone number, given the member's name 6. Display all members who are currently renting a particular movie 0. Return to the main menu ===== Enter your choice (1/2/3/4/5/6/0) => 0 </pre>
Expected Result	The main menu is displayed
Actual Result	<pre> ----- Welcome to the Community Library Movie DVD Management System ----- ===== MAIN MENU ===== 1. Staff Login 2. Member Login 0. Exit ===== Enter your choice (1/2/0) => _ </pre>
Test Passed	

Menu Option 1

Functionality Under Test: Add a new movie if a new DVD movie is not in the system.

Test	Add a new movie with valid information to the system.
Test Data	<ul style="list-style-type: none"> Title: Movie A

	<ul style="list-style-type: none"> • Genre: 1 • Classification: 2 • Duration: 100 • Copies: 8
Expected Result	Movie is added. Successful message will be displayed.
Actual Result	<pre> ===== Add New Movie DVDs ===== Enter the movie title => Movie A You are adding a new movie! Please add a few more details about this movie ----- Select the movie genre: 1. Action 2. Comedy 3. History 4. Drama 5. Western Enter your choice (1/2/3/4/5) => 1 ----- Select the movie classification: 1. G 2. PG 3. M 4. M15Plus Enter your choice (1/2/3/4) => 2 ----- Enter movie duration => 100 ----- Enter the number of copies => 8 The movie (Movie A) was added to the database! ===== Press enter to return to staff menu... </pre>
Test Passed	

Test	Enter an invalid genre choice (not a number between 1-5, other string)
Test Data	<ul style="list-style-type: none"> • Title: Hi • Genre: 6, 13i
Expected Result	Warning message is displayed. User will be asked to re-enter their choice of movie genre.

Actual Result	<pre> ===== Add New Movie DVDs ===== Enter the movie title => Hi You are adding a new movie! Please add a few more details about this movie ----- Select the movie genre: 1. Action 2. Comedy 3. History 4. Drama 5. Western Enter your choice (1/2/3/4/5) => 6 !!!! Invalid choice (6): Your choice must be an integer from 1 to 5! Re-enter your choice (1/2/3/4/5) => 13i !!!! Invalid choice (13i): Your choice must be an integer from 1 to 5! Re-enter your choice (1/2/3/4/5) => </pre>
Test Passed	

Test	Enter an invalid movie classification choice (not a number between 1 and 4, other string)
Test Data	<ul style="list-style-type: none"> • Title: Movie B • Genre: 4 • Classification: 5, PG
Expected Result	Warning message is displayed. User will be asked to re-enter their movie classification choice.
Actual Result	<pre> ----- Select the movie classification: 1. G 2. PG 3. M 4. M15Plus Enter your choice (1/2/3/4) => 5 !!!! Invalid choice (5). Must enter an integer from 1 to 4! Re-enter your choice (1/2/3/4) => PG !!!! Invalid choice (PG). Must enter an integer from 1 to 4! Re-enter your choice (1/2/3/4) => </pre>
Test Passed	

Test	Enter invalid input for movie duration (integer that <= 0, a string).
Test Data	<ul style="list-style-type: none"> Title: Movie B Genre: 4 Classification: 3 Duration: 0, -99, hello
Expected Result	Warning message is displayed. User will be asked to re-enter the movie duration.
Actual Result	<pre> Select the movie genre: 1. Action 2. Comedy 3. History 4. Drama 5. Western Enter your choice (1/2/3/4/5) => 2 ----- Select the movie classification: 1. G 2. PG 3. M 4. M15Plus Enter your choice (1/2/3/4) => 3 ----- Enter movie duration => 0 !!!! Invalid duration (0). Please enter a positive integer. Re-enter duration => -99 !!!! Invalid duration (-99). Please enter a positive integer. Re-enter duration => hello !!!! Invalid duration (hello). Please enter a positive integer. Re-enter duration => </pre>
Test Passed	

Test	Enter invalid input for number of copies (integer that <= 0, a string)
Test Data	<ul style="list-style-type: none"> Title: Movie B Genre: 4 Classification: 3 Duration: 120 Copies: abc, -1, 0
Expected Result	Warning message is displayed. User will be asked to re-enter the number of copies.

