

Displaying top 10 borrowed movies

For displaying the top 10 borrowed movies, I utilise an insertion sort algorithm and a function to output only the first 10 elements of an array. For my implementation, the static array containing a list of all the movies is updated at the same time a new movie is added or deleted from the movie collection.

ALGORITHM *InsertionSort()*

//Sorts a static array $A[0 \dots n - 1]$ in descending order

for $i \leftarrow 1$ to $n - 1$ do

$v \leftarrow A[i]$

$j \leftarrow i - 1$

while $j \geq 0$ and $A[j] < v$ do

$A[j + 1] \leftarrow A[j]$

$j \leftarrow j - 1$

$A[j + 1] \leftarrow v$

The for loop iterates through the array starting from the $A[1]$ element to $A[n - 1]$. $A[0]$ is excluded in the iteration as it is part of the sorted sublist and $A[i]$ is removed from the array and stored in a temporary value v per iteration of the for loop. The while loop decrements through the sorted sublist $A[0 \dots j]$ and checks if the movie stored in v has a larger *timesBorrowed* value than the previously sorted movies. If this is the case, the movie stored in $A[j]$ is stored in $A[j + 1]$. If v has a smaller value for *timesBorrowed* than one of the sorted movies, it is inserted into the index after $A[j]$ in the sorted sublist.

The best case for this algorithm would be $\theta(n)$ if the array is already sorted in descending order according to the *timesBorrowed* value. As the elements would already be in order, is no need for the second while loop to execute. The basic operation, which is the $A[j] < v$ comparison, is only executed once for each iteration of the for loop.

$$C_{best}(n) = \sum_{i=1}^{n-1} 1 = n - 1 \in \theta(n)$$

In terms of worst case and average case, the time complexity would be $\theta(n^2)$ as mentioned in the Week 3 Lecture. If the array is initially unsorted or sorted in ascending order, both loops are executed for every iteration of the algorithm.

ALGORITHM *showTop10()*

//Iterates through sorted array and prints first 10 elements

for $k \leftarrow 0$ to 10 do

print $A[i].movieName$

print $A[i].timesRented$

Each print statement is considered to have a time complexity of $\theta(1)$. As these statements are part of a for loop executed up to 10 times, the overall time complexity of this algorithm is $\theta(n)$.

Functionality Testing Results:

Successful staff login:

```
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
Staff verification...
Enter staff username: staff
Enter staff password: today123
Successful Login!
Loading staff menu...

=====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 return to main menu):
```

Unsuccessful staff login:

```
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
Staff verification...
Enter staff username: staff
Enter staff password: today464
Incorrect password for staff login.
Returning to main menu...

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):
```

Registering a member successfully

```
Register a new member...
Please enter member's first name: Lucy
Please enter member's last name: Tran
Please enter member's contact number: 0423154634
Please enter member's address: 9 Cherry Lane
Please enter a 4 digit password: 1234
```

Registering a member with an invalid password

```
Register a new member...
Please enter member's first name: Wilson
Please enter member's last name: Nguyen
Please enter member's contact number: 0489758753
Please enter member's address: 23 Oak Street
Please enter a 4 digit password: 345
Invalid password. Please re-enter a valid password (4 digits): ok
Invalid password. Please re-enter a valid password (4 digits): 0345
Successfully added Wilson Nguyen
```

Attempt to register an existing member

```
Register a new member...
Please enter member's first name: Lucy
Please enter member's last name: Tran
Lucy Tran is already registered
```

Find member's phone number

```
Find registered member's phone number...
Please enter member's first name: Lucy
Please enter member's last name: Tran
Phone number for Lucy Tran was found to be: 0423154634
```

Attempt to find phone number for un-registered member

```
Find registered member's phone number...
Please enter member's first name: Sarah
Please enter member's last name: Smith
Phone number for Sarah Smith could not be found...
```

Verified member login

```
Member verification...
Please enter member's username (LastnameFirstname): TranLucy
Please enter member's password (4 digits): 1234
Welcome Lucy...

=====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 10 most popular movies
0. Return to main menu
=====
Please make a selection (1 - 5 or 0 to return to main menu):
```

Login with incorrect password

```
Member verification...
Please enter member's username (LastnameFirstname): TranLucy
Please enter member's password (4 digits): 5678
Could not verify user...
Returning to main menu...
```

