

CAB301 Algorithms and Complexity - Semester 1 2020

Development of a Software Application for a Community Library to Manage its Movie DVDs

Written in \LaTeX



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1 Top 10 most frequently borrowed movie algorithm

Return top 10 Movies($\mathcal{B}[m(\text{root})]$)

```
//Uses a generic BinarySearchTree class I created
//This class is iterable using in-order traversal
//Uses a MoviePair class to store name of movie and number of borrows
//MoviePair comparable such that MoviePair objects with more borrows are seen as
//being less than those with less borrows
//Input: A Binary Search Tree of Movies
//Output: An array of movie names associated with the top ten movies
1:  $\mathcal{T}[mp] \leftarrow \phi$  //Initialized BST of MoviePair with root null
2:  $A[0..9] \leftarrow \phi$  //Initializes empty array of 10 items
3: for each  $m \in \mathcal{B}$  do //For each movie in the BST
4:    $mp \leftarrow m[m.name, m.borrows]$ 
5:    $\mathcal{T}[mp].addNode(mp)$ 
6:  $i = 0$ 
7: for each  $mp \in \mathcal{T}[mp]$  do
8:   if  $i = 10$  then
9:     break
10:   $A[i] = mp.name$ 
11:   $i \leftarrow i + 1$ 
12: return  $A[1..9]$ 
```

2 Analysis of the Top 10 Algorithm

In examining the first for loop the either operation $mp \leftarrow m[m.name, m.borrows]$ or $\mathcal{T}[mp].addNode(mp)$ could be consider the basic operations. These basic operations are in a for loop which iterates over each node in the input Binary Search Tree. Since the number of movies in the BST equates to the input size n then the time complexity of the first for loop could be consider $c(n) = n$. Now since the second for loop contains a break within it that breaks after 10 iterations. Its complexity can therefore be considered a constant and does not need to be considered. Thus leaving the efficiency as $c(n) = n$ and the asymptotic efficiency class as $c(n) = \Theta(n)$.

3 Demonstration of the Community Library Movie Management Software

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

Please make a selection (0-2, or 0 to return to main menu): 1
Enter username: staff
Enter Password: today12
Invalid Credentials

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

Please make a selection (0-2, or 0 to return to main menu): 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 (0-4, or 0 to return to main menu):
```

Figure 1: Logging in as a staff member

As can be seen when logging in with invalid credentials the access is refused. When logging in with the valid staff credentials the user is returned the 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 (0-4, or 0 to return to main menu): 1
Enter the movie title: Avatar
Enter the starring actors(s): Actor1, Actor 2
Enter the director(s): Director 1, Director 2

Select the genre:
1. Drama
2. Adventure
3. Family
4. Action
5. Sci-Fi
6. Comedy
7. Animation
8. Thriller
9. Other
Make selection(1-9): 3

Select the classification:
1. General (G)
2. Parental Guidance (PG)
3. Mature (M15+)
4. Mature Accompanied (MA15+)
Make Selection(1-4): 2
Enter the duration (minutes): 150
Enter the release date (year): 2010
Enter the number of copies available: 5

Avatar has been added.
```

Figure 2: Staff creating a new movie

The user can then select 1 in order to add a new movie. They are then presented with a series of prompts in order to select the movie attributes. These include the movie title, list of directors, a list of actors, the genre, classification, duration, release date and available copies

```

5. Sci-Fi
6. Comedy
7. Animation
8. Thriller
9. Other
Make selection(1-9): 3

Select the classification:
1. General (G)
2. Parental Guidance (PG)
3. Mature (M15+)
4. Mature Accompanied (MA15+)
Make Selection(1-4): 2
Enter the duration (minutes): 150
Enter the release date (year): 2010
Enter the number of copies available: 5

Avatar has been added.

=====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 (0-4, or 0 to return to main menu): 1
Enter the movie title: Avatar
Enter the number of copies you would like to add: 5
There are now 10 copies of Avatar

=====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 (0-4, or 0 to return to main menu):