Actual Result	<pre> ----- Enter movie duration => 120 ----- Enter the number of copies => abc !!!! Invalid number of copies (abc). Please enter a positive integer. Re-enter the number of copies => -1 !!!! Invalid number of copies (-1). Please enter a positive integer. Re-enter the number of copies => 0 !!!! Invalid number of copies (0). Please enter a positive integer. Re-enter the number of copies => </pre>
Test Passed	

Functionality Under Test: Add DVDs to a movie that already exists

Test	Enter a valid input for the number of addition DVDs copies
Test Data	<ul style="list-style-type: none"> Title: Movie 1 (with current number of copies: 2) Number of DVDs to add: 3
Expected Result	The new total number of DVD copies (5) is displayed.
Actual Result	<pre> ===== Add New Movie DVDs ===== Enter the movie title => Movie 1 ----- Enter the number of new DVDs to add => 3 The number of DVDs is updated (Total copies: 5). ===== Press enter to return to staff menu... </pre>
Test Passed	

Test	Enter invalid input for the number of DVDs to add (integer that <= 0, a string)
Test Data	<ul style="list-style-type: none"> Title: Movie 1 Total copies: 1 Number of DVDs to add: abc, -2, 0
Expected Result	Warning message is displayed. User will be asked to re-enter the number of copies.

Actual Result	<pre> ===== Add New Movie DVDs ===== Enter the movie title => Movie 1 ----- Enter the number of new DVDs to add => abc !!!! Invalid number of copies (abc). Please enter a positive integer. Re-enter the number of copies => -2 !!!! Invalid number of copies (-2). Please enter a positive integer. Re-enter the number of copies => 0 !!!! Invalid number of copies (0). Please enter a positive integer. Re-enter the number of copies => </pre>
Test Passed	

Menu Option 2

Functionality Under Test: Remove a number of DVD copies from a movie

Test	Enter a number less than the number of DVDs available was removed.
Test Data	<ul style="list-style-type: none"> Title: Movie 4 (total copies: 3, available copies: 3) Number of DVDs to delete: 2
Expected Result	DVD copies of the movie is successfully removed.
Actual Result	<pre> ===== Remove DVD ===== Enter the movie title => Movie 4 ----- Enter the number of DVD copies to remove => 2 2 DVD copy/ies of the movie are removed. ===== Press Enter to return to staff menu..._ </pre>
Test Passed	

Test	Enter an invalid input for the number of DVD copies to be removed (integer <= 0 or greater than the number of available DVDs, string)
------	---

Test Data	<ul style="list-style-type: none"> Title: Movie 1 (total copies: 10, available copies: 10) Number of DVDs to delete: -3, ninety-nine, 99
Expected Result	Warning message is displayed. User will be asked to re-enter their input. The form is stopped if a positive integer is entered and a message notifying successful/unsuccessful action.
Actual Result	<pre> ===== Remove DVD ===== Enter the movie title => Movie 1 ----- Enter the number of DVD copies to remove => -3 !!!! Invalid number of copies (-3). Please enter a positive integer. Re-enter the number of copies => ninety-nine !!!! Invalid number of copies (ninety-nine). Please enter a positive integer. Re-enter the number of copies => 99 Cannot remove 99 DVD copy/ies of the movie. There is not enough copies available to remove. ===== Press Enter to return to staff menu... </pre>
Test Passed	

Test	Enter an existed Movie.
Test Data	<ul style="list-style-type: none"> Title: NOT A MOVIE
Expected Result	Warning message will display: "DVD copies of NOT A MOVIE cannot be deleted because that movie is not in the database".
Actual Result	<pre> ===== Remove DVD ===== Enter the movie title => NOT A MOVIE DVD copies of NOT A MOVIE cannot be deleted because that movie is not in the database ===== Press Enter to return to staff menu... </pre>
Test Passed	

Functionality Under Test: Delete the movie from the system if all the copies are deleted.

