DSA Mids Lab exam

Section A

May 18, 2022

Instructions for the exam

1. This is a 2 hour exam.
2. You will be submitting your problems on the OJ
3. All the data structures will be provided in a .c file. You can copy them into your code and use them as required. You can modify them as well. Please go through the template code before using it (at-least the function definitions).
4. Problems A and B are worth **100 points** each, and Problem C is worth **200** points.
5. Refer to the time limit and memory limit of each problem on OJ.

Problem A

Given a binary search tree with n nodes, return a linked list with n nodes whose i^{th} node contains the sum of the i^{th} largest element in the binary search tree and the i^{th} smallest element in the binary search tree.

For this question, you will be provided the template code in file *a.c* which will contain the ADT for binary tree and linked list. You only have to implement the function *LL* ans(BT* bt, int n)*. You can write additional methods to solve this problem, but ONLY inside the designated area specified by comments. **Any change in code outside designated area will lead to a straight 0 in this problem**.

Constraints

Number of test cases $1 \leq T \leq 100$
$1 \leq n \leq 2 \times 10^4$
$-10^8 \leq$ node values $\leq 10^8$

Input format

- First line contains an integer T, the number of test cases.
- For every test case the first line contains an integer n, the number of nodes in the binary search tree.
- Then n lines follow that contain three integers; p, wc and val. p ($-1 \leq p < n$) denotes the parent of the current node (-1 if it is the root). If wc ($-1 \leq wc \leq 1$) is 0, then the current node is the left child of the parent, and if it is 1, then the current node is the right child of the parent (It is -1 when the node is the root). val ($-10^8 \leq val \leq 10^8$) is the value of the node. *(Note that p is zero-indexed)*
- The input is a valid binary search tree.

Examples

Sample Testcase 1

Input

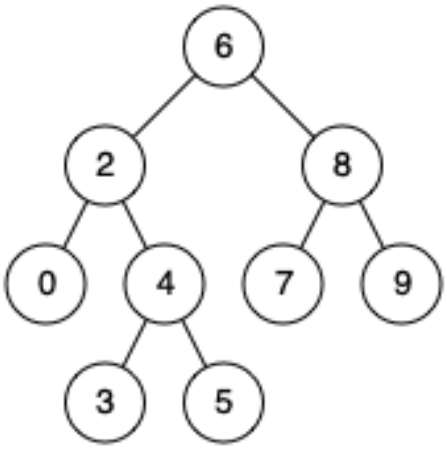
1
9
-1 -1 6
0 0 2
1 0 0
1 1 4
3 0 3
3 1 5
0 1 8
6 0 7
6 1 9

Output

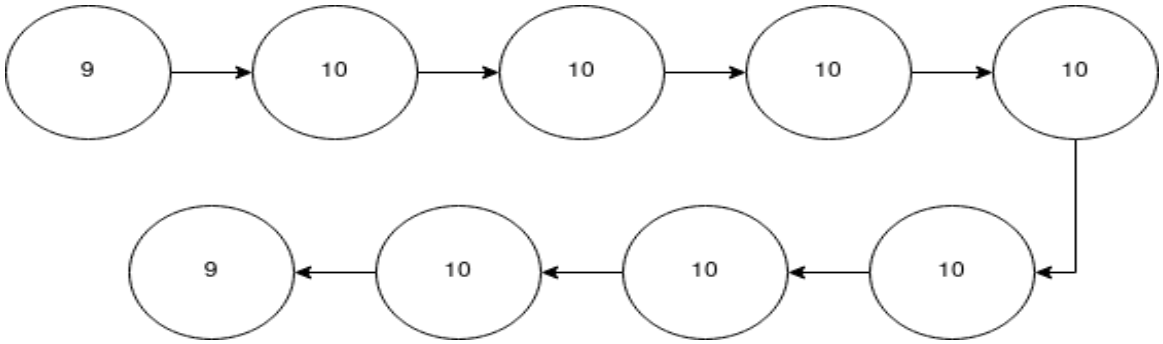
9 10 10 10 10 10 10 10 9

Explanation

The Binary search tree is as follows.



Then, the linked list it should return is as follows


9
10
10
10
10
9
10
10
10

Problem B

Definition. The next greater element of a number a in an array is the first element strictly greater than a occurring after a in the array

Definition. A circular array is an array where the next element of the last element is the first element of the array

Given a circular integer array of length N, find the next greater element for every element in the integer array.
If the next greater element for a number does not exist, print -1 for that number

Constraints

Number of testcases $1 \leq T \leq 100$
$1 \leq N \leq 10^6$
$0 \leq$ numbers $\leq 10^8$

Input Format

- First line contains T, the number of test cases
- For every test case the first line contains a single integer N.
- The following line contains N integers, denoting the elements of the circular array

Output Format

Output T lines, where each line corresponds to the corresponding testcase.

For every test case, output N integers, i^{th} of which is the next greater element of the i^{th} number given as the input for that test case.

Example

Sample Testcase 1

Input

1
1 2 3 4 3

Output

2 3 4 -1 4

Explanation

For the first 3 elements, the next greater is the element right after it. The 4^{th} element has no greater element in the array. In a normal array the last element would not have a next greater element, but since this is a circular array, its next greater element is the 4^{th} element, whose value is 4.

Problem C

Given two integer arrays a and b of size n each. For a real number d and arrays a ad b, create a new array c such that $\forall i \in [1, n], c_i = d \cdot a_i + b_i$. By choosing an optimal value of d, find the maximum number of elements of array c that you can make 0.

Constraints

Subtask 1 (20 points)

$1 \leq n \leq 10^3$
$\forall i \in [1, n], -10^3 \leq a_i, b_i \leq 10^3$

Subtask 2 (80 points)

$1 \leq n \leq 2 \times 10^5$
$\forall i \in [1, n], -10^9 \leq a_i, b_i \leq 10^9$

Input format

- First line contains and integer n.
- Second line n integers of array a; $a_1, a_2, \ldots, a_n$.
- Third line n integers of array b; $b_1, b_2, \ldots, b_n$.

Output format

A single number denoting the maximum number of elements of array c that you can make 0.

Example

Sample Testcase 1

Input

5
1 2 3 4 5
2 4 7 11 3

Output

2

Explanation

By choosing $d = -2$, you can get array c to be $[0, 0, 1, 3, -7]$. Hence, answer is 2.

Sample Testcase 2

Input

3
13 37 39
1 2 3

Output

2

Explanation

By choosing $d = -\frac{1}{13}$, you can get array c to be $[0, -\frac{11}{13}, 0]$. Hence, answer is 2.