```

Figure 3: Adding copies to the movie

If the user re-enters the number 1 once returned back to the staff menu and then enters an existing movie. As can be seen they can add additional copies of the movie.

```

Enter the movie title: Avatar
Enter the number of copies you would like to add: 5
There are now 10 copies of Avatar

=====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 (0-4, or 0 to return to main menu): 3
Enter member's first name: John
Enter member's last name: Smith
Enter member's address: 1 James st
Enter member's phone number: 0123456789
Enter member's password(4 digits): 1234
Successfully added John Smith
=====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 (0-4, or 0 to return to main menu): 4
Please enter member's first name: John
Please enter member's last name: Smith
John Smith's number is 123456789

=====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 (0-4, or 0 to return to main menu): |

```

Figure 4: Creating a New User and Searching for their number

From the staff menu the user can also add a user by entering 3. They are then prompted to enter the following details about the user: first name, last name, address, number, and a four digit password. As seen above once the user is created their number can also be retrieved.

```

Please enter member's last name: Smith
John Smith's number is 123456789

=====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 (0-4, or 0 to return to main menu): 3
Enter member's first name: John
Enter member's last name: Smith
John Smith has already registered.

=====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 (0-4, or 0 to return to main menu): 1
Enter the movie title: BeeMovie
Enter the staring actors(s): MoreActors
Enter the director(s): aDirector

Select the genre:
1. Drama
2. Adventure
3. Family
4. Action
5. Sci-Fi
6. Comedy
7. Animation
8. Thriller
9. Other
Make selection(1-9): 4

```

Figure 5: Registering a user a second time

As can be seen, a user of the same name cannot be added to the system twice. After which two a couple more movie where create for demonstration

```

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 (0-4, or 0 to return to main menu): 0

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

Please make a selection (0-2, or 0 to return to main menu): 2
Enter username: SmithJohn
Enter Password: 1244
Invalid Credentials

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

Please make a selection (0-2, or 0 to return to main menu): 2
Enter username: SmithJohn
Enter Password: 1234

=====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 (0-5, or 0 to return to main menu):

```

Figure 6: Logging in as a member

Using 0 to return to the main menu a user can then log in with as an existing staff menu provided the correct password is provided.

```
Please make a selection (0-5, or 0 to return to main menu): 1
```

```
Title: Avatar  
Starring: Actor1, Actor 2  
Director(s): Director 1, Direcotor 2  
Genre: Family  
Classification: Parental Guidance (PG)  
Release Date: 2010  
Duration: 150 minutes  
Copies Available: 10  
Times Rented: 0
```

```
Title: BeeMovie  
Starring: MoreAcotrs  
Director(s): aDirector  
Genre: Action  
Classification: Parental Guidance (PG)  
Release Date: 2010  
Duration: 200 minutes  
Copies Available: 5  
Times Rented: 0
```

```
Title: Cast Away  
Starring: one Actor, two Actor  
Director(s): director  
Genre: Thriller  
Classification: Mature Accompanied (MA15+)  
Release Date: 2009  
Duration: 200 minutes  
Copies Available: 1  
Times Rented: 0
```

```
Title: Godzilla  
Starring: actor  
Director(s): director  
Genre: Sci-Fi  
Classification: Mature (M15+)  
Release Date: 2008
```

Figure 7: Displaying Movies Alphabetically

From the member menu a user can display movies by entering the number 1. As can be see each movie is displayed with all its information and in alphabetical order

```
Duration: 60 minutes
Copies Available: 0
Times Rented: 0

=====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 (0-5, or 0 to return to main menu): 2
Please enter the movie you wish to borrow: Cast Away
You have borrowed the movie Cast Away

=====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 (0-5, or 0 to return to main menu): 3
Enter the movie you wish to return: Godzilla
Invalid movie name

=====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 (0-5, or 0 to return to main menu):
```

