Lecture 8

Problem 8.1[15 points] Observe that whenever we reference the size attribute of a node in either OS-SELECT or OS-RANK, we use it only to compute a rank. Accordingly, suppose we store in each node its rank in the subtree of which it is the root. Show how to maintain this information during insertion and deletion. (Remember that these two operations can cause rotations.)

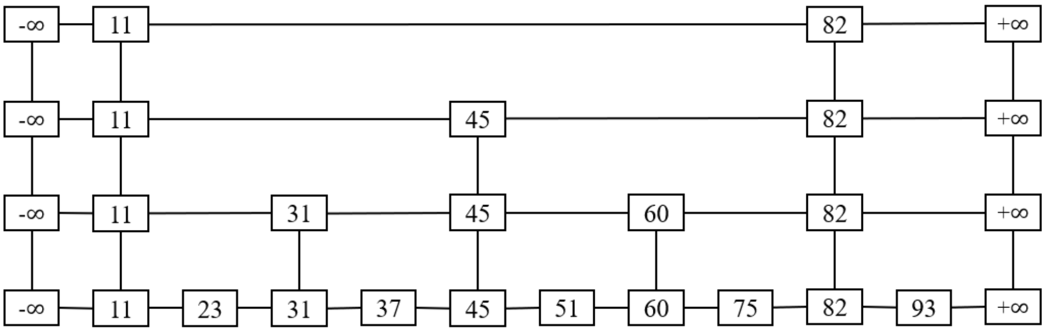
Problem 8.2[10 points] Given an interval tree T and an interval i, describe how to list all intervals in T that overlap i in O(min(n,klgn)) time, where k is the number of intervals in the output list. (Hint: One simple method makes several queries, modifying the tree between queries. A slightly more complicated method does not modify the tree.)

Lecture 9

Problem 9.1[20 points]

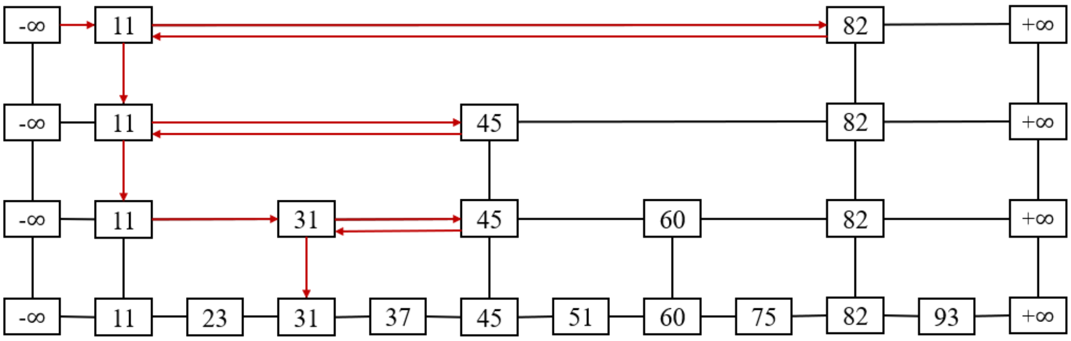
(1) Please show how to search 51 in the next skip list. Each comparison is an intermediate step, and you need to provide each step. The answer can be shown in one picture and the example is shown as follows:

(2) Please show how to search 93 in the next skip list.



Picture 1. The skip list

Search 31



Picture 2. The example of solution

Problem 9.2[20 points]

(1) Please design the data structure of the nodes in the skip list and the data structure of skip list separately.

(2) Please give the code for deleting operation in the skip list. Please give the effective C code directly instead of pseudo code whose name should be Skip_List_Delete().

Lecture 10

Problem 10.1[20 points] Suppose we perform a sequence of n operations on a data structure in which the ith operation costs i if i is an exact power of 2,and 1 otherwise. Choose any two of three methods to determine the amortized cost per operation, respectively.

Problem 10.2[15 points] Show how to implement a queue with two ordinary stacks so that the amortized cost of each ENQUEUE and each DEQUEUEDEQUEUE operation is O(1).