Report:

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1. A recursive in-order traverse is used to implement converting binary search tree (movie collection) to array.
   The sort algorithm is bubble sort to descend movie with rent times.
   Display descending sort is implemented by for loop (foreach);

2. The time complexity of recursive in-order traverse is Θ (n). Because if binary search tree has n nodes, each node should be traversed, and the operation will repeat n times. Other codes in the method are essential operation and each value is equal to 1., which can be ignored when compared with n times.
   The time complexity of bubble sort is Θ(n^2). The inner loop executes n-1-i times; the outer loop operates n – 1 times. The formula is:

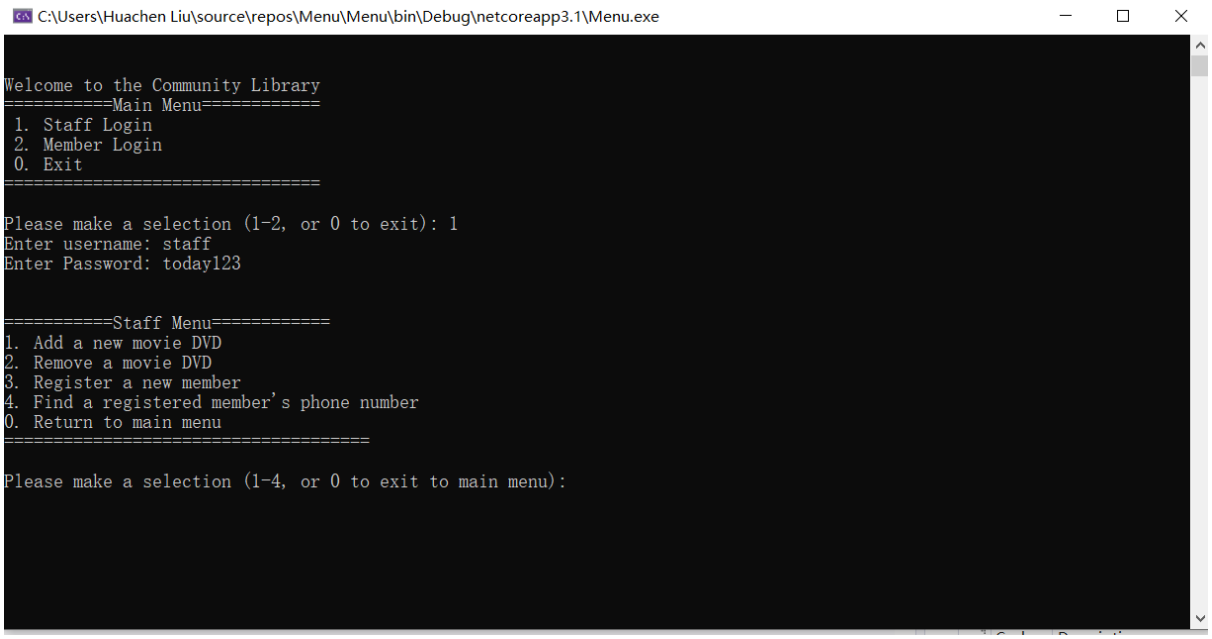
$$C(n) = \sum_{i=0}^{n-2} \sum_{j=0}^{n-2-i} 1 = \sum_{i=0}^{n-2} [(n-2-i) - 0 + 1]$$

$$= \sum_{i=0}^{n-2} (n-1-i) = \frac{(n-1)n}{2} \in \Theta(n^2).$$

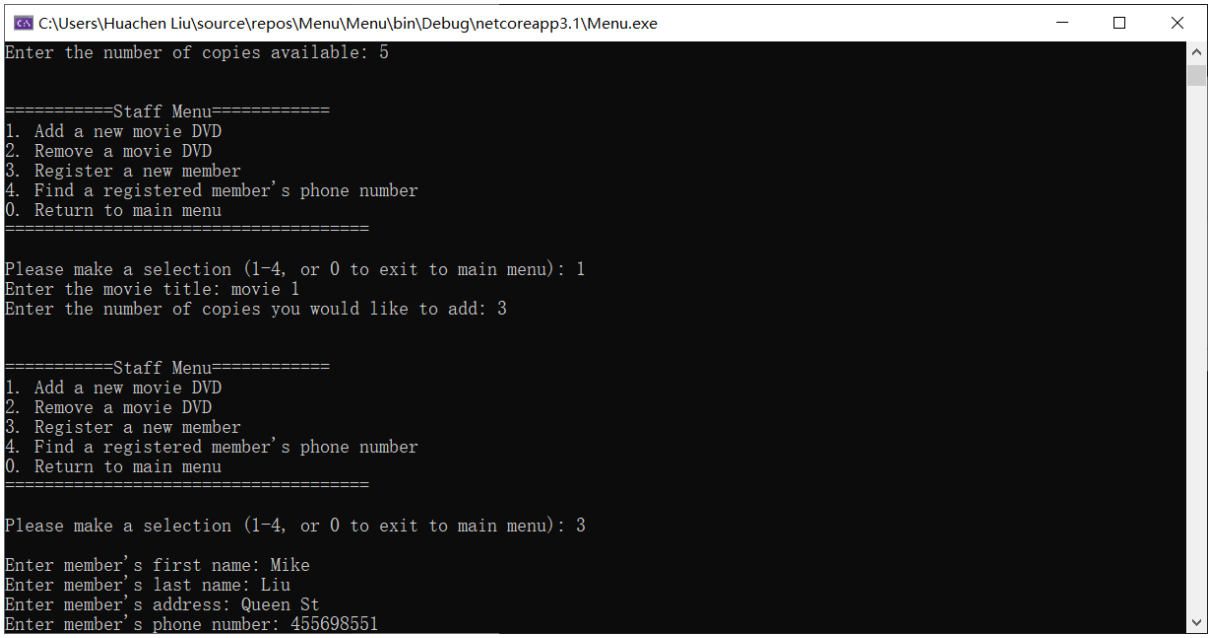
   Then, display results with for loop executes n - 1 times, which the time complexity is Θ (n).