Test	The movie is deleted when all of its DVD copies are not currently borrowed and are deleted.
Test Data	<ul style="list-style-type: none"> Title: Movie 2 (total copies: 2, available copies: 2) Number of DVDs to delete: 2
Expected Result	Movie successfully deleted
Actual Result	<pre> ===== Remove DVD ===== Enter the movie title => Movie 2 ----- Enter the number of DVD copies to remove => 2 All the DVD copies of Movie 2 are removed. The movie is deleted from the database ===== Press Enter to return to staff menu... </pre>
Test Passed	

Test	Unable to remove a movie if some of its DVDs are currently borrowed.
Test Data	<ul style="list-style-type: none"> Title: Movie 4 Total copies: 10 Available copies: 8 Number of DVDs to delete: 10
Expected Result	Movie was not deleted. Warning message will display.
Actual Result	<pre> ===== Remove DVD ===== Enter the movie title => Movie 4 ----- Enter the number of DVD copies to remove => 10 Cannot remove 10 DVD copy/ies of the movie. There is not enough available copies available to remove. </pre>
Test Passed	

Menu Option 3

Functionality Under Test: Register a new member

Test	Add a member with valid input information.
------	--

Test Data	<ul style="list-style-type: none"> • First Name: Tom • Last Name: Math • Phone Number: 0123123123 • Pin: 1231
Expected Result	Member is added to the database. The message “Member is successfully added” is displayed
Actual Result	<pre> ===== Add Member ===== Enter the member's first name => Tom ----- Enter the member's last name => Math ----- Enter the member's contact phone number => 0123123123 ----- Enter the member's PIN => 1231 ----- Member is added successfully! ===== Press Enter to return to staff menu... </pre>
Test Passed	

Test	Enter an invalid phone Number (phone number does not start with zero and not have 10 digits, phone number is not an integer)
Test Data	<ul style="list-style-type: none"> • First Name: Tim • Last Name: Lardy • Phone Number: 1234567891, 123, string
Expected Result	Phone number entered will not be accepted. Warning message is displayed. User will be asked to re-enter their phone number.

Actual Result	<pre> ===== Add Member ===== Enter the member's first name => Tim ----- Enter the member's last name => Lardy ----- Enter the member's contact phone number => 1234567891 !!!! Invalid input (1234567891). Please enter a valid phone number. Phone number => 123 !!!! Invalid input (123). Please enter a valid phone number. Phone number => string !!!! Invalid input (string). Please enter a valid phone number. Phone number => _ </pre>
Test Passed	

Test	Enter an invalid PIN. (Pin does not have a length of 4-6 digits, pin is not an integer)
Test Data	<ul style="list-style-type: none"> • First Name: Tim • Last Name: Lardy • Phone Number: 0123456789 • Pin: 1234567, 123, stringPIN
Expected Result	Pin entered will not be accepted. Warning message is displayed. User will be asked to try re-enter their PIN.
Actual Result	<pre> Phone number => 0123123123 ----- Enter the member's PIN => 1234567 !!!! Invalid input (1234567): Please enter a valid PIN number. PIN number => 123 !!!! Invalid input (123): Please enter a valid PIN number. PIN number => stringPIN !!!! Invalid input (stringPIN): Please enter a valid PIN number. PIN number => </pre>
Test Passed	

Test	Add an existed member.
------	------------------------

Test Data	<ul style="list-style-type: none"> • First Name: Tim • Last Name: Lardy • Phone Number: 0123456789 • Pin: 1234
Expected Result	Member will not be added A message is displayed to inform user that this member is existed
Actual Result	<pre> ===== Add Member ===== Enter the member's first name => Tim Enter the member's last name => Lardy Enter the member's contact phone number => 0123456789 Enter the member's PIN => 1234 Member Lardy, Tim already exists in the system. ===== Press Enter to return to staff menu... </pre>
Test Passed	

