

## Project report – Sohichi Kitai- n10140981

(1) An algorithm that I implemented for displaying top 10 borrowed movie list.

### BST

I used a simple binary search tree algorithm, which is different from the one implemented for storing movies, to sort borrowed movie times in descending order.

In other words, the new BST stores movie lists corresponding to main BST when new nodes are made, but order and the base of comparing two nodes are different. The main BST compares two nodes by movie title using the “CompareTo()” function, whereas, the BST for sorting uses the numbers of a Borrowed time to compare each node. Every time when users decide to display the top 10 rankings, the new binary search just displays ranking in descending order by just using the BST algorithm. I initially tried to use other sorting algorithms, but I just realized that using a new BST is much easier than implementing a new sort algorithm.

```
//This function is used for creating a new BST to display top 10 popular movies.
public void Insert_sort(Movie[] value) {

    Node newnode = new Node();

    newnode.item = value;

    if (sort_root == null)
    {
        sort_root = newnode;
    }
    else
    {
        Node current = sort_root;

        Node parent;

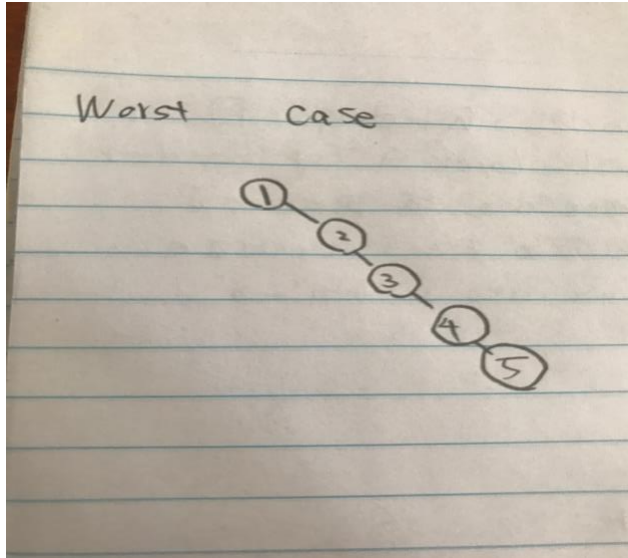
        while (current != null)
        {
            parent = current;
            ///Using nested foreach to compare given node value and current node value.
            foreach (var values in value)
            {
                foreach (var current_value in current.item)
                {
                    ///Compare two title to find a name comes first in alphabetical order.
                    if (values.Borrowed_time <= current_value.Borrowed_time)
                    {
                        current = current.Left;

                        if (current == null)
                        {
                            parent.Left = newnode;
                        }
                    }
                    else
                    {
                        current = current.Right;
                        if (current == null)
                        {
                            parent.Right = newnode;
                        }
                    }
                }
            }
        }
    }
}
```

(2) Analysis of time complexity of the algorithm that I implemented.

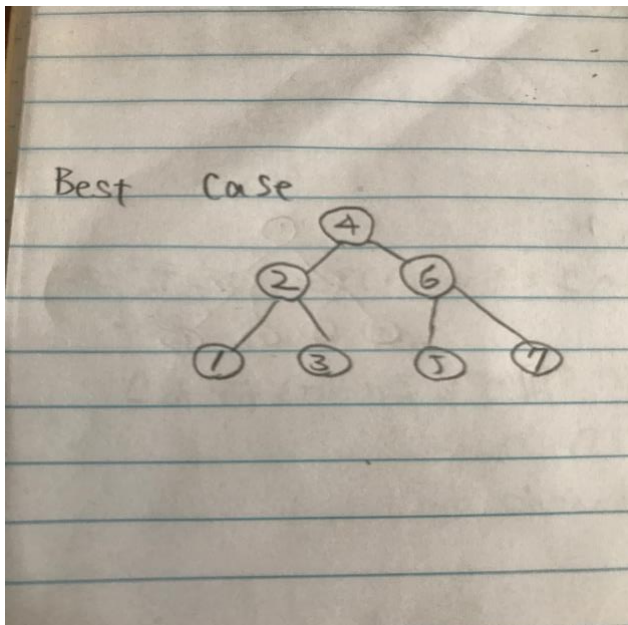
I use "if(values.Borrowed\_time <= current.Borrowed\_time)" as elementary operation, as you can see above the picture. The time complexity for all BST operations such as, insertion, deletion, and find node, are all  $O(h)$ , where  $h$  is the height of a BST. Thus time complexity of BST is  $O(h)$ .