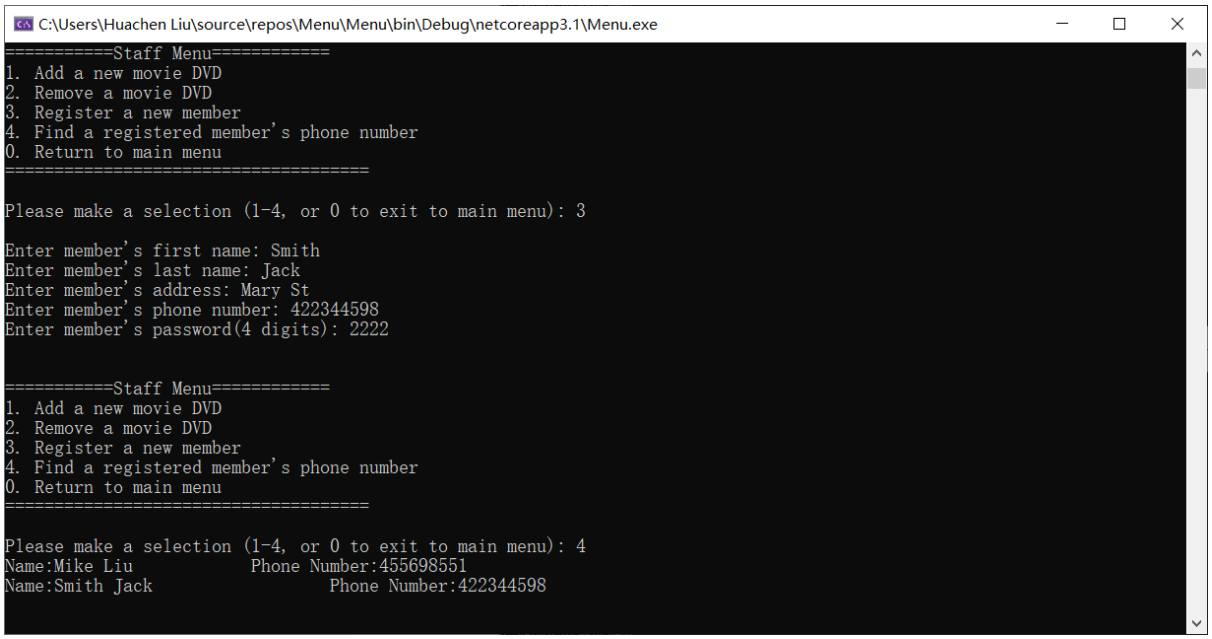
   In conclusion, the time efficiency of method is Θ ($n^2 + 2n$) ∈ Θ (n^2).

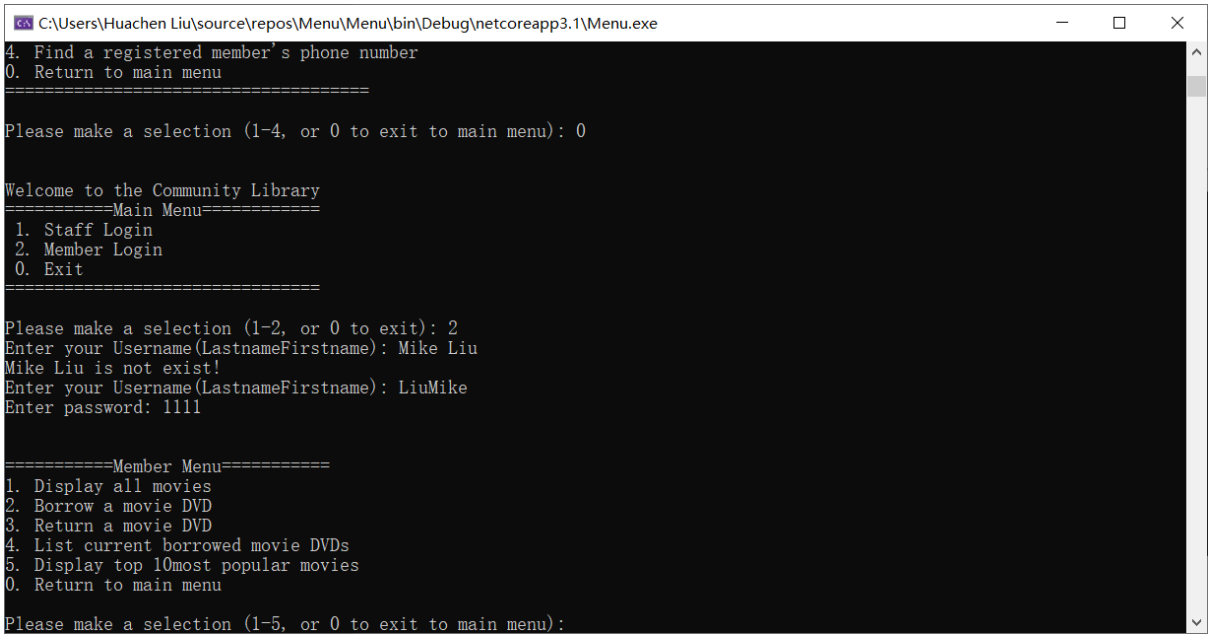
3.