Menu Option 4

Functionality Under Test: Remove a registered member from the system

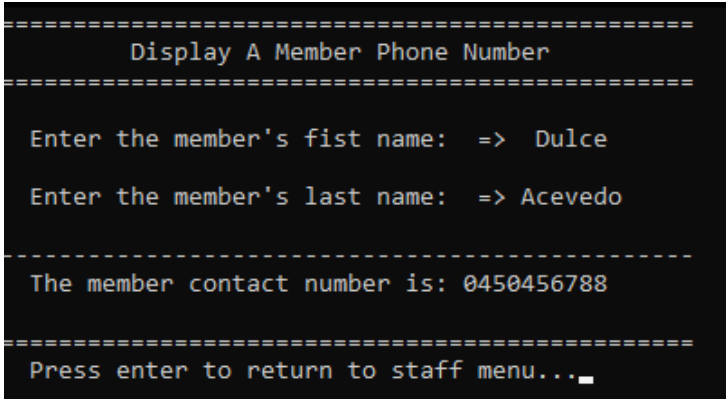
Test	Delete an existed member.
Test Data	<ul style="list-style-type: none"> • First Name: Dulce • Last Name: Acevedo • Movies Borrowing: None
Expected Result	Member will be deleted successfully. An according message is also displayed.
Actual Result	<pre> ===== Remove Member ===== Enter the member's first name => Dulce Enter the member's last name => Acevedo Member is removed successfully! ===== Press enter to return to staff menu... </pre>
Test Passed	

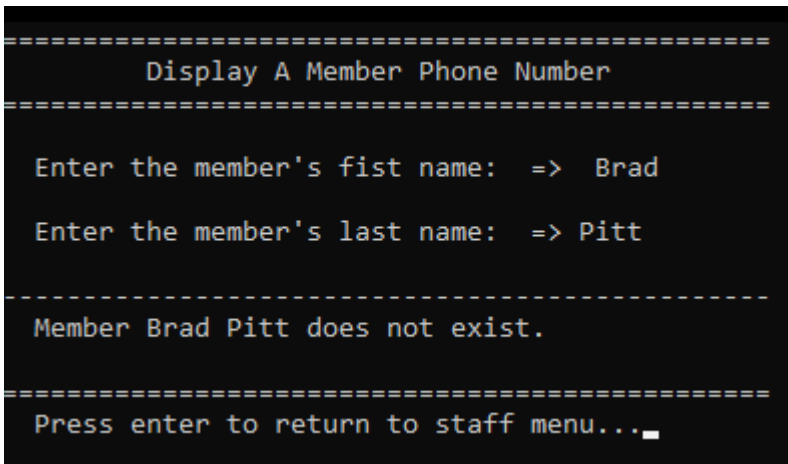
Test	Delete a member currently borrowing DVDs.
Test Data	<ul style="list-style-type: none"> • First Name: Anthony • Last Name: Nguyen • Movies Borrowing: 2
Expected Result	Member is not deleted because they are currently borrowing movies. An according message is also displayed.
Actual Result	<pre> ===== Remove Member ===== Enter the member's first name => Anthony Enter the member's last name => Nguyen Member is not deleted because they are currently borrowing DVD(s). ===== Press enter to return to staff menu... </pre>
Test Passed	

Test	Delete a non-existed member
Test Data	<ul style="list-style-type: none"> • Member that are not in the system. • First Name: Angelina • Last Name: Jolie
Expected Result	Member cannot be deleted as they do not exist. An according message is also displayed.
Actual Result	<pre> ===== Remove Member ===== Enter the member's first name => Angelina Enter the member's last name => Jolie Member Jolie, Angelina cannot be deleted as they do not exist in the system ===== Press enter to return to staff menu... </pre>
Test Passed	

