

CAB301

PROJECT

PHASE 3

Group 57

Team Members:

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1.0 Introduction

Our team has developed a software application through usage of various data structures and efficient algorithms for a community library which allows them to manage their DVDs.

The software, once completed, will allow for the staff member to store information about a particular movie including the title, genre, classification, and duration of the movie in minutes. The genres that the software recognizes include Comedy, Drama, History, Action or Western whereas movie classifications can be labelled as General (G), Parental Guidance (PG), Mature (M) or Mature Accompanied (MA15+).

The software allows the staff member to register new members with the community to enable the borrowing of DVDs. When a member is being registered, their first name, last name and a valid contact phone number is saved in the system. It also allows for the staff member to set a valid password for the member.

Staff members can also remove a registered member from the system, given that they have no DVDs under their name.

The system also keeps a borrowing record under each member's name, listing the DVDs they are currently holding, the maximum number being five and each movie they are borrowing must be unique.

The software will also allow the staff member to add new DVDs of a movie to the system and to remove DVDs of a movie from the system. The total number of copies of the movie owned by the community library will automatically be updated by the system. The staff member can also use the system to display a member's contact phone number, given their first and last name, as well as display a list of all the members currently borrowing a particular movie.

While the software has many uses for a staff member, it can also allow registered members to do various things. Registered members can display the information about the movies in alphabetical order and the number of available copies. Members can borrow and return a movie though the system. They can also use the system to display the DVDs under their borrowing record and to list the three most frequently borrowed movies in the community library.

2.0 Design and Analysis of Algorithms

2.1 Algorithm Design (Pseudocode)

```
ALGORITHM FindLargestElements ( $A[0 \dots n - 1]$ )
// Finds the three largest elements in a randomly stored array.
// Input: An array of randomly stored elements ( $A[0 \dots n - 1]$ ).
// Output: Returns the three largest elements in the array.
```

```

first ← second ← third ← - ∞
if n < 3 return
else
    for i ← 0 to n - 1 do
        if A[i] > first
            third = second
            second = first
            first = A[i]

        else if A[i] > second
            third = second
            second = A[i]

        else if A[i] > third
            third = A[i]

```

2.2 Algorithm Analysis Through Empirical Analysis

Step 1: Understand the experiment's purpose

The experiment's purpose is to develop a hypothesis about the algorithm's efficiency class.

Step 2: Decide on the efficiency metric to be measured and the measurement unit

The efficiency metric for this experiment is the number of time's the basic operation is executed.

Step 3: Decide on characteristics of input sample

The size of the sample inputs for this experiment will range from 1000 to 20,000, in steps of 1000. The experiment will be run 20 times and then the average count for each input size will be calculated.

The basic operations of the algorithm are $i < n - 1$ and $A[i] > third$. Therefore, an operation counter (integer) will be placed as a measurement of time efficiency.

Step 4: Prepare a program implementing the algorithm for the experimentation and

Step 5: Generate a sample of inputs

```
public static int FindLargestElements(int[] array)
{
    int first, second, third;
    int count = 0;
    first = second = third = int.MinValue;

    if (array.Length < 3)
    {
        Console.WriteLine("Invalid Input");
    }
    else
    {
        for (int i = 0; i < array.Length; i++)
        {
            count++;
            if (array[i] > first)
            {
                third = second;
                second = first;
                first = array[i];
            }
            else if (array[i] > second)
            {
                third = second;
                second = array[i];
            }
            else if (array[i] > third)
            {
                third = array[i];
                count++;
            }
        }
    }
    return count;
}
```

```

static int[] GenerateRandomArray(int size)
{
    int[] array = new int[size];

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

    for (int i = 0; i < array.Length; i++)
    {
        array[i] = rnd.Next(Int32.MaxValue);
    }
    return array;
}

public static void Main(string[] args)
{

    int noOfRuns = 20;
    for (int size = 1000; size <= 20000; size += 1000)
    {
        long totalCounts = 0;
        double averageCount = 0;
        for (int i = 1; i <= noOfRuns; i++)
        {
            int[] A = GenerateRandomArray(size);
            int count = FindLargestElements(A);
            totalCounts += count;
        }
        averageCount = totalCounts * 1.0 / noOfRuns;
        Console.WriteLine("Size = " + size + "; Average Count = " + averageCount);
    }
}