Login with password starting with '0'

```
Member verification...
Please enter member's username (LastnameFirstname): NguyenWilson
Please enter member's password (4 digits): 0345
Welcome Wilson...

=====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 10 most popular movies
0. Return to main menu
=====
Please make a selection (1 - 5 or 0 to return to main menu):
```

Attempt to login with another member's password

```
Member verification...
Please enter member's username (LastnameFirstname): NguyenWilson
Please enter member's password (4 digits): 1234
Could not verify user...
Returning to main menu...
```

Attempt to login with password containing letters

```
Member verification...
Please enter member's username (LastnameFirstname): TranLucy
Please enter member's password (4 digits): 3d4g
Could not verify user...
Returning to main menu...
```

Adding a new movie to the movie collection [Staff Menu]

```
Add a new movie DVD...
Movie title: Spiderman
Starring actor(s): Tobey Maguire
Director: Sam Raimi
Duration (Minutes): 121
Release Date (Year): 2002

1. Drama
2. Adventure
3. Family
4. Action
5. Sci-Fi
6. Comedy
7. Animated
8. Thriller
9. Other
Genre (1 - 9): 4

1. General (G)
2. Parental Guidance (PG)
3. Mature (M15+)
4. Mature Accompanied (MA15+)
Classification (1 - 4): 2
Available copies: 4
Spiderman has been added to the movie collection...
```

After a successful member login, the new movie is shown:

```
Welcome Lucy...

=====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 10 most popular movies
0. Return to main menu
=====
Please make a selection (1 - 5 or 0 to return to main menu): 1

Displaying all movies...

Movie name: Spiderman
Starring actor(s): Tobey Maguire
Director: Sam Raimi
Duration (Hours): 121
Release date (Year): 2002
Genre: Action
Classification: PG
Available copies: 4
Times borrowed: 0
```

Attempt to add existing movie to collection

```
=====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 return to main menu): 1

Add a new movie DVD...
Movie title: Spiderman
Duplicate movie title found in movie collection!
How many additional copies would you like to add? 3
```

Available copies is updated in the member menu:

```
Displaying all movies...

Movie name: Spiderman
Starring actor(s): Tobey Maguire
Director: Sam Raimi
Duration (Hours): 121
Release date (Year): 2002
Genre: Action
Classification: PG
Available copies: 7
Times borrowed: 0
```

Display all movies shown alphabetically (Batman added to collection after Spiderman):

```
Displaying all movies...

Movie name: Batman
Starring actor(s): Jack Nicholson
Director: Tim Burton
Duration (Hours): 126
Release date (Year): 1989
Genre: Adventure
Classification: PG
Available copies: 3
Times borrowed: 0

Movie name: Spiderman
Starring actor(s): Tobey Maguire
Director: Sam Raimi
Duration (Hours): 121
Release date (Year): 2002
Genre: Action
Classification: PG
Available copies: 7
Times borrowed: 0
```

Attempt to borrow a movie that does not exist in the movie collection:

```
Borrow a movie DVD...
What movie would you like to borrow? Ironman
Ironman does not exist in library...
```

Borrowing a movie:

```
Borrow a movie DVD...
What movie would you like to borrow? Spiderman
You have successfully borrowed Spiderman
```

Displaying all the movies updates available copies and times borrowed values for Spiderman

```
Displaying all movies...

Movie name: Batman
Starring actor(s): Jack Nicholson
Director: Tim Burton
Duration (Hours): 126
Release date (Year): 1989
Genre: Adventure
Classification: PG
Available copies: 3
Times borrowed: 0

Movie name: Spiderman
Starring actor(s): Tobey Maguire
Director: Sam Raimi
Duration (Hours): 121
Release date (Year): 2002
Genre: Action
Classification: PG
Available copies: 6
Times borrowed: 1
```

The borrowed movie is also shown in the 'List current borrowed movie DVDs' menu:

```
Current borrowed movie DVDs...
Spiderman
```

Attempt to borrow the same movie again (if still borrowed)

```
Borrow a movie DVD...
What movie would you like to borrow? Spiderman
You have already borrowed Spiderman...
```

Info in *Display all movies* doesn't change for Spiderman:

```
Movie name: Spiderman
Starring actor(s): Tobey Maguire
Director: Sam Raimi
Duration (Hours): 121
Release date (Year): 2002
Genre: Action
Classification: PG
Available copies: 6
Times borrowed: 1
```