Menu Option 5

Functionality Under Test: Display a member's contact phone number, given the member's name

Test	Display an existed member's phone number.
Test Data	<ul style="list-style-type: none"> • First Name: Dulce • Last Name: Acevedo
Expected Result	The member's phone number is displayed
Actual Result	 <pre> ===== Display A Member Phone Number ===== Enter the member's first name: => Dulce Enter the member's last name: => Acevedo ----- The member contact number is: 0450456788 ----- Press enter to return to staff menu..._ </pre>
Test Passed	

Test	Display a non-existed member's phone number.
Test Data	<ul style="list-style-type: none"> • First Name: Brad • Last Name: Pitt
Expected Result	Number will not be displayed as the member does not exist. An according message is also displayed.
Actual Result	 <pre> ===== Display A Member Phone Number ===== Enter the member's first name: => Brad Enter the member's last name: => Pitt ----- Member Brad Pitt does not exist. ----- Press enter to return to staff menu..._ </pre>
Test Passed	

Menu Option 6

Functionality Under Test: Display all members who are currently renting a particular movie

Test	Display all borrowers of a movie which is borrowed by some members
Test Data	<ul style="list-style-type: none"> Title: Movie 4 Borrowers: Dulce Acevedo, Rodo N and Anthony Nguyen.
Expected Result	The current borrowers of the movie will be successfully displayed
Actual Result	<pre>===== Display Borrowers of a Movie ===== Please enter the movie title => Movie 4 Borrowers of Movie 4: Acevedo, Dulce N, Rodo Nguyen, Anthony ===== Press enter to return to staff menu...</pre>
Test Passed	

Test	Display all borrowers of a movie which is not borrowed by any member
Test Data	<ul style="list-style-type: none"> Title: Movie 1 No Borrowers: 0
Expected Result	No borrower is displayed.
Actual Result	<pre>===== Display Borrowers of a Movie ===== Please enter the movie title => Movie 1 No one is borrowing this movie currently. ===== Press enter to return to staff menu...</pre>
Test Passed	

Test	Display all borrowers of a non-existed movie
Test Data	<ul style="list-style-type: none"> Movie name entered: Advengers (not existed in the system)
Expected Result	No borrowers will be displayed.
Actual Result	<pre>===== Display Borrowers of a Movie ===== Please enter the movie title => Advengers Movie does not exist ===== Press enter to return to staff menu...</pre>
Test Passed	

3.2.3 Member Menu

Functionality Under Test: Choose Action

Test	Enter a valid choice (an integer from 0 to 6)
Test Data	<ul style="list-style-type: none"> Choice: 3 <pre>===== Member Menu ===== 1. Browse all the movies 2. Display all the information about a movie, given the movie's title 3. Borrow a movie DVD 4. Return a movie DVD 5. List current borrowing movies 6. Display the top 3 movies rented by the members 0. Return to the main menu ===== Enter your choice (1/2/3/4/5/6/0) => 3_</pre>
Expected Result	Corresponding sub-menu is displayed. In this case, it's "Borrow a movie".
Actual Result	<pre>===== Borrow Movie ===== Enter movie would you like to borrow => _</pre>
Test Passed	

Test	Enter an invalid choice (an integer not from 0 to 6, string)
------	--

Test Data	<ul style="list-style-type: none"> Choice: 019, lalala
Expected Result	Warning Message is displayed followed by refreshed member menu
Actual Result	<pre> Invalid choice (019): Your choice must be an integer from 0 to 6! ===== Member Menu ===== 1. Browse all the movies 2. Display all the information about a movie, given the movie's title 3. Borrow a movie DVD 4. Return a movie DVD 5. List current borrowing movies 6. Display the top 3 movies rented by the members 0. Return to the main menu ===== Enter your choice (1/2/3/4/5/6/0) => Invalid choice (lalala): Your choice must be an integer from 0 to 6! ===== Member Menu ===== 1. Browse all the movies 2. Display all the information about a movie, given the movie's title 3. Borrow a movie DVD 4. Return a movie DVD 5. List current borrowing movies 6. Display the top 3 movies rented by the members 0. Return to the main menu ===== Enter your choice (1/2/3/4/5/6/0) => _ </pre>
Test Passed	