```

Step 6: Run the algorithm on the sample's inputs and record the data observed

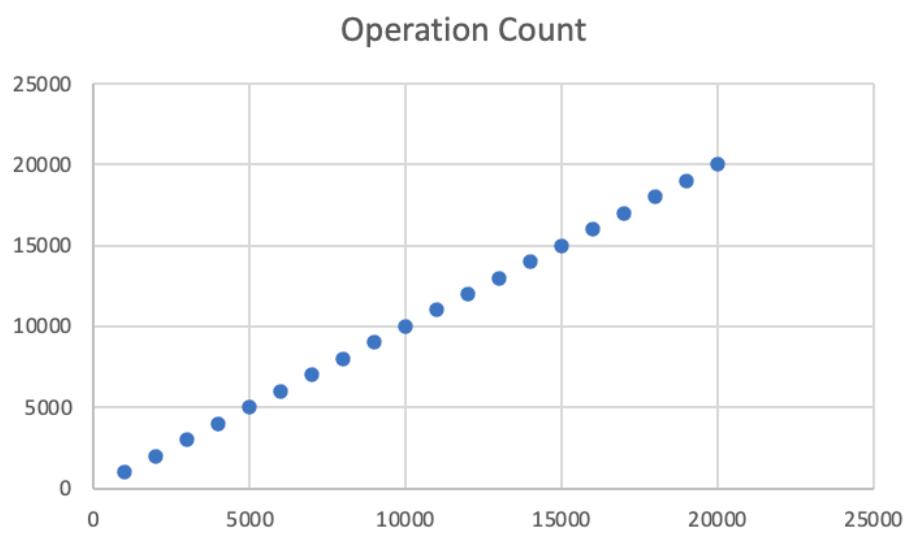
Below are the results of the experimentation:

Size of Input (n)	Average Count
1000	1006.05
2000	2007.75
3000	3007.55
4000	4006.65
5000	5006.85
6000	6007.7
7000	7008.5
8000	8007.95
9000	9008
10000	10008.5
11000	11008.25
12000	12008.85
13000	13008.65
14000	14008.6
15000	15009.4

16000	16007.9
17000	17009.2
18000	18008.2
19000	19009.1
20000	20009.8

Step 7: Analyse the data observed

Firstly, let's model the results in a graph to get a brief idea of the efficiency. At a glimpse, the behaviour of the program looks linear, it can assume that the efficiency class is in the order of n .



To further prove this hypothesis:

Let $t(n) = cg(n)$,
where c is a constant,
 $g(n)$ is the efficiency function

Let's calculate the ratio of $t(2n)$ and $t(n)$:

$$\frac{t(2n)}{t(n)} = \frac{t(2000)}{t(1000)} = \frac{2007.75}{1006.05} \approx 1.995$$

$$\frac{t(2n)}{t(n)} = \frac{t(8000)}{t(4000)} = \frac{8007.95}{4006.65} \approx 1.999$$

$$\frac{t(2n)}{t(n)} = \frac{t(12000)}{t(6000)} = \frac{12008.85}{6007.7} \approx 1.999$$

Therefore,

$$\frac{t(2n)}{t(n)} = \frac{c(2n)}{c(n)} = \frac{2n}{n} = 2$$

∴ Average efficiency is in the order of n

Since the ratio of $t(2n)$ and $t(n)$ is greater than 1, the algorithm is less efficient than $O(1)$; and the ratio is relatively close to 2, therefore, the efficiency class of this algorithm is $O(n)$.