Different members have different movie records (Member Wilson hasn't borrowed any movies yet):

```
Member verification...
Please enter member's username (LastnameFirstname): NguyenWilson
Please enter member's password (4 digits): 0345
Welcome Wilson...

=====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 10 most popular movies
0. Return to main menu
=====
Please make a selection (1 - 5 or 0 to return to main menu): 4

Current borrowed movie DVDs...
No movies have been borrowed yet.
```

Attempt to borrow a movie that has no more copies available (Movie Aquaman added with 0 copies)

```
Borrow a movie DVD...
What movie would you like to borrow? Aquaman
Sorry, there are no more copies of Aquaman...
```

Info in member's (Wilson) current borrowed movie DVDs remains unchanged:

```
Current borrowed movie DVDs...
No movies have been borrowed yet.
```

Attempt to return a movie member hasn't loaned out

```
Return a movie DVD...
What movie would you like to return? Aquaman
You don't have the movie Aquaman to return...
```


This doesn't impact the available copies or times borrowed values when all movies are displayed:

```
Movie name: Aquaman
Starring actor(s): Jason Momoa
Director: James Wan
Duration (Hours): 143
Release date (Year): 2018
Genre: Action
Classification: PG
Available copies: 0
Times borrowed: 0
```

Return a movie that was loaned (Lucy):

```
Current borrowed movie DVDs...
Spiderman

=====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 10 most popular movies
0. Return to main menu
=====
Please make a selection (1 - 5 or 0 to return to main menu): 3

Return a movie DVD...
What movie would you like to return? Spiderman
You have successfully returned Spiderman

=====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 10 most popular movies
0. Return to main menu
=====
Please make a selection (1 - 5 or 0 to return to main menu): 4

Current borrowed movie DVDs...
No movies have been borrowed yet.
```

Returning Spiderman updates the available copies value when all movies are displayed:

```
Movie name: Spiderman
Starring actor(s): Tobey Maguire
Director: Sam Raimi
Duration (Hours): 121
Release date (Year): 2002
Genre: Action
Classification: PG
Available copies: 7
Times borrowed: 1
```

Attempt to borrow more than 10 movies:

Current member (Justin) has borrowed the following 10 movies:

```
Current borrowed movie DVDs...
Spiderman
Batman
Perfect Blue
The Nightmare Before Christmas
Lucy
Forrest Gump
Holes
Red Dog
Incredibles
Paprika
```

This is the output returned when they attempt to borrow another movie.

```
Borrow a movie DVD...
What movie would you like to borrow? Aquaman
You already have 10 movies borrowed. Cannot borrow anymore movies.
```

Top 10 movies:

```
Top 10 most popular movies...

1. Spiderman
Times rented: 6

2. Batman
Times rented: 5

3. Perfect Blue
Times rented: 5

4. The Nightmare Before Christmas
Times rented: 4

5. Lucy
Times rented: 4

6. Forrest Gump
Times rented: 3

7. Holes
Times rented: 2

8. Red Dog
Times rented: 2

9. Paprika
Times rented: 1

10. Incredibles
Times rented: 1
```

As there are 11 movies and the movie Aquaman had not been borrowed, it is excluded from the top 10 results.

Remove movie from collection (Movie Incredibles is removed through Staff Menu and a member had previously rented out)

If a staff member were to remove the movie *Incredibles* in the Staff Menu:

```
Remove a movie DVD...  
Enter a movie title to remove from the collection: Incredibles  
You have successfully removed Incredibles...
```

All instances of *Incredibles* is removed from member's movie records. Justin's updated borrowed movie list:

```
Current borrowed movie DVDs...  
Spiderman  
Batman  
Perfect Blue  
The Nightmare Before Christmas  
Lucy  
Forrest Gump  
Holes  
Red Dog  
Paprika
```

Updated top 10 movies list:

```
Top 10 most popular movies...  
  
1. Spiderman  
Times rented: 6  
  
2. Batman  
Times rented: 5  
  
3. Perfect Blue  
Times rented: 5  
  
4. The Nightmare Before Christmas  
Times rented: 4  
  
5. Lucy  
Times rented: 4  
  
6. Forrest Gump  
Times rented: 3  
  
7. Holes  
Times rented: 2  
  
8. Red Dog  
Times rented: 2  
  
9. Paprika  
Times rented: 1  
  
10. Aquaman  
Times rented: 0
```