Worst Case:



Considering the worst case of a BST, in case of worst case, the BST have to be a skewed BST, and we have to go through from the root node to the deepest node. As matter of the fact, the height of BST will be  $n$ . Thus the worst case of BST become  $O(h)$ .

Best Case:



Considering the best case of a BST, in case of best case, that means the BST is a balanced BST. Besides, the height of the BST is  $\log(n)$ . Thus time complexity of BST in best case become  $O(\log(n))$ , which is considered to be efficient algorithm.

### (3) Functional testing results

Test	Positive Outcome	Negative Outcome	Edge Case	Result	Appendix
Try to login as a staff in main page	A staff can login to staff page providing proper passwords.	A staff cannot access to the staff page.	Providing wrong login information.	Pass	1
Add a new movie	A staff can add a new movie providing enough information.	A staff cannot add a new movie.	A staff provided same movie titles.	Pass	2
Remove a movie	A staff can remove existed movie from database.	A staff cannot remove a movie from lists.	A staff provided a movie title does not exist.	Pass	3
Register a new member	A staff can add a new member.	A staff cannot add a new member.	A staff provided insufficient information.	Pass	4
Find registered user's phone number	A staff can find registered member's phone number.	The application does not show phone num.	A staff provided wrong user name.	Pass	5
Return to main menu	Successfully returned to main menu	null	Users put invalid numbers.	Pass	6
Try to login as a registered member	Users try to login to member page with registered info.	Users cannot login to member page.	Users put invalid information.	Pass	7
Display all movies list	Users can display all borrowed movie lists.	Users cannot display movie lists.	Users put invalid numbers.	Pass	8
Borrow a movie	Users can borrow a movie from database.	Users cannot borrow movies.	Users put invalid movie titles.	Pass	9
Return a borrowed movie	Users can return a movie to database.	Users cannot return movies.	Users put invalid movie titles.	Pass	10
List current borrowed movie lists	Users can show what movies they have borrowed(list).	Users cannot show borrowed movie lists.	Users put invalid information.	Pass	11
Display top10 most borrowed movie lists	Users can display the top 10 most frequently borrowed lists.	Users cannot display top 10 lists.	Users put invalid numbers.	Pass	12
Borrow counter increment when it's borrowed	Borrowed counter increment when users borrowed a movie.	Borrowed counter does not increment.	null	Pass	13
Borrow counter decrement when it's borrowed	Borrowed counter decrement when users returned a movie.	Borrowed counter does not decrement.	null	Pass	14
Each user have different borrowed lists.	Users have different borrowed lists.	Users share all borrow movie lists.	null	Pass	15

#### Appendix:

(reminder: Those screenshots are not corresponding to each photos, and also intended only to demonstrate each functionality respectively.)

1)

```
=====
Welcome to Library Administrator
=====

-----
Main Menu
-----

1 : Staff Login
2 : Member Login
0 : Exit

1

Please provide the Staff username.

[staff

Please provide the Staff password.

[today123
You successfully logged in as a staff
```

2):

```
=====
-----Staff Login-----
=====
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 put 1,2,3,4, or 0
1
Enter a movie title :
[movie1
Enter a movie starring :
[actor1
Enter a movie director :
[director1
Choose a movie genre :
1): Drama
2): Adventure
3): Family
4): Action
5): Sci-Fi
6): Comedy
7): Animated
8): Thriller,
9): Other
3
Family
Choose a movie classification :
1):General (G)
2):Parental Guidance (PG)
3):Mature (M15+)
4):Mature Accompanied (MA15+)
4
Mature Accompanied (MA15+)
Enter a movie duration :
[90
Enter a movie date(year) :
[2019
Enter a number of movie copies that you want to add:
[10
```

3):

```
=====
-----Staff Login-----
=====
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 put 1,2,3,4, or 0
2
Which movie you wanna delete
[movie1
```

4):

```
=====
-----Staff Login-----
=====
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 put 1,2,3,4, or 0
3
Enter member's first name?
[souichi
Enter member's last name?
[kitai
Enter member's address?
[7 Waminda Street
Enter member's phone numbers?
[0468325935
Enter member's password?(4 digits)
[1111
```

5):

```
=====
-----Staff Login-----
=====
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 put 1,2,3,4, or 0
4
Which member's phone number you want to search?
kitaisouichi
kitaisouichi's phone number: 0468325935
```

6):

```
=====
-----Staff Login-----
=====
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 put 1,2,3,4, or 0
0

Back to Main menu
```

7):

```
=====
Welcome to Library Administrator
=====

-----
Main Menu
-----
1 : Staff Login
2 : Member Login
0 : Exit

2
Enter your username?
kitaisouichi
Enter your password(4 digits)?
1111
User is matched
You successfully logined as kitaisouichi
=====
```