Since the worst-case efficiency is $O(n)$, $t(n) = cn$

To find c,

$$c = \frac{t(n)}{n}$$

Let $n = 1000$,

$$c = \frac{t(1000)}{1000} = \frac{1006.05}{1000} \approx 1.00665$$

Therefore,

$$t(n) = 1.00665n$$

To find the count using our equation, substitute some values of n,

$$n = 2000$$

$$\begin{aligned} t(n) &= 1.00665n \\ t(2000) &= 1.00665 \times 2000 = 2013.3 \end{aligned}$$

$$n = 5000$$

$$\begin{aligned} t(n) &= 1.00665n \\ t(5000) &= 1.00665 \times 5000 = 5033.25 \end{aligned}$$

$$n = 12000$$

$$\begin{aligned} t(n) &= 1.00665n \\ t(12000) &= 1.00665 \times 12000 = 12079.8 \end{aligned}$$

∴ These values are relatively similar to the test results.

=

3.0 Software Test Plan and Test Results

3.1 Test Plan

After completing the program, the next step for this project is to perform unit testing on all functionalities that have been implemented into the program. There will be a number of scenarios that the program will be tested against, with a set of data that is prepared in advance by the team for each of the scenarios.

CAB301 Program Functionality Testing							
DATE:	27/5/2022						
TESTERS:	Marshall Le, Ni Tran Le, Shaun Hoang						
TEST	DETAILED TESTING CASE	METHOD/STRATEGY	INSTRUCTION/PRE-CONDITION	EXPECTED RESULT	PASS	FAIL	ERROR DESCRIPTION
TEST #1	Add new DVDs of a movie to the system	Walkthrough (Team Testing)	Insert a movie with its information into the library	If the movie is new, then all the information about the movie and the number of the new movie DVDs should be entered into the system If the movie is already in the library, then only the total quantity of the movie DVDs needs to be updated, but the information about the movie needs not to be re-entered.	✓		No error is detected in the program
TEST #2	Remove DVDs of a movie from the system	Walkthrough (Team Testing)	Decrease the number of total DVD copies of a movie	A decrease in the number of total DVD copies of a movie. If the number of total copies reach to zero, the movie will be removed from the library	✓		No error is detected in the program
TEST #3	Register a new member with the system	Walkthrough (Team Testing)	Insert a new member's details into the registered member list	The new member's first name, last name, contact phone number are recorded in the system, a password is set by the member via the staff. The system must check and make sure the phone number and the password are valid. A contact phone number is valid if it has 10 digits, and the first digit is a '0'. A password is valid if it has 4-6 digits.	✓		No error is detected in the program
TEST #4	Remove a registered member from the system	Walkthrough (Team Testing)	Delete all details of a registered member from the list	A registered member with no movie DVD that is currently on loan, is removed from the system	✓		No error is detected in the program
TEST #5	Display a member's contact phone number	Walkthrough (Team Testing)	Fetch the contact phone number of a member in search	Print out a member's contact phone number, under their full name.	✓		No error is detected in the program
TEST #6	Display all the members who are currently renting a particular movie	Walkthrough (Team Testing)	Fetch a list of members who is currently renting a movie in search	Print out all the members who are currently renting a particular movie	✓		No error is detected in the program