Figure 8: Borrowing a movie

Once back at the staff menu that the user is returned to they can select 2 and enter the name of the movie they wish to borrow. Notice if the movie is a movie that has no copies available, such as Godzilla. The user is unable to borrow it.

```
Please make a selection (0-5, or 0 to return to main menu): 1

Title: Avatar
Starring: Actor1, Actor 2
Director(s): Director 1, Direcotor 2
Genre: Family
Classification: Parental Guidance (PG)
Release Date: 2010
Duration: 150 minutes
Copies Available: 10
Times Rented: 0

Title: BeeMovie
Starring: MoreAcotrs
Director(s): aDirector
Genre: Action
Classification: Parental Guidance (PG)
Release Date: 2010
Duration: 200 minutes
Copies Available: 5
Times Rented: 0

Title: Cast Away
Starring: one Actor, two Actor
Director(s): director
Genre: Thriller
Classification: Mature Accompanied (MA15+)
Release Date: 2009
Duration: 200 minutes
Copies Available: 0
Times Rented: 1

Title: Godzilla
Starring: actor
Director(s): director
Genre: Sci-Fi
Classification: Mature (M15+)
Release Date: 2008
```

Figure 9: Times rented incremented and copies available is decremented

Now notice that since Cast Away has now been borrowed their are now no longer any copies available. Also since it was rented its now been recorded that its been rented once.

```

=====

Please make a selection (0-5, or 0 to return to main menu): 4
You have borrowed the following movies:
Cast Away

=====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 (0-5, or 0 to return to main menu): 3
Enter the movie you wish to return: Cast Away
You returned the movie Cast Away

=====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 (0-5, or 0 to return to main menu): 4
You have no borrowed movies

=====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 (0-5, or 0 to return to main menu):

```

Figure 10: Listing borrowed movies

From the member menu it can be seen above that by entering 4 the member can view their borrowed movies. Notice that it lists the movie Cast Away then after returning the movie using 3 and entering the name again. It now states that they have no borrowed movies

```
Please make a selection (0-5, or 0 to return to main menu): 1

Title: Avatar
Starring: Actor1, Actor 2
Director(s): Director 1, Direcotor 2
Genre: Family
Classification: Parental Guidance (PG)
Release Date: 2010
Duration: 150 minutes
Copies Available: 10
Times Rented: 0

Title: BeeMovie
Starring: MoreAcotrs
Director(s): aDirector
Genre: Action
Classification: Parental Guidance (PG)
Release Date: 2010
Duration: 200 minutes
Copies Available: 5
Times Rented: 0

Title: Cast Away
Starring: one Actor, two Actor
Director(s): director
Genre: Thriller
Classification: Mature Accompanied (MA15+)
Release Date: 2009
Duration: 200 minutes
Copies Available: 1
Times Rented: 1

Title: Godzilla
Starring: actor
Director(s): director
Genre: Sci-Fi
Classification: Mature (M15+)
Release Date: 2008
```

Figure 11: Copies incremented again once movie returned

Notice now that the movie Cast Away now has copies available since its been returned

```
Please make a selection (0-5, or 0 to return to main menu): 0

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

Please make a selection (0-2, or 0 to return to main menu): 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 (0-4, or 0 to return to main menu): 2
Enter the name of the movie you wish to delete: Godzilla
The movie Godzilla 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 (0-4, or 0 to return to main menu): 0

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

Figure 12: Deleting Movie

As seen above, entering zero returns the user to the main menu. Now a staff member logs in and by selecting 2 they are able to remove a movie Godzilla

```
4. List current borrowed movie DVDs
5. Display top 10 most popular movies
0. Return to main menu
=====

Please make a selection (0-5, or 0 to return to main menu): 1

Title: Avatar
Starring: Actor1, Actor 2
Director(s): Director 1, Direcotor 2
Genre: Family
Classification: Parental Guidance (PG)
Release Date: 2010
Duration: 150 minutes
Copies Available: 10
Times Rented: 0

Title: BeeMovie
Starring: MoreAcotrs
Director(s): aDirector
Genre: Action
Classification: Parental Guidance (PG)
Release Date: 2010
Duration: 200 minutes
Copies Available: 5
Times Rented: 0

Title: Cast Away
Starring: one Actor, two Actor
Director(s): director
Genre: Thriller
Classification: Mature Accompanied (MA15+)
Release Date: 2009
Duration: 200 minutes
Copies Available: 1
Times Rented: 1

=====Member Menu=====
```

Figure 13: Movie deleted

Now returning to the main menu, then logging in as a member again and displaying movies. It can be seen that the movie Godzilla is gone