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
Welcome to the Community Library
==========Main Menu==========
1. Staff Login
2. Member Login
0. Exit
==============================
Please make a selection (1-2, or 0 to exit): 1
Enter username: staff
Enter Password: today123
==========Staff Menu==========
1. Add a new movie DVD
2. Remove a movie DVD
3. Register a new member
4. Find a registered member's phone number
0. Return to main menu
====================================
Please make a selection (1-4, or 0 to exit to main menu):


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
2. Remove a movie DVD
3. Register a new member
4. Find a registered member's phone number
0. Return to main menu
====================================
Please make a selection (1-4, or 0 to exit to main menu): 1
Enter the movie title: movie 1
Enter the starring actor(s): actor 1
Enter the director(s): director 2
Select the genre:
1. Drama
2. Adventure
3. Family
4. Action
5. Sci-Fi
6. Comedy
7. Thrille
8. Other
Make Selection(1-8): 2
Select the classification:
1. General (G)
2. Parental Guidance (PG)
3. Mature (M15+)
4. Mature Accompanied (MA15+)
Make Selection(1-4): 3
Enter the duration (minutes): 90
Enter the release date (year): 1850


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
Enter the number of copies available: 5
==========Staff Menu==========
1. Add a new movie DVD
2. Remove a movie DVD
3. Register a new member
4. Find a registered member's phone number
0. Return to main menu
======================================
Please make a selection (1-4, or 0 to exit to main menu): 1
Enter the movie title: movie 1
Enter the number of copies you would like to add: 3
==========Staff Menu==========
1. Add a new movie DVD
2. Remove a movie DVD
3. Register a new member
4. Find a registered member's phone number
0. Return to main menu
======================================
Please make a selection (1-4, or 0 to exit to main menu): 3
Enter member's first name: Mike
Enter member's last name: Liu
Enter member's address: Queen St
Enter member's phone number: 455698551