TEST #7	Display all the information about all the movie DVDs in dictionary order of the movie title	Walkthrough (Team Testing)	Fetch all movies and its information	Information about all the movie DVDs and number of the movie DVDs currently in the community library are displayed in alphabetical/dictionary/lexicographic order of the movie title	✓		No error is detected in the program
TEST #8	Display the information about a movie	Walkthrough (Team Testing)	Fetch a movie's information	All information of a movie is printed out	✓		No error is detected in the program
TEST #9	Borrow a movie DVD from the community library	Walkthrough (Team Testing)	Insert a movie into a member's and movie's borrowing list	The member who borrows a copy of a movie, will appear in that movie's borrow list and the number of available copy will decrease. The movie will appear in the member's borrow list	✓		No error is detected in the program
TEST #10	Return a movie DVD to the community library	Walkthrough (Team Testing)	Delete a movie into a member's and movie's borrowing list	The member who returns a copy of a movie he/she borrowed, will be removed from that movie's borrow list and the number of available copy will increase. The movie will disappear in the member's borrow list	✓		No error is detected in the program
TEST #11	List current movie DVDs that are currently borrowing by the registered member	Walkthrough (Team Testing)	Fetch all movies that are in a registered member's borrow list	A list of movies will be printed out under the registered member's name	✓		No error is detected in the program
TEST #12	Display the top three (3) most frequently borrowed movies	Walkthrough (Team Testing)	Fetch the movies that has the highest frequency of borrowing	Top three (3) most frequently borrowed movies by the members are displayed 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)	✓		No error is detected in the program

3.2 Test Results

Invalid menu input cases:

```

Select E:\QUT_Projects\Sem1_2022\CAB_301\Group57_Cab301_Ass3\Group57_Cab301_Ass3\b
=====
Welcome to Community Library Movie DVD Management System
=====
=====Main Menu=====
1. Staff Login
2. Member Login
0. Exit
Enter your choice ==> (1/2/0)
5
Invalid Input. Please enter the one of the options above
=====
Welcome to Community Library Movie DVD Management System
=====
=====Main Menu=====
1. Staff Login
2. Member Login
0. Exit
Enter your choice ==> (1/2/0)
-
```

```
Enter your choice ==> (1/2/0)
1
Enter your account name:
staff
Enter your Password:
today123
Login Successfully as Staff
=====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)
10
Invalid Input. Please enter the one of the options above
    Staff Menu
```

```
2
Enter your First name:
Shaun
Enter your Last name:
Hoang
Enter your Password:
2001
Login Successfully as User. Hello Shaun Hoang
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
10
Input not in range. Please enter the one of the options above
    Member Menu
```

Staff login function:

- 1) Case: Staff account name is wrong

```
=====
Welcome to Community Library Movie DVD Management System
=====
=====Main Menu=====
1. Staff Login
2. Member Login
0. Exit
Enter your choice ==> (1/2/0)
1
Enter your account name:
staff1
Enter your Password:
today1234
Incorrect password or Account Name... Please try again
```

2) Case: Staff password is wrong

```
=====
Welcome to Community Library Movie DVD Management System
=====
=====Main Menu=====
1. Staff Login
2. Member Login
0. Exit
Enter your choice ==> (1/2/0)
1
Enter your account name:
staff
Enter your Password:
today1234
Incorrect password or Account Name... Please try again
```

3) Case: Staff login success

```
1. Staff Login
2. Member Login
0. Exit
Enter your choice ==> (1/2/0)
1
Enter your account name:
staff
Enter your Password:
today123
Login Successfully as Staff
=====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)
```

Staff Add DVDs function:

- 1) Case: The movie is not in the system => Add the new movie with all new information correctly

```
Login Successfully as Staff
=====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
Find if the movie is existing in the system:
DeadPool
The movie does not exist in the system
Add new dvds of a movie
Enter movie name:
DeadPool
List of options for genre:
1: Action
2: Comedy
3: History
4: Drama
5: Western
Enter movie genre:
2
List of options for classification:
1: G
2: PG
3: M
4: M15Plus
Enter movie classification:
4
Enter movie duration:
90
Enter movie quantity:
8
A new movie has been added to the system
DeadPool, Comedy, M15Plus, 90, 8
=====Staff Menu=====
```

