

CS 253 (Spring 2024) Assignment 2: Skip List

Problem and Requirements:

For this project, you will be completing the implementation of `SkipList` as an ordered map. The implementation shown in class is missing the following methods:

- `remove(Key k)`: delete the entry that contains the key k
- `firstEntry()`: return the entry with the smallest key value
- `lastEntry()`: Return the entry with the largest key value
- `ceilingEntry(Key k)`: return the entry with the smallest key value that is $\geq k$
- `floorEntry(Key k)`: return the entry with the largest key value that is $\leq k$
- `upperEntry(Key k)`: return the entry with the smallest key value that is $> k$
- `lowerEntry(Key k)`: return the entry with the largest key value that is $< k$

You must add these methods to the provided `SkipList.java` class to complete the implementation.

Pseudocode for Remove Algorithm

Input: Key k .

Output: If k exists in the skip list, remove it and return its value. If k does not exist on the skip list, return null.

```
p ← findEntry(k)
if p.key ≠ k then
    return null
end if { //Currently p is on the lowest level of the skip list }
value ← p.value
while p ≠ null do
    p.left.right ← p.right
    p.right.left ← p.left
end while
return value
```

Tips for the Other Methods

The `firstEntry()` and `lastEntry()` find the largest and smallest key values in the skip list. You can use the head and tail variables respectively to help find these values quickly.

For the other four methods, you can use `findEntry()` to get “near” the entry that you are looking for. From there, you simply have to make a small adjustment to ensure that you return exactly the entry that you are looking for.

Getting Started:

- Download the starter code from Canvas and understand it.
- Add the above methods.
- Run and test your program with various inputs. Use the test code that is provided to help debug, but try to alter the test code to test various cases that may occur.

Honor Code The assignment is governed by the College Honor Code and Departmental Policy. Please remember to have the following comment included at the top of the files.

```
/*  
THIS CODE WAS MY OWN WORK, IT WAS WRITTEN WITHOUT CONSULTING ANY  
SOURCES OUTSIDE OF THOSE APPROVED BY THE INSTRUCTOR. _Your_Name_Here_  
*/
```

Submission:

Submit your completed `SkipList.java` file directly within GradeScope.

Grading:

- If your program does not compile, you will get 0 points.
- Correctness
 - Your program correctly removes entries from the skip list when the key is found. (25pts)
 - The other six methods are correctly implemented (10pts each)
- Robustness (your program never crashes) (10 pts)
- Code clarity and style (5pts)