8):

```
=====
-----Member Login-----
=====
1: Display all movies
2: Borrow a movie DVD
3: Return a movie DVD
4: List current borrowed movie list
5: Display top 10 most frequently borrowed movie
0: Return to main menu
=====
Please put 1,2,3,4, or 0

1
Movie Title: movie1
Movie starring: actor1
Movie director: director1
Movie genre: Family
Movie classification: Mature Accompanied (MA15+)
Movie duration: 90
Movie date: 2019
Movie copies: 10
Borrowed times: 0

Movie Title: movie2
Movie starring: actor2, actress2
Movie director: director2
Movie genre: Other
Movie classification: Parental Guidance (PG)
Movie duration: 120
Movie date: 2020
Movie copies: 10
Borrowed times: 0

Movie Title: movie3
Movie starring: actor3
Movie director: director3
Movie genre: Sci-Fi
Movie classification: General (G)
Movie duration: 90
Movie date: 2018
Movie copies: 10
Borrowed times: 0

Movie Title: movie4
Movie starring: actor4
Movie director: director4
Movie genre: Action
Movie classification: Mature (M15+)
Movie duration: 90
Movie date: 2017
Movie copies: 10
Borrowed times: 0

Movie Title: movie5
Movie starring: actor5
Movie director: director5
Movie genre: Action
Movie classification: Mature (M15+)
Movie duration: 90
Movie date: 2018
Movie copies: 10
Borrowed times: 0
```

9):

```
=====
-----Member Login-----
=====
1: Display all movies
2: Borrow a movie DVD
3: Return a movie DVD
4: List current borrowed movie list
5: Display top 10 most frequently borrowed movie
0: Return to main menu
=====
Please put 1,2,3,4, or 0

2
Which movie you want to borrow?
movie1
You succesfully borrowed movie1
```

10):

```
=====
-----Member Login-----
=====
1: Display all movies
2: Borrow a movie DVD
3: Return a movie DVD
4: List current borrowed movie list
5: Display top 10 most frequently borrowed movie
0: Return to main menu
=====
Please put 1,2,3,4, or 0

3
Which movie you want to return?
movie1
You successfully returned movie1
=====
```

11):

```
=====
-----Member Login-----
=====
1: Display all movies
2: Borrow a movie DVD
3: Return a movie DVD
4: List current borrowed movie list
5: Display top 10 most frequently borrowed movie
0: Return to main menu
=====
Please put 1,2,3,4, or 0

4
You have borrowed:
Movie1: movie1
Movie2: movie4
Movie3: movie3
```



12):

```
=====
-----Member Login-----
=====
1: Display all movies
2: Borrow a movie DVD
3: Return a movie DVD
4: List current borrowed movie list
5: Display top 10 most frequently borrowed movie
0: Return to main menu
=====
Please put 1,2,3,4, or 0

5
Movie Title: movie1
Borrowed times: 2

Movie Title: movie3
Borrowed times: 1

Movie Title: movie4
Borrowed times: 1

Movie Title: movie2
Borrowed times: 0

Movie Title: movie5
Borrowed times: 0
=====
```

13,14):

Movie Title: movie1  
Movie starring: actor1  
Movie director: director1  
Movie genre: Family  
Movie classification: Mature Accompanied (MA15+)  
Movie duration: 90  
Movie date: 2019  
Movie copies: 9  
Borrowed times: 1

Movie Title: movie2  
Movie starring: actor2, actress2  
Movie director: director2  
Movie genre: Other  
Movie classification: Parental Guidance (PG)  
Movie duration: 120  
Movie date: 2020  
Movie copies: 10  
Borrowed times: 0

Movie Title: movie3  
Movie starring: actor3  
Movie director: director3  
Movie genre: Sci-Fi  
Movie classification: General (G)  
Movie duration: 90  
Movie date: 2018  
Movie copies: 9  
Borrowed times: 1

Movie Title: movie4  
Movie starring: actor4  
Movie director: director4  
Movie genre: Action  
Movie classification: Mature (M15+)  
Movie duration: 90  
Movie date: 2017  
Movie copies: 9  
Borrowed times: 1

Movie Title: movie5

15):This is different user's login menu

```
=====
-----Member Login-----
=====
1: Display all movies
2: Borrow a movie DVD
3: Return a movie DVD
4: List current borrowed movie list
5: Display top 10 most frequently borrowed movie
0: Return to main menu
=====
Please put 1,2,3,4, or 0

4
You have borrowed:
Movie1: movie1
```