ALGORITHM DisplayTopTenRented (Root, Comparator)

//Sort the root node with the comparator (in decreasing rented number order), then print the top 10 through in-order traversal

afterSort <- Sort(null, Root, Comparator)

Inorder(afterSort,10)

ALGORITM Sort(Acc, ToSort, Comparator)

//Sort the tree in order that is defined by the comparator

//Input: Acc, ToSort, Comparator

//Output: return the node after sorted

If current = null

   return null

else

   afterSort <- add(Acc,ToSort,Comparator)

   afterSort <- Sort(afterSort, ToSort.left, Comparator)

   afterSort <- Sort(afterSort, ToSort.right, Comparator)

   return afterSort

ALGORITM Inorder(Node, k)

//Print top k elements of the node with BST in-order traversal

//printed is a **global** variable that is initially 0

//Input: Node, k

Inorder(Node.left, k)

If printed >= k **return**

print the current element

if (++printed >= k) **return**

Inorder(Node.right, k)

Time Complexity Analysis

1. The first part of the algorithm is to sort the BST by the decreasing rented number, which is implemented by copying the entire original BST to another BST which has the comparator that compares the rented number of the nodes.

   The main operations include pre-order traversal and adding the element into the BST. The time complexity to travel through all the elements in the original BST is O(n) and it will add the element to the new BST which will consume O(logn) each. As a result, it will be O(n logn) overall.

2. The second part of the algorithm is to print the top k elements from the new BST, which will be O(k). In this assignment, the k is 10.

3. The overall time complexity of the algorithm is O(nlogn + k) or O(nlogn + 10) = O(nlogn).

Functional Testing

1. Staff Login

Figure 1 Successfully 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 Login:
Enter username: staff
Enter password: today123
You successfully login!

==========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): |
```

Figure 2 Failed to 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 Login:
Enter username: staff
Enter password: asdfasdf
Failed to 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): |
```

2. Add movie DVDs

Figure 3 Add Movie (not available currently)

```
Please make a selection (1-4 or 0 to return to main menu): 1
Adding movie...
Enter the movie title: Monster
Starring: 5
Director: Tom Hanks
Duration: 5 mins

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

Select the classification
1. General (G)
2. Parental Guidance (PG)
3. Mature (M15+)
4. Mature Accompanied (MA15+)
Please make a selection (1-4):2
Release Date: 2019
Enter the number of copies available: 4
Added 4 copies of Monster
```

Figure 4 Add copies (if available)

```
Please make a selection (1-4 or 0 to return to main menu): 1
Adding movie...
Enter the movie title: Monster
Enter the number of copies available: 5
Added 5 copies of Monster
```

3. Remove movie DVD

Figure 5 The movie was removed

```
=========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): 2
Removing movie...
Enter movie title: Monster
Monsterwas removed
```

4. Add member

Figure 6 Successfully 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 (1-4 or 0 to return to main menu): 3
Enter member's first name: A
Enter member's last name: B
Enter member's address: 21 Enoggera St
Enter member's phone number: 0423668021
Enter member's password(4-digit integer):1234
Successfully added A B
```

Figure 7 Repeated enquiry if the password is not 4-digit password

```
==========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): 3
Enter member's first name: Q
Enter member's last name: W
Enter member's address: 21 Eran St
Enter member's phone number: 0919009019
Enter member's password(4-digit integer):13345
Enter member's password(4-digit integer):abcd
Enter member's password(4-digit integer):1234
Successfully added Q W
```

5. Find member contact no.

Figure 8 Find the contact no

```
==========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): 4
Enter member's first name: A
Enter member's last name: B
A B phone number is: 0423668021
```

```
=========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): 4
Enter member's first name: b
Enter member's last name: a
The member is not found
```

6. Member Login

Figure 10 Successfully 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): 2
Member Login:
Enter username(LastnameFirstname): BA
Enter password: 1234
You successfully login!
```

Figure 11 Failed to 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): 2
Member Login:
Enter username(LastnameFirstname): BA
Enter password: 12222
Failed to login!
```

7. Display all the information about all the movie DVDs in alphabetical order

Figure 12 Display the information


```
=========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

All library's collections:
Title: Monster
Starring: 5
Director: Tom Hanks
Genre: Drama
Classification: Parental Guidance (PG)
Duration: 5 mins
Release Date: 2019
Copies of available: 9
Times rented: 0

Title: Storm
Starring: 5
Director: Milo Duo
Genre: Drama
Classification: General (G)
Duration: 5 mins
Release Date: 2013
Copies of available: 5
Times rented: 0
```

8. Borrow the movie DVD

Figure 13 Successfully borrowed

```
==========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): 2
Enter the movie title: Monster
You borrowed Monster
```

Figure 14 Try to borrow when the user has got one

```
Please make a selection (1-5 or 0 to return to main menu): 2
Enter the movie title: Monster
You've already borrowed Monster
```

9. Return the movie DVD

Figure 15 Returned the DVD

```
==========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
Enter the movie title: Monster
You returned Monster
```

10. List current borrowing movies

Figure 16 None was displayed since the only borrowed DVD was returned

```
==========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


You are currently borrowing:
```

Figure 17 If borrow the movie again

```
Please make a selection (1-5 or 0 to return to main menu): 2
Enter the movie title: Monster
You borrowed Monster


=========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

You are currently borrowing:
Monster
```

11. Display top 10 most popular movies

Figure 18 Junit testing

```java
@Test
public void displayTopTenRented(){

    for (int i = 0; i < 15; i++){
        movies.addCopies(new Movie( title: "movie" + i),  copies: 5);
    }

    assertDoesNotThrow(() -> movies.rent( movieTitle: "movie0",  amount: 2));
    assertDoesNotThrow(() -> movies.rent( movieTitle: "movie1",  amount: 3));
    assertDoesNotThrow(() -> movies.rent( movieTitle: "movie2",  amount: 1));

    movies.displayTopTenRented();
}
```

```
movie1 borrowed 3 times.
movie0 borrowed 2 times.
movie2 borrowed 1 times.
movie9 borrowed 0 times.
movie8 borrowed 0 times.
movie7 borrowed 0 times.
movie6 borrowed 0 times.
movie5 borrowed 0 times.
movie4 borrowed 0 times.
movie3 borrowed 0 times.
```