Problem H. Classical Data Structure Problem

Problem Description

You are given a set $S = \{a[0], a[1], \ldots, a[n-1]\}$, and you will have to support q operations of three types on this set:

1. Remove the smallest integer from S. It is guaranteed that $S \neq \emptyset$.
2. Remove the largest integer from S. It is guaranteed that $S \neq \emptyset$.
3. Insert $\mathsf{MEX}(S)$ into S.

Define $\mathsf{MEX}(S)$ as the smallest non-negative integer that has not appeared in S.

Let $ans[i]$ be the i^{th} removed or inserted integer, please output $ans[0], ans[1], \ldots, ans[q-1]$.

Input Format

- line 1: $n \;\; q$
- line 2: $a[0] \;\; a[1] \;\; \cdots \;\; a[n-1]$
- line 3: $op[0] \;\; op[1] \;\; \cdots \;\; op[q-1]$

Output Format

- line $1+i$ $(0 \leq i \leq q-1)$: $ans[i]$

Constraints

- $0 \leq n \leq 200\,000$.
- $1 \leq q \leq 1\,000\,000$.
- $0 \leq a[i] \leq 10^9$ for $i = 0, 1, \ldots, n-1$.
- $a[i] \neq a[j]$ for $i \neq j$.
- $1 \leq op[i] \leq 3$ for $i = 0, 1, \ldots, q-1$.
- All the inputs are integers.

Subtasks

1. (15 points) $n \leq 1000$; $q \leq 1000$.
2. (15 points) $op[i] \in \{1, 2\}$ for $i = 0, 1, \ldots, q-1$.
3. (30 points) $op[i] \in \{2, 3\}$ for $i = 0, 1, \ldots, q-1$.
4. (30 points) $n = 0$.
5. (10 points) No additional constraints.

No.	Testdata Range	Time Limit (ms)	Memory Limit (KiB)
Samples	1-4	2000	262144
1	1-10	2000	262144
2	11-16	2000	262144
3	17-23	2000	262144
4	24-30	2000	262144
5	1-36	2000	262144

Samples

Sample Input 1

```
5 7
4 8 7 6 3
1 3 2 3 1 3 2
```

This sample input satisfies the constraints of Subtasks 1, 5.

Sample Output 1

```
3
0
8
1
0
0
7
```

Sample Input 2

```
5 5
4 2 0 6 9
1 2 2 1 2
```

This sample input satisfies the constraints of Subtasks 1, 2, 5.

Sample Output 2

```
0
9
6
2
4
```

Sample Input 3

```
6 8
31 4 15 9 26 1000000000
3 2 2 3 3 3 2 3
```

This sample input satisfies the constraints of Subtasks 1, 3, 5.

Sample Output 3

```
0
1000000000
31
1
2
3
26
5
```

Sample Input 4

```
0 4

3 2 3 1
```

This sample input satisfies the constraints of Subtasks 1, 4, 5.

Sample Output 4

```
0
0
0
0
```