2) Case: Add new movie with invalid information of a negative value

```

Enter your choice ==> (1/2/3/4/5/6/0)
1
Find if the movie is existing in the system:
abc
The movie does not exist in the system
Add new dvds of a movie
Enter movie name:
SpyxFamily
List of options for genre:
1: Action
2: Comedy
3: History
4: Drama
5: Western
Enter movie genre:
2
List of options for classification:
1: G
2: PG
3: M
4: M15Plus
Enter movie classification:
2
Enter movie duration:
-100
Invalid Input. Please enter a numeric value
Invalid Duration. Please try again
=====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)

```

3) Case: Add new movie with invalid information for genre or classification

```

Find if the movie is existing in the system:
abc
The movie does not exist in the system
Add new dvds of a movie
Enter movie name:
SpyxFamily
List of options for genre:
1: Action
2: Comedy
3: History
4: Drama
5: Western
Enter movie genre:
2
List of options for classification:
1: G
2: PG
3: M
4: M15Plus
Enter movie classification:
5
Invalid genre. Please try again with the option from 1-4
=====Staff Menu=====

```

- 4) Case: The movie is in the system => Add valid DVDs quantity

```
=====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
Find if the movie is existing in the system:
Loki
The movie exist in the system. You just need add on quantity
Please choose the quantity of DVDs you want to add to the movie:
2
2 DVDs has been added to the Loki. Available Copies: 10. Total Copies: 10
```

- 5) Case: The movie is in the system => Add invalid DVDs quantity

```
Enter your choice ==> (1/2/3/4/5/6/0)
1
Find if the movie is existing in the system:
Starwars
The movie exist in the system. You just need add on quantity
Please choose the quantity of DVDs you want to add to the movie:
6
The total of DVDs exceed the maximum 10 DVDs of a movie with 1 DVDs. Please try add smaller number
=====Staff Menu=====
```

- 6) Case: Movie in the system, but the total copies of that movie has reached the limit

```
2 DVDs has been added to the Loki. Available Copies: 10. Total Copies: 10
=====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
Find if the movie is existing in the system:
Loki
The movie exist in the system. But total copies is reach the limit. You can't add more DVDs
=====Staff Menu=====
```

Staff Remove DVDs function:

- 1) Case: Staff enter a correct movie name, correct quantity

```
=====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)
2
Avengers, Action, M15Plus, 50, 10
DeadPool, Comedy, M15Plus, 90, 8
DrStrange, Action, M15Plus, 50, 7
IronMan, Action, M15Plus, 120, 10
Loki, Action, M15Plus, 50, 8
Starwars, Action, G, 90, 5
Please choose a movie you want to remove DVDs:
DeadPool
Please choose the quantity of DVDs you want to add to the movie:
6
6 Dvds has been removed out of a movie
=====Staff Menu=====
```

2) Case: Staff enter a incorrect movie name

```
=====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)
2
Avengers, Action, M15Plus, 50, 10
DrStrange, Action, M15Plus, 50, 7
IronMan, Action, M15Plus, 120, 10
Loki, Action, M15Plus, 50, 8
Starwars, Action, G, 90, 5
Please choose a movie you want to remove DVDs:
Dragon ball
The movie is not inside the system. Please see the list above to choose correctly
=====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)
```

3) Case: Staff enter a correct movie name, incorrect quantity

```
Enter your choice ==> (1/2/3/4/5/6/0)
2
Avengers, Action, M15Plus, 50, 10
DrStrange, Action, M15Plus, 50, 7
IronMan, Action, M15Plus, 120, 10
Loki, Action, M15Plus, 50, 8
Starwars, Action, G, 90, 5
Please choose a movie you want to remove DVDs:
Avengers
Please choose the quantity of DVDs you want to delete from the movie:
11
The delete quantity is greater than the amount in the system. Please try again
=====Staff Menu=====
```

Staff Register new member function:

- 1) Case: Staff register a new member, given all information correctly => User added to the system

```
=====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)  
3  
Register a new member  
Please enter user's First Name:  
Phuc  
Please enter user's Last Name:  
Hoang  
Please enter user's phone number:  
0123456789  
Please enter user's pin/password:  
0987  
Register successfully  
Hoang, Phuc, 0123456789, 0987  
Hoang, Shaun, 0450880110, 2001  
Le, Marshall, 0987654321, 1234  
Le, Ni, 0123456789, 5678
```

