Algorithms

Homework 2: due 16 May 2019

1. You are to write a program that supports the following operations on order-statistic trees. An *order-statistic tree* is a red-black tree with *size* information stored in each node. We maintain a dynamic set of integers in an order-statistic tree. Assume that integers are in the range of [1..9999] and initially tree T is empty.

- OS-Insert(T, x) returns x if integer x is not already in order-statistic tree T (i.e., x is inserted); 0 otherwise.
- OS-Delete(T, x) returns x if integer x is in T (i.e., x is deleted); 0 otherwise.
- OS-Select(T, i) returns the i-th smallest integer in T if the number of integers in T is $\geq i$; 0 otherwise.
- OS-Rank(T, x) returns the rank of x among the integers in T if x is in T; 0 otherwise.

An input file contains a sequence of operations. In the input file OS-Insert$(T, 17)$ is denoted by I 17, OS-Delete$(T, 8)$ by D 8, OS-Select$(T, 5)$ by S 5, and OS-Rank$(T, 9)$ by R 9. Put a space between two operations.

2. Your program should proceed as follows.

(1) Read an input sequence and print it.

(2) Run your program on the input sequence. Print the output sequence.

(3) Check the correctness of your program by a checker program. Print the result of checking. A checker program gets the input and output sequences as its input and checks whether the output sequence is correct or not. Write a checker program by using an array $A[1..9999]$.

- Explain how your checker program works in your report.
- Hand in your report, programs, and an example running (with two input sequences) by email to `yychoi@theory.snu.ac.kr`.
- Write down the environment you run your program and how to run your program in your report.
- Write comments appropriately in your program.