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
==========Staff Menu==========
1. Add a new movie DVD
2. Remove a movie DVD
3. Register a new member
4. Find a registered member's phone number
0. Return to main menu
======================================
Please make a selection (1-4, or 0 to exit to main menu): 3
Enter member's first name: Smith
Enter member's last name: Jack
Enter member's address: Mary St
Enter member's phone number: 422344598
Enter member's password(4 digits): 2222
==========Staff Menu==========
1. Add a new movie DVD
2. Remove a movie DVD
3. Register a new member
4. Find a registered member's phone number
0. Return to main menu
======================================
Please make a selection (1-4, or 0 to exit to main menu): 4
Name:Mike Liu Phone Number:455698551
Name:Smith Jack Phone Number:422344598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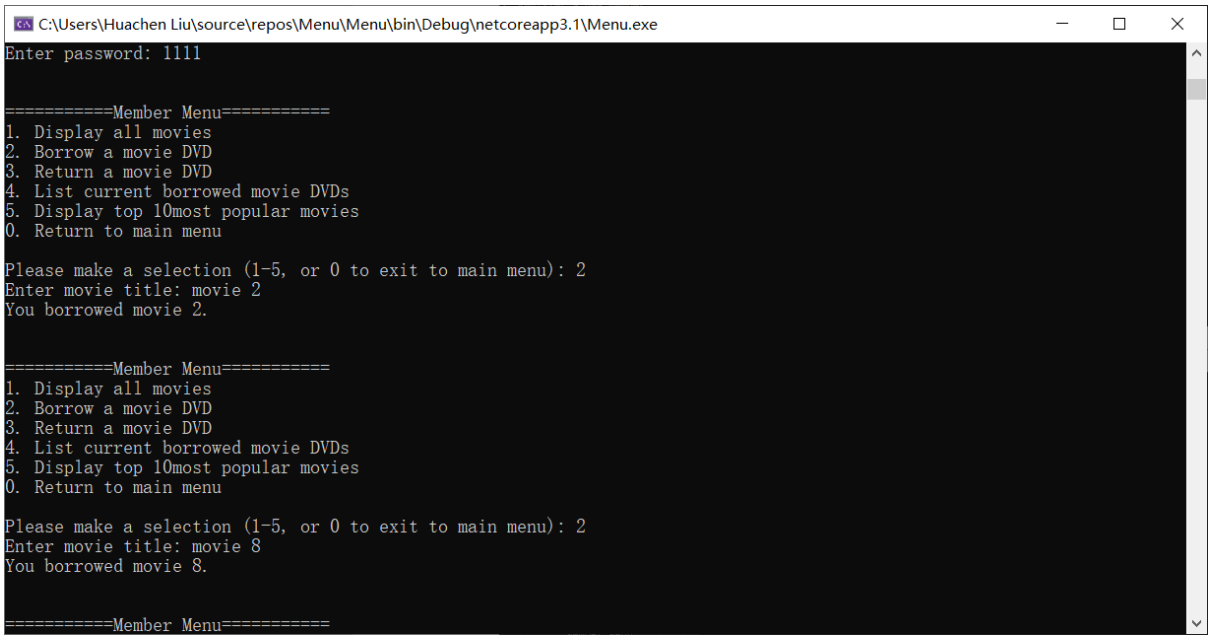
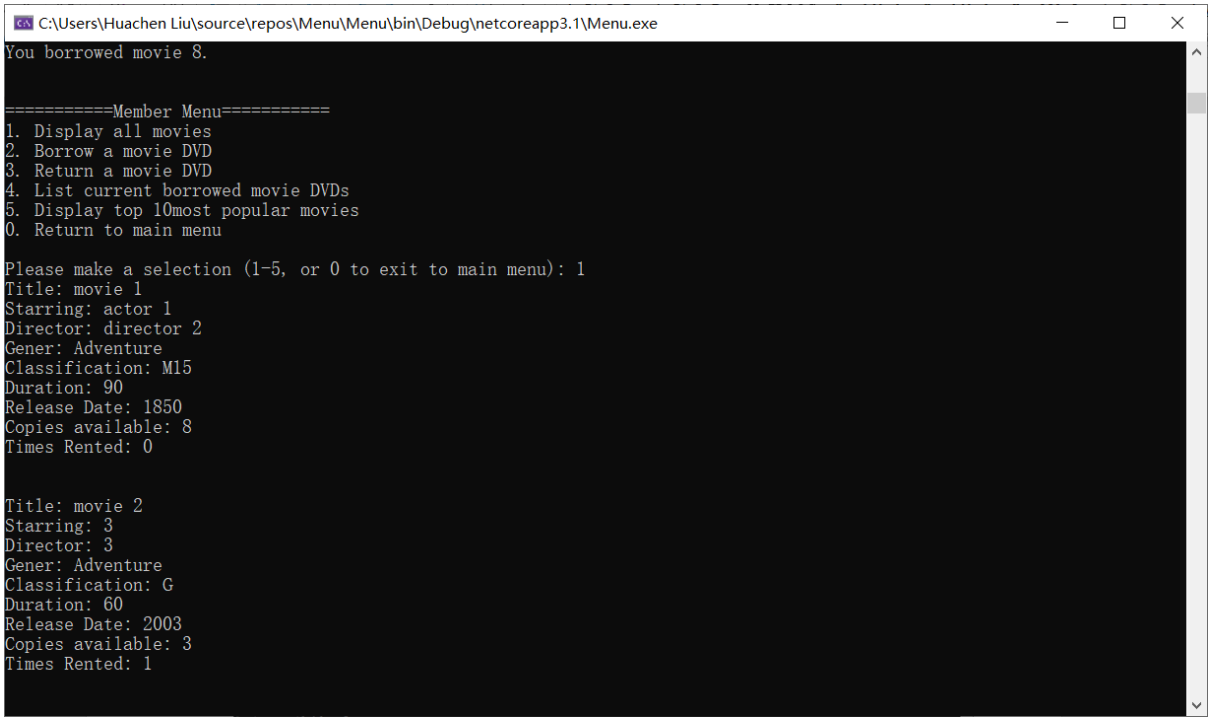
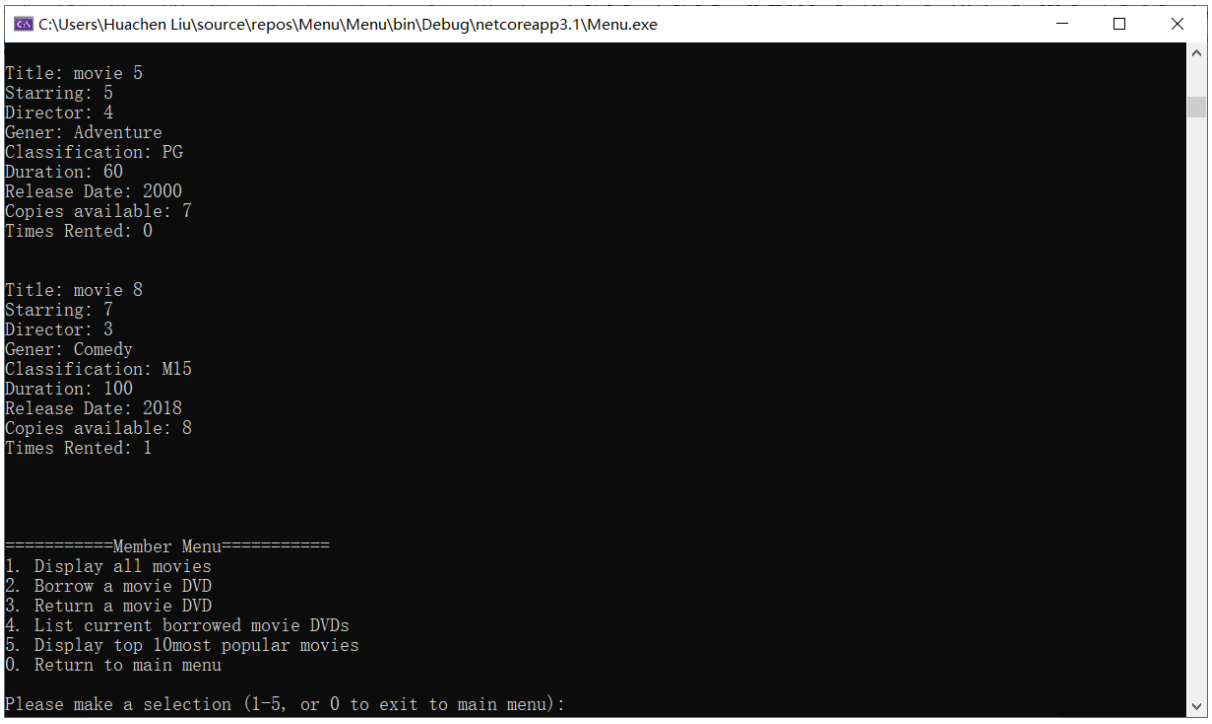
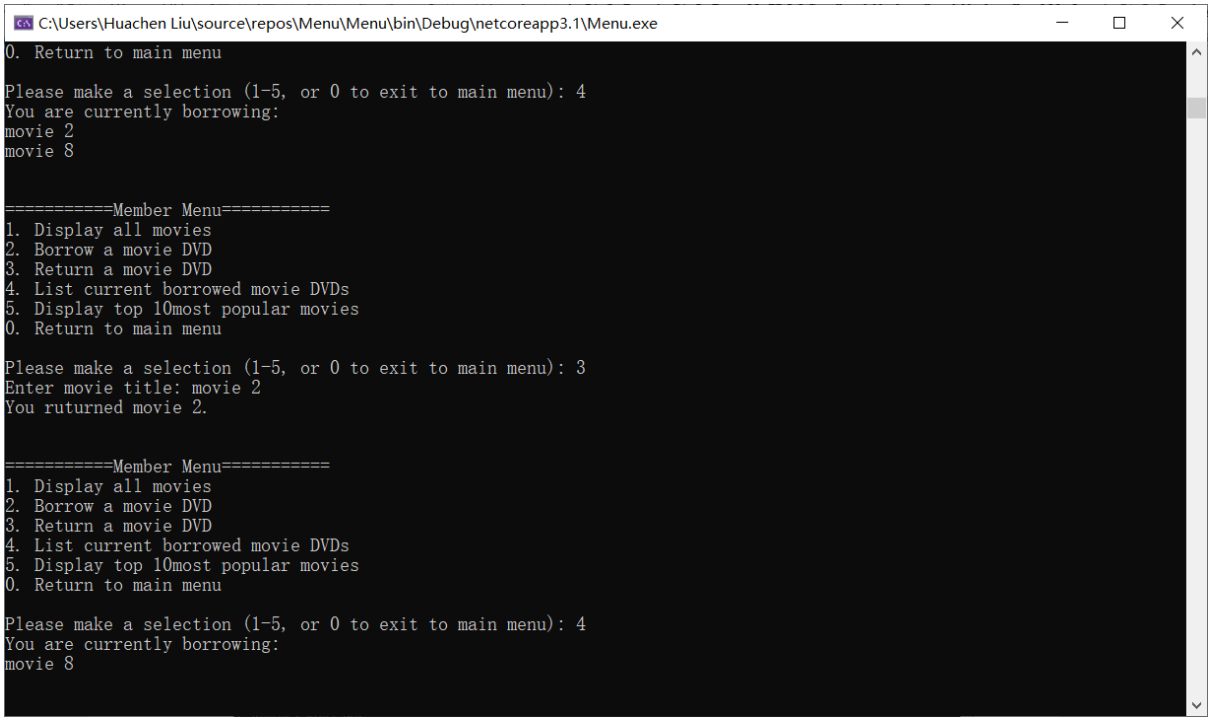
4. Find a registered member's phone number
0. Return to main menu
==========
Please make a selection (1-4, or 0 to exit to main menu): 0
Welcome to the Community Library
==========Main Menu==========
1. Staff Login
2. Member Login
0. Exit
==========
Please make a selection (1-2, or 0 to exit): 2
Enter your Username(LastnameFirstname): Mike Liu
Mike Liu is not exist!
Enter your Username(LastnameFirstname): LiuMike
Enter password: 1111
==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu):