Menu Option 0

Functionality Under Test: Return to menu

Test	Return to main menu
Test Data	<ul style="list-style-type: none"> Choice: 0 <pre> ===== Member Menu ===== 1. Browse all the movies 2. Display all the information about a movie, given the movie's title 3. Borrow a movie DVD 4. Return a movie DVD 5. List current borrowing movies 6. Display the top 3 movies rented by the members 0. Return to the main menu ===== Enter your choice (1/2/3/4/5/6/0) => 0_ </pre>
Expected Result	The main menu will be displayed

Actual Result	<pre> ----- Welcome to the Community Library Movie DVD Management System ----- ===== MAIN MENU ===== 1. Staff Login 2. Member Login 0. Exit ===== Enter your choice (1/2/0) => _ </pre>
Test Passed	

Menu Option 1

Functionality Under Test: Display information about all movie DVDs in the library in alphabetical order, including the number of the movie DVDs currently available.

Test	Display all movies' information
Test Data	<ul style="list-style-type: none"> Title: Movie 1, Genre: Western, Classification: G, Duration: 101, Total Copies: 1, Available copies: 1 Title: Movie 2, Genre: Action, Classification: G, Duration: 102, Total Copies: 2, Available copies: 1 Title: Movie 3, Genre: History, Classification: PG, Duration:103, Total Copies: 5, Available copies:2 Title: Movie 4, Genre: History, Classification: PG, Duration: 104, Total Copies: 10, Available copies:7
Expected Result	All movies are successfully display with all the information
Actual Result	<pre> ===== Movie Collection ===== >>> Movie: Movie 1, Western, G, 101, 1 >>> Movie: Movie 2, Action, G, 102, 1 >>> Movie: Movie 3, History, PG, 103, 2 >>> Movie: Movie 4, History, PG, 104, 7 ===== Press enter to return to member menu... </pre>
Test Passed	

Test	Display all movies' information while no movie is added
Test Data	none
Expected Result	A message is displayed to inform user that no movie is available.

Actual Result	<pre>===== Movie Collection ===== Movie list is currently empty, please check back later. ===== Press enter to return to member menu..._</pre>
Test Passed	

Menu Option 2

Functionality Under Test: Display all the information about a movie, given the movie's title.

Test	Display a valid movie's information
Test Data	<ul style="list-style-type: none"> Title: Movie 1, Genre: Western, Classification: G, Duration: 101, Total Copies: 0 Movie name entered: Movie 1
Expected Result	The information of the movie with that name was displayed
Actual Result	<pre>===== Movie Information ===== Enter the movie name => Movie 1 >>> Movie: Movie 1, Western, G, 101, 0 ===== Press enter to return to member menu..._</pre>
Test Passed	

Empty test

Test	Display a non-existed movie
Test Data	<ul style="list-style-type: none"> Title: NOT A MOVIE
Expected Result	The information of the movie with that name will not be displayed because it does not exist.

Actual Result	<pre>===== Movie Information ===== Enter the movie name => NOT A MOVIE Movie does not exist in the system ===== Press enter to return to member menu...</pre>
Test Passed	

Menu Option 3

Functionality Under Test: Borrow a movie DV

Test	Borrow a valid movie
Test Data	<ul style="list-style-type: none"> Title: Movie 3, Total Copies: 5, Available copies:2 Movie name entered: Movie 3
Expected Result	The member successfully borrowed the movie selected
Actual Result	<pre>===== Borrow Movie ===== Enter movie would you like to borrow => Movie 3 The movie is successfully borrowed ===== Press enter to return to member menu...</pre>
Test Passed	