- 2) Case: Staff register a new member, given wrong phone number

```
=====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)  
3  
Register a new member  
Please enter user's First Name:  
Shawn  
Please enter user's Last Name:  
Hoang2001  
Please enter user's phone number:  
012345678969  
Invalid Phone Number. It must contain 10 digits start with digit 0. Please try again
```

- 3) Case: Staff register a new member, given wrong pin

```
=====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)
3
Register a new member
Please enter user's First Name:
Tuan
Please enter user's Last Name:
Minh Hoang
Please enter user's phone number:
0123456789
Please enter user's pin/password:
12312312312312
Invalid pin. It must contain 4-6 digits. Please try again
=====Staff Menu=====
1. Add new DVDs of a new movie to the system
2. Remove DVDs of a movie from the system
```

Staff Remove registered member function

- 1) Case: Staff remove a registered user from the system, with correct name input

```
=====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)
4
Remove a registered member
Please enter delete First Name:
Phuc
Please enter delete Last Name:
Hoang
Phuc Hoang has been deleted
```

- 2) Case: Staff input the name incorrectly or user is not inside the system

```
=====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)
4
Remove a registered member
Please enter delete First Name:

Please enter delete Last Name:

The user does not exist. Please try again
=====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)
```

Staff Display member's phone number

- 1) Case: Staff input correct user name

```
Hoang has been deleted
=====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)
5
Display a member's phone number
Please enter member First Name:
Shaun
Please enter member Last Name:
Hoang
The contact phone number of Shaun Hoang is: 0450880110
```

- 2) Case: User is not inside the system

```
=====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)
5
Display a member's phone number
Please enter member First Name:
Lara
Please enter member Last Name:
Le
The user does not exist. Please try again
```

Staff Display borrowers list function:

1) Case: Staff input a correct movie name

```
Login Successfully as Staff
=====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)
6
Display all members who are currently renting a movie
Enter the movie you want to display borrowers
DrStrange
Le, Marshall, 0987654321, 1234
```

2) Case: Staff input a incorrect movie name

```
=====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)
6
Display all members who are currently renting a movie
Enter the movie you want to display borrowers
Naruto
Could not find the movie. Please try again
```

3) Case: Staff input a correct movie, but there is no borrower

```
=====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)
6
Display all members who are currently renting a movie
Enter the movie you want to display borrowers
Loki
This movie has no borrower
      Staff Menu
```

User login function:

- 1) Case: User Last name or First name input wrong

```
Enter your First name:
Shaun
Enter your Last name:
Hoag
Incorrect Account Name... Please try again
=====
Welcome to Community Library Movie DVD Management System
=====
=====Main Menu=====
1. Staff Login
2. Member Login
0. Exit
Enter your choice ==> (1/2/0)
2
Enter your First name:
Shawn
Enter your Last name:
Hoang
Incorrect Account Name... Please try again
=====
Welcome to Community Library Movie DVD Management System
=====
=====Main Menu=====
1. Staff Login
2. Member Login
0. Exit
Enter your choice ==> (1/2/0)
```

- 2) Case: User password wrong

```
1. Staff Login
2. Member Login
0. Exit
Enter your choice ==> (1/2/0)
2
Enter your First name:
Shaun
Enter your Last name:
Hoang
Enter your Password:
12345
Incorrect Password... Please try again
=====
Welcome to Community Library Movie DVD Management System
=====
=====Main Menu=====
1. Staff Login
2. Member Login
0. Exit
Enter your choice ==> (1/2/0)
```

