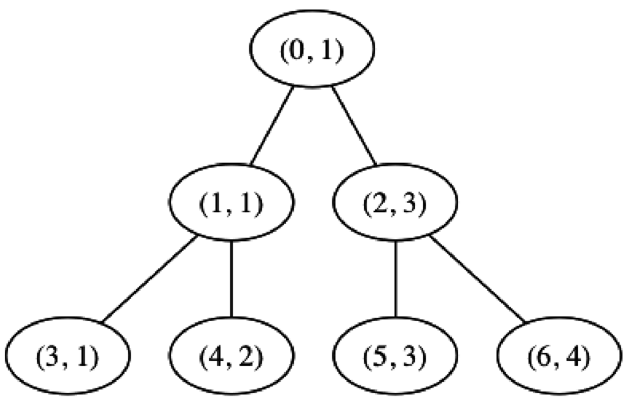
Inverse RMQ

HackerRank

Range Minimum Query is a well-known problem: given an array of distinct integers with size $n = 2^k$ and m queries, find the minimum element on subsegment $[L_i, R_i]$.

One of the most efficient and famous solutions to this problem is a *segment tree*. A segment tree is a full binary tree with $2 \cdot n - 1$ nodes where the leaves contain the values of the original array and each non-leaf node contains the minimum value of its entire subtree.

Usually, a segment tree is represented as an array of integers with $2 \cdot n - 1$ elements. The left child of the i^{th} node is in the $(2 \cdot i + 1)^{th}$ cell, and the right child is in the $(2 \cdot i + 2)^{th}$ cell. For example, $A = [1, 1, 3, 1, 2, 3, 4]$ represents the following segment tree where the first number in a node describes the array index, i, in A and the second number denotes the value stored at index i (which corresponds to the minimum value in that node's subtree):



You've just used n *distinct* integers to construct your first segment tree and saved it as an array, A, of $2 \cdot n - 1$ values. Unfortunately, some evil guy came and either shuffled or altered the elements in your array. Can you use the altered data to restore the original array? If no, print `NO` on a new line; otherwise, print two lines where the first line contains the word `YES` and the second line contains $2 \cdot n - 1$ space-separated integers denoting the array's original values. If there are several possible original arrays, print the lexicographically smallest one.

Input Format

The first line contains a single integer, n, denoting the size of the array.
The second line contains $2 \cdot n - 1$ space-separated integers denoting the shuffled values of the segment tree.

Constraints

- $1 \leq n \leq 2^{18}$
- n is a power of two.
- Each value in the segment tree is between -10^9 and 10^9.

Output Format

Print `NO` if this array could not be constructed by shuffling some segment tree. Otherwise, print `YES` on the first line, and $2 \cdot n - 1$ space-separated integers describing the respective values of the original array on the second line. If there are several possible answers, print the lexicographically smallest one.

Sample Input 0

```
4
3 1 3 1 2 4 1
```

Sample Output 0

```
YES
1 1 3 1 2 3 4
```

Explanation 0

This is the same segment tree shown in the *Problem Statement* above.

Sample Input 1

```
2
1 1 1
```

Sample Output 1

```
NO
```

Explanation 1

A segment tree with three nodes would consist of a root, a left child, and a right child. Because all three numbers in this array are the same and the leaves of the segment tree must be n distinct integers, it's not possible to reconstruct the original array.