Test	Borrow a movie twice
Test Data	<ul style="list-style-type: none"> Title: Movie 3, Total Copies: 5, Available copies:2 Movie name entered: Movie 3 Member already has a copy borrowed
Expected Result	The member cannot borrow the movie selected because they already did. An according message is displayed

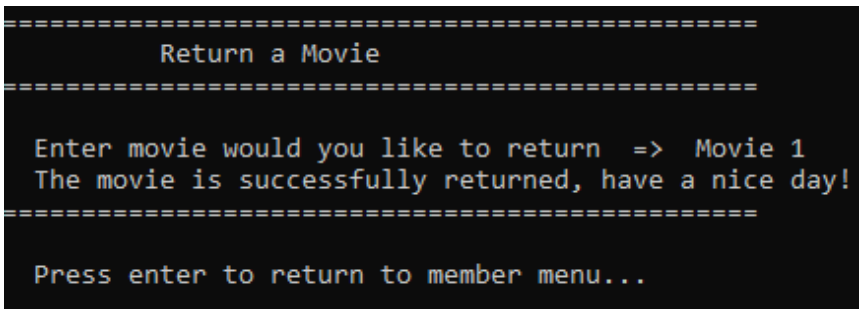
Actual Result	<pre>===== Borrow Movie ===== Enter movie would you like to borrow => Movie 3 You already have a copy of the movie. Borrowing movie unsuccessful ===== Press enter to return to member menu..._</pre>
Test Passed	

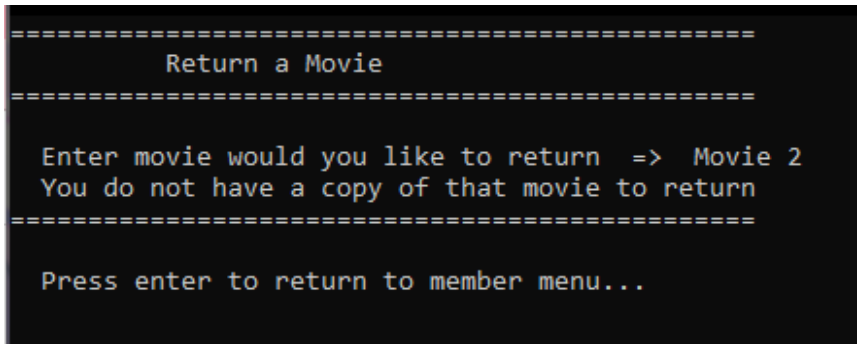
Test	Borrowing a movie with no available copy left
Test Data	<ul style="list-style-type: none"> Title: Movie 1, Total Copies: 1, Available copies: 0 Movie name entered: Movie 1
Expected Result	The member cannot borrow the movie selected because there is no copy available
Actual Result	<pre>===== Borrow Movie ===== Enter movie would you like to borrow => Movie 1 No more copies of this movie are available for borrowing Borrowing movie unsuccessful =====</pre>
Test Passed	

Test	Borrow a non-existed movie
Test Data	<ul style="list-style-type: none"> Movie name entered: NOT A MOVIE
Expected Result	The member cannot borrow the movie selected because the movie does not exist
Actual Result	<pre>===== Borrow Movie ===== Enter movie would you like to borrow => NOT A MOVIE Movie does not exist in the system ===== Press enter to return to member menu..._</pre>
Test Passed	

Menu Option 4

Functionality Under Test: Return a movie DVD

Test	Return a valid movie
Test Data	<ul style="list-style-type: none">• Member has a copy of Movie 1• Movie name entered: Movie 1
Expected Result	The copy of the movie was successfully returned
Actual Result	 <pre>===== Return a Movie ===== Enter movie would you like to return => Movie 1 The movie is successfully returned, have a nice day! ===== Press enter to return to member menu...</pre>
Test Passed	

Test	Return a DVD that was not borrowed before
Test Data	<ul style="list-style-type: none">• Member does not have a copy of Movie 2.• Movie name entered: Movie 2
Expected Result	No copy of the movie selected was returned as the member does not have any copy
Actual Result	 <pre>===== Return a Movie ===== Enter movie would you like to return => Movie 2 You do not have a copy of that movie to return ===== Press enter to return to member menu...</pre>
Test Passed	