3) Case: Username and password correct

```
=====
Welcome to Community Library Movie DVD Management System
=====
=====Main Menu=====
1. Staff Login
2. Member Login
0. Exit
Enter your choice ==> (1/2/0)
2
Enter your First name:
Shaun
Enter your Last name:
Hoang
Enter your Password:
2001
Login Successfully as User. Hello Shaun Hoang
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
```

User Display all movies in system function:

```
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
1
Browse movie
Avengers, Action, M15Plus, 50, 10
DeadPool, Comedy, M15Plus, 90, 2
DrStrange, Action, M15Plus, 50, 6
IronMan, Action, M15Plus, 120, 10
Loki, Action, M15Plus, 50, 8
Starwars, Action, G, 90, 5
```

User Display a movie info function:

- 1) Case: User input a movie name correctly

```
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
2
Display movie info
Enter the movie title you want to see the information: Loki
Loki, Action, M15Plus, 50, 8
```

- 2) Case: User input a movie name incorrectly

```
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
2
Display movie info
Enter the movie title you want to see the information: Kimetsu no Yaiba
The movie does not exist, please enter the correct title
```

User Borrow a movie DVD function:

- 1) Case: User login and borrow a movie successfully (given the movie name correctly)

```
Welcome to Community Library Movie DVD Management System
=====
=====Main Menu=====
1. Staff Login
2. Member Login
0. Exit
Enter your choice ==> (1/2/0)
2
Enter your First name:
Marshall
Enter your Last name:
Le
Enter your Password:
1234
Le, Marshall, 0987654321, 1234
Login Successfully as User. Hello Marshall Le
=====
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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
Borrow movie
Enter the movie you want to borrow: DrStrange
You have borrowed DrStrange successfully
=====
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
```

2) Case: User borrow a movie in the list (given the movie name incorrectly)

```
=====
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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
Borrow movie
Enter the movie you want to borrow: Kimetsu no Yaiba
There is no movie like this in our system. Please try again
```

User Return a movie DVD function:

1) Case: User have a movie inside the borrow list, enter the title to return correctly

```
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
4
Return a movie DVD
Enter the movie you want to return: DrStrange
You have return DrStrange successfully
```

2) Case: User did not borrow the given movie

```
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
4
Return a movie DVD
Enter the movie you want to return: Loki
You have not borrow this movie. Please try again
```

3) Case: User enter the title to return incorrectly

```
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
4
Return a movie DVD
Enter the movie you want to return: Kimetsu no Yaiba
There is no movie like this in your borrow list. Please try again
```

User Display list of movie that user current borrowing function:

1) Case: User's borrow list does contain movies

```
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
5
List current borrowings
Avengers, Action, M15Plus, 50, 9
DrStrange, Action, M15Plus, 50, 6
Loki, Action, M15Plus, 50, 7
```

2) Case: User's borrow list is empty

```
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
5
List current borrowings
You did not borrow any movie yet.
```

User Display top 3 movies rented by users function

1) Case: the number of borrowings DVDs is empty

```
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
6
Display top 3 movies
Not enough movie being borrowed. Please borrow more.
```

2) Case: Returns the top 3 borrowed movies, ordered by the frequency of borrowing

```
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
6
Display top 3 movies
#1: Loki, Action, M15Plus, 50, 5, Number of borrowings: 3
#2: DrStrange, Action, M15Plus, 50, 5, Number of borrowings: 2
#3: IronMan, Action, M15Plus, 120, 9, Number of borrowings: 1
```

3) Case: There are movies that has the same frequency of borrowing

```
=====Member Menu=====
1. Browse all the movies
2. Display all the information about a movie, given the title of the movie
3. Borrow a movie DVD
4. Return a movie DVD
5. List current borrowing
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)
6
Display top 3 movies
#1: DrStrange, Action, M15Plus, 50, 4, Number of borrowings: 3
#2: Loki, Action, M15Plus, 50, 5, Number of borrowings: 3
#3: IronMan, Action, M15Plus, 120, 9, Number of borrowings: 1
```