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
Enter password: 1111
==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu): 2
Enter movie title: movie 2
You borrowed movie 2.
==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu): 2
Enter movie title: movie 8
You borrowed movie 8.
==========Member Menu==========


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
You borrowed movie 8.
==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu): 1
Title: movie 1
Starring: actor 1
Director: director 2
Gener: Adventure
Classification: M15
Duration: 90
Release Date: 1850
Copies available: 8
Times Rented: 0
Title: movie 2
Starring: 3
Director: 3
Gener: Adventure
Classification: G
Duration: 60
Release Date: 2003
Copies available: 3
Times Rented: 1


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
Title: movie 5
Starring: 5
Director: 4
Gener: Adventure
Classification: PG
Duration: 60
Release Date: 2000
Copies available: 7
Times Rented: 0
Title: movie 8
Starring: 7
Director: 3
Gener: Comedy
Classification: M15
Duration: 100
Release Date: 2018
Copies available: 8
Times Rented: 1
==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu):


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
0. Return to main menu

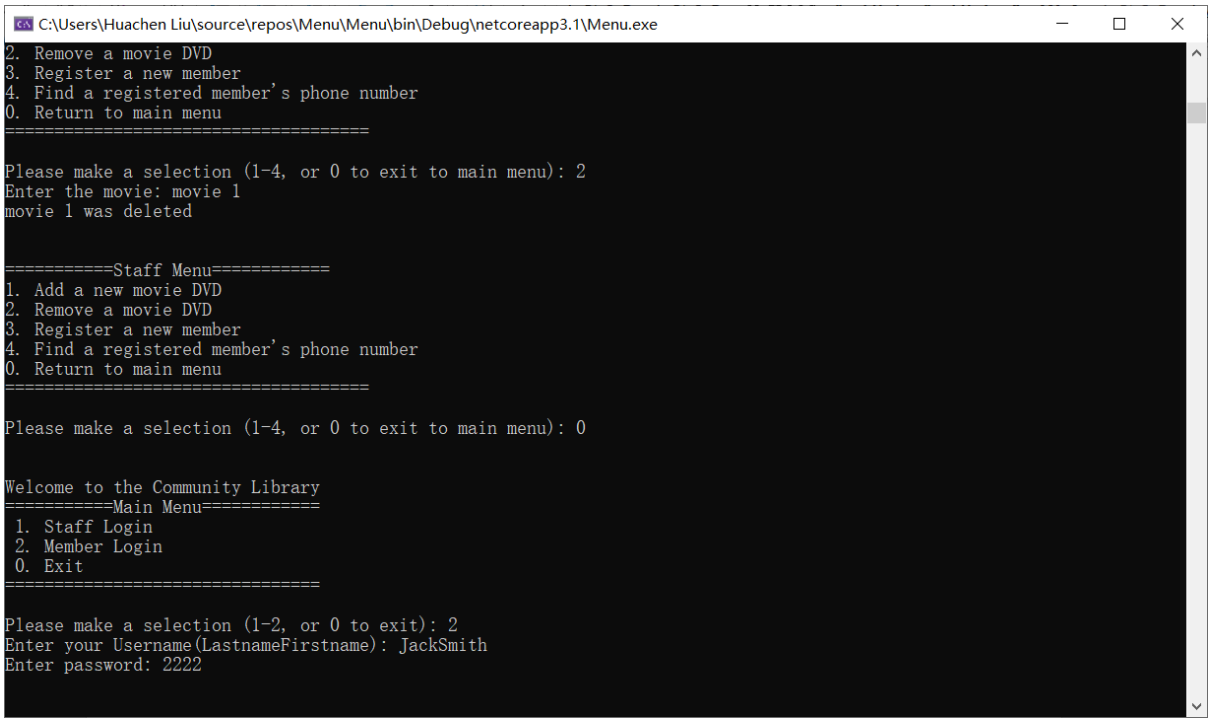
Please make a selection (1-5, or 0 to exit to main menu): 4
You are currently borrowing:
movie 2
movie 8

==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu

Please make a selection (1-5, or 0 to exit to main menu): 3
Enter movie title: movie 2
You ruturned movie 2.

==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu

Please make a selection (1-5, or 0 to exit to main menu): 4
You are currently borrowing:
movie 8


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
2. Remove a movie DVD
3. Register a new member
4. Find a registered member's phone number
0. Return to main menu
====================================

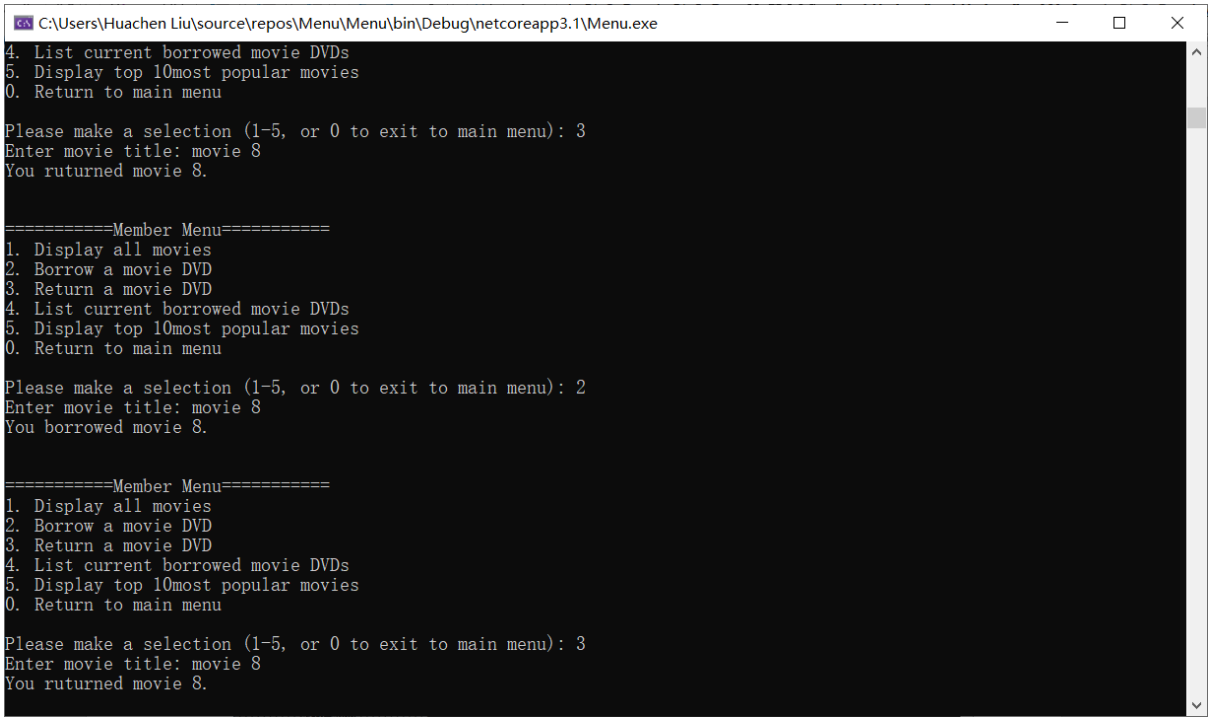
Please make a selection (1-4, or 0 to exit to main menu): 2
Enter the movie: movie 1
movie 1 was deleted