Test	Return a non-existed movie
Test Data	<ul style="list-style-type: none">• Movie name entered: NOT A MOVIE• That movie does not exist in the system

Expected Result	No copy of the movie selected was returned as the movie does not exist
Actual Result	<pre> ===== Return a Movie ===== Enter movie would you like to return => NOT A MOVIE You do not have a copy of that movie to return ===== Press enter to return to member menu... </pre>
Test Passed	

Menu Option 5

Functionality Under Test: Display List current movies that are currently borrowed by the registered member.

Test	List all borrowing movies
Test Data	<ul style="list-style-type: none"> • Movies being borrowed by the member and the information: <ul style="list-style-type: none"> ◦ >>> Movie: Movie 1, Western, G, 101, 0 ◦ >>> Movie: Movie 4, History, PG, 104, 7
Expected Result	All movies that the member is currently borrowing are displayed
Actual Result	<pre> ===== Your borrowing movies: >>> Movie: Movie 1, Western, G, 101, 0 >>> Movie: Movie 4, History, PG, 104, 7 ===== Press enter to return to member menu..._ </pre>
Test Passed	

Test	List the borrowing movies while the member is not currently borrowing any movies
Test Data	<ul style="list-style-type: none"> • Member is not currently borrowing any movies
Expected Result	< Empty > is printed to the console.

Actual Result	<pre>===== Your borrowing movies: < Empty > ===== Press enter to return to member menu..._</pre>
Test Passed	

Menu Option 6

Functionality Under Test: Display the top three (3) most frequently borrowed movies by the members in the descending order of their frequency. The display should include the title of the movie and frequency (the number of times that the movie has been borrowed by registered members by now)

Test	List the top 3 most frequently borrowed movies
Test Data	<ul style="list-style-type: none"> • Movie 1(borrowed 0 times) • Movie 3 (borrowed 3 times) • Movie 4 (borrowed 4 times) • Movie 2 (borrowed 0 times)
Expected Result	Top three most frequently borrowed movies displayed
Actual Result	<pre>===== Top3 Most Borrowed Movies: Top 1 - Movie 3 (borrowed 4 times) Top 2 - Movie 4 (borrowed 3 times) Top 3 - Movie 1 (borrowed 0 times) ===== Press enter to return to member menu...</pre>
Test Passed	

Test	List the top 3 most frequently borrowed movies while there are less than three movies available
Test Data	<ul style="list-style-type: none"> • Movie 1(borrowed 1 times) • Movie 4 (borrowed 3 times) • No more movies available
Expected Result	It will show not available for the third top 3, since there are only 2 movies that have been borrowed

Actual Result	<pre>===== Top3 Most Borrowed Movies: Top 1 - Movie 4 (borrowed 3 times) Top 2 - Movie 1 (borrowed 1 times) Top 3 - Not available ===== Press enter to return to member menu...</pre>
Test Passed	

Test	List the top 3 most frequently borrowed movies while some movies have the same numbers of borrowed frequencies.
Test Data	<ul style="list-style-type: none"> • Movie 3 (borrowed 3 times) • Movie 4 (borrowed 3 times) • Movie 2 (borrowed 1 times) • Movie 1 (borrowed 0 times)
Expected Result	<p>Top three most frequently borrowed movies will be displayed. They will be displayed in alphabetical/dictionary/lexicographic if some movies have the same borrowed frequency.</p> <p>Order: Top 1: Movie 3, Top 2: Movie 4, Top 3: Movie 2.</p>
Actual Result	<pre>===== Top3 Most Borrowed Movies: Top 1 - Movie 3 (borrowed 3 times) Top 2 - Movie 4 (borrowed 3 times) Top 3 - Movie 2 (borrowed 1 times)</pre>
Test Passed	