IOITC 2015 Finals, Day 3

D-Array

You are given an array $A[1], A[2], .., A[N]$, which is a permutation of $\{1, .., N\}$. Put $A[0] = 0$.
For all i in $[1, N]$, $PreviousSmaller[i] = max\ j$, such that $j < i$ and $A[j] < A[i]$.

 Consider a tree T corresponding to A, which is defined as follows:
0 is the root, and $Parent[i] = PreviousSmaller[i]$, for all i in $[1, N]$.
 This is a tree with $N + 1$ nodes. (Node i in the tree T corresponds to the index i in the array A)
$dist(i, j) = $ distance between nodes i and j. (eg. $dist(u, Parent[u]) = 1$)

 Define $D[i] = dist(i, i - 1) - 1$

 Consider the sequence $(D[1], D[2], D[3], .., D[N])$. This is called $SpecialSequence(A)$. ie. given an A, there is an unique $SpecialSequence$ corresponding to it, and we'll call that $SpecialSequence(A)$.

 There are three things you need to do:

 Task 1. Given A, find $SpecialSequence(A)$. Call it S^*. Output S^* as space separated integers.

 Task 2. Consider all the $n!$ permutations that A could have taken. Let S be the set (note: set, and not multiset. So duplicates should not be considered) of all the $SpecialSequences$ corresponding to each of them.
ie. $S = \{SpecialSequence(B) \mid B$ is a permutation of $\{1, .., N\}\}$
Find the lexicographic rank of S^* in S, modulo $10^9 + 7$.

 Task 3. Consider all the $n!$ permutations that A could have taken. Consider all the trees corresponding to them. Now, among these trees, pick only those trees in which the root (ie. 0) has exactly two children. Let this set of trees be called $TwoRootChildren$.
 Consider all the permutations of $\{1..N\}$ which have their corresponding tree in $TwoRootChildren$. Let this set of permutations be called $TwoChildrenPermutations$.
Now, let the set of $SpecialSequences$ corresponding to these permutations be $TwoChildrenSequences$.
ie. $SpecialSequence(TwoChildrenPermutations) = TwoChildrenSequences$.
Output the size of $TwoChildrenSequences$ modulo $10^9 + 7$.
(Note that this task is dependent only on n, and independent of the array A.)

Input

The first line of input will contain one integer N.

The second line contains N space separated integers denoting array A.

The third line of input will contain one integer t.
t denotes which all tasks you will have to perform. ($0 \leq t \leq 2$)

Output

If $t == 0$, then output the D-Array $(D[1], D[2], D[3], .., D[N])$ as space separated integers in the first line.
If $t == 1$, do the above, and in addition, output the result of Task 2 as an integer in the second line.
If $t == 2$, do the above two, and in addition, output the result of Task 3 as an integer in the third line.

Test Data

In all the subtasks,
$1 \leq N \leq 10^3$

Subtask 1 (20 Points): $t = 0$.

Subtask 2 (40 Points): $t = 1$.

Subtask 2 (40 Points): $t = 2$.

Sample Input1	**Sample Output1**
5	0 0 0 0 0
1 2 3 4 5	1
2	14

Sample Input2	**Sample Output2**
5	0 1 0 0 0
3 1 2 4 5	33
2	14

Limits

Time: 1 second

Memory: 256 MB