==========Staff Menu==========
1. Add a new movie DVD
2. Remove a movie DVD
3. Register a new member
4. Find a registered member's phone number
0. Return to main menu
====================================

Please make a selection (1-4, or 0 to exit to main menu): 0

Welcome to the Community Library
==========Main Menu==========
 1. Staff Login
 2. Member Login
 0. Exit
==============================

Please make a selection (1-2, or 0 to exit): 2
Enter your Username(LastnameFirstname): JackSmith
Enter password: 2222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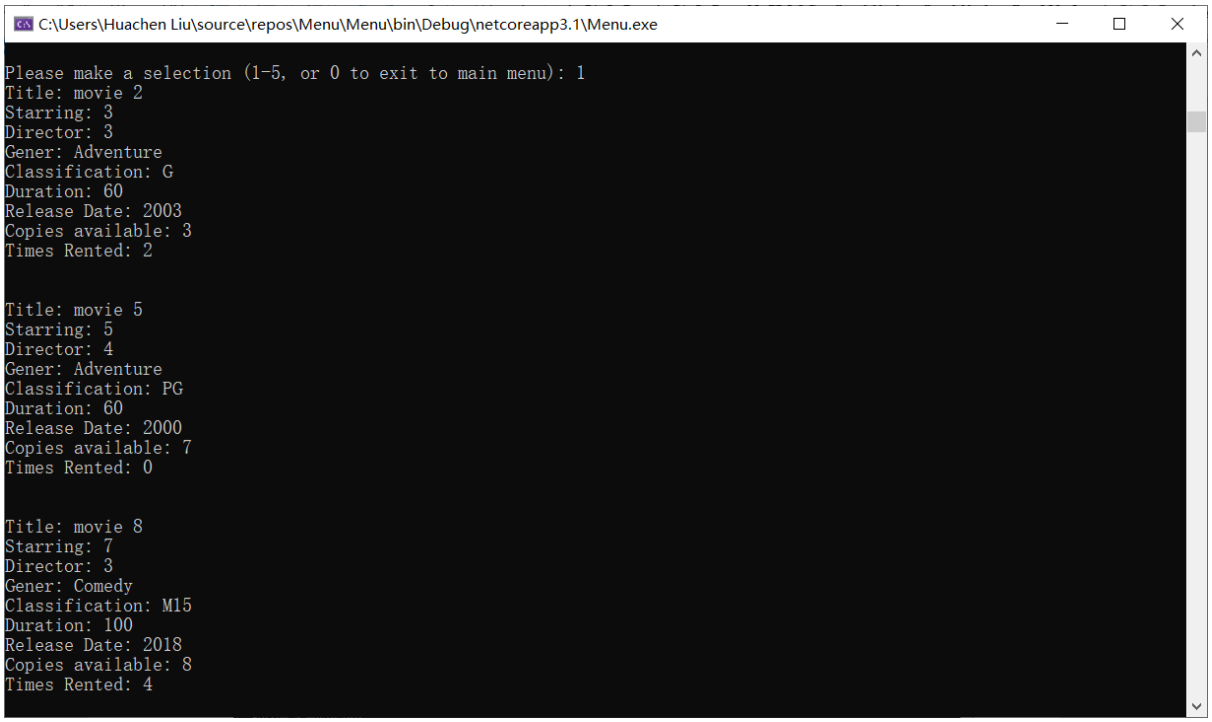
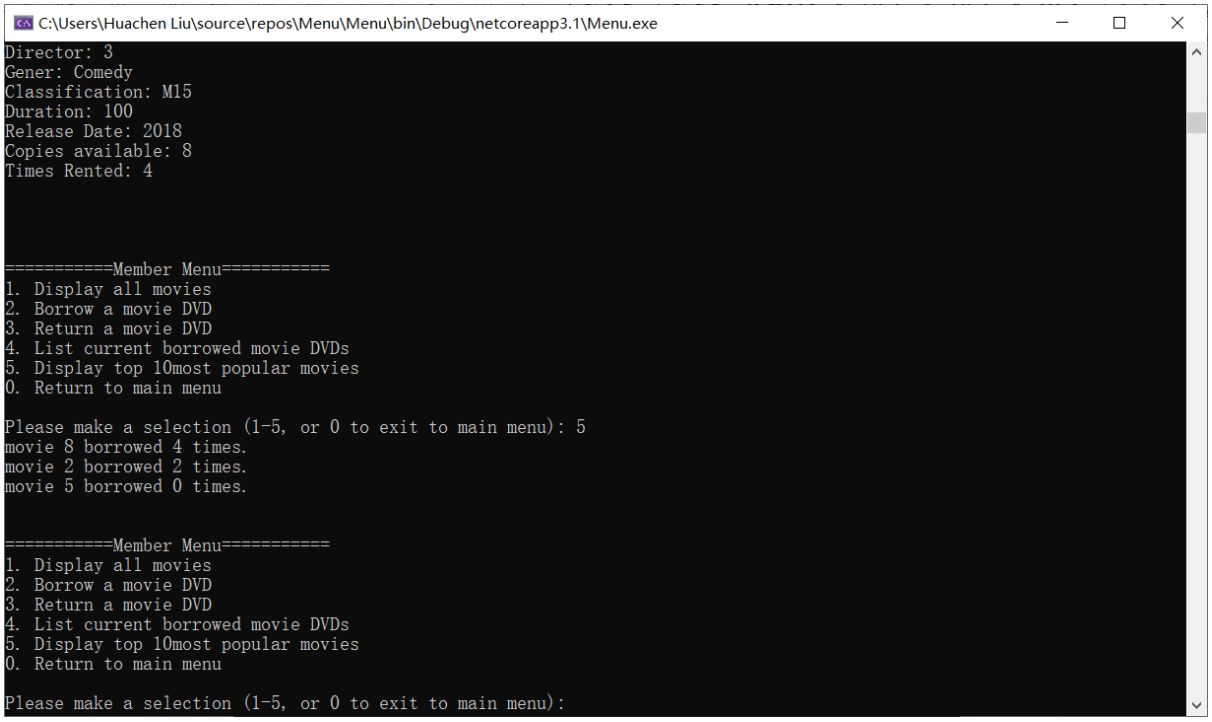
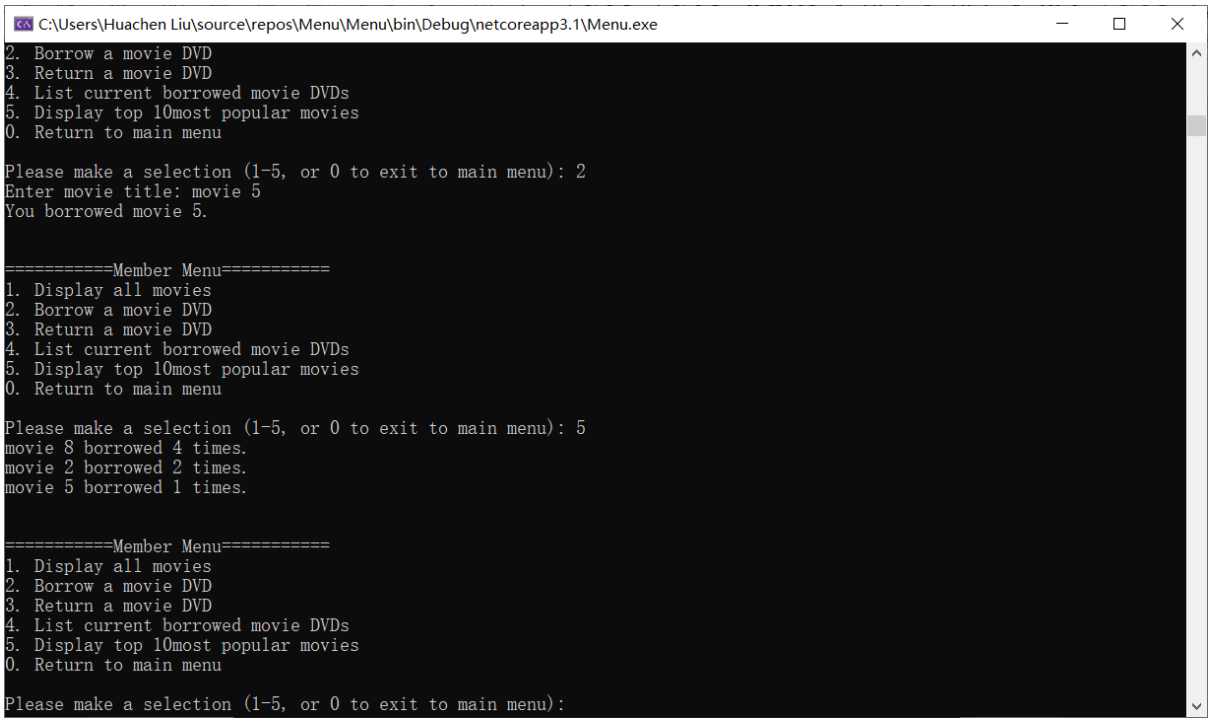
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu): 3
Enter movie title: movie 8
You ruturned movie 8.
==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu): 2
Enter movie title: movie 8
You borrowed movie 8.
==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu): 3
Enter movie title: movie 8
You ruturned movie 8.


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
Please make a selection (1-5, or 0 to exit to main menu): 1
Title: movie 2
Starring: 3
Director: 3
Gener: Adventure
Classification: G
Duration: 60
Release Date: 2003
Copies available: 3
Times Rented: 2
Title: movie 5
Starring: 5
Director: 4
Gener: Adventure
Classification: PG
Duration: 60
Release Date: 2000
Copies available: 7
Times Rented: 0
Title: movie 8
Starring: 7
Director: 3
Gener: Comedy
Classification: M15
Duration: 100
Release Date: 2018
Copies available: 8
Times Rented: 4


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
Director: 3
Gener: Comedy
Classification: M15
Duration: 100
Release Date: 2018
Copies available: 8
Times Rented: 4
==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu): 5
movie 8 borrowed 4 times.
movie 2 borrowed 2 times.
movie 5 borrowed 0 times.
==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu):


C:\Users\Huachen Liu\source\repos\Menu\Menu\bin\Debug\netcoreapp3.1\Menu.exe
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu): 2
Enter movie title: movie 5
You borrowed movie 5.
==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu): 5
movie 8 borrowed 4 times.
movie 2 borrowed 2 times.
movie 5 borrowed 1 times.
==========Member Menu==========
1. Display all movies
2. Borrow a movie DVD
3. Return a movie DVD
4. List current borrowed movie DVDs
5. Display top 10most popular movies
0. Return to main menu
Please make a selection (1-5, or 0 to exit to main menu):