IOI '20 P1 - Comparing Plants

Time limit: 2.0s **Memory limit:** 512M

Hazel the botanist visited a special exhibition in the Singapore Botanical Gardens. In this exhibition, n plants of **distinct heights** are placed in a circle. These plants are labelled from 0 to $n-1$ in clockwise order, with plant $n-1$ beside plant 0.

For each plant i $(0 \leq i \leq n-1)$, Hazel compared plant i to each of the next $k-1$ plants in clockwise order, and wrote down the number $r[i]$ denoting how many of these plants $k-1$ are taller than plant i. Thus, each value $r[i]$ depends on the relative heights of some k consecutive plants.

For example, suppose $n=5$, $k=3$ and $i=3$. The next $k-1=2$ plants in clockwise order from plant $i=3$ would be plant 4 and plant 0. If plant 4 was taller than plant 3 and plant 0 was shorter than plant 3, Hazel would write down $r[3]=1$.

You may assume that Hazel recorded the values $r[i]$ correctly. Thus, there is at least one configuration of distinct heights of plants consistent with these values.

You were asked to compare the heights of q pairs of plants. Sadly, you do not have access to the exhibition. Your only source of information is Hazel's notebook with the value k and the sequence of values $r[0], \ \ldots, \ r[n-1]$.

For each pair of different plants x and y that need to be compared, determine which of the three following situations occurs:

- Plant x is definitely taller than plant y: in any configuration of distinct heights $h[0], \ \ldots, \ h[n-1]$ consistent with the array r we have $h[x] > h[y]$.
- Plant x is definitely shorter than plant y: in any configuration of distinct heights $h[0], \ \ldots, \ h[n-1]$ consistent with the array r we have $h[x] < h[y]$.
- The comparison is inconclusive: neither of the previous two cases applies.

Implementation details

You should implement the following procedure:

```
void init(int k, std::vector<int> r)
```

- k: the number of consecutive plants whose heights determine each individual value $r[i]$.
- r : an array of size n, where $r[i]$ is the number of plants taller than plant i among the next $k-1$ plants in clockwise order.
- This procedure is called exactly once, before any calls to `compare_plants`.

```
int compare_plants(int x, int y)
```

- x, y: labels of the plants to be compared

- x, y: labels of the plants to be compared.
- This procedure should return:
  - 1 if plant x is definitely taller than plant y,
  - -1 if plant x is definitely shorter than plant y,
  - 0 if the comparison is inconclusive.
- This procedure is called exactly q times.

Examples

Example 1

Consider the following call:

```
init(3, {0, 1, 1, 2})
```

Let's say the grader calls `compare_plants(0, 2)`. Since $r[0] = 0$ we can immediately infer that plant 2 is not taller than plant 0. Therefore, the call should return 1.

Let's say the grader calls `compare_plants(1, 2)` next. For all possible configurations of heights that fit the constraints above, plant 1 is shorter than plant 2. Therefore, the call should return -1.

Example 2

Consider the following call:

```
init(2, {0, 1, 0, 1})
```

Let's say the grader calls `compare_plants(0, 3)`. Since $r[3] = 1$, we know that plant 0 is taller than plant 3. Therefore, the call should return 1.

Let's say the grader calls `compare_plants(1, 3)` next. Two configurations of heights $[3, 1, 4, 2]$ and $[3, 2, 4, 1]$ are both consistent with Hazel's measurements. Since plant 1 is shorter than plant 3 in one configuration and taller than plant 3 in the other, this call should return 0.

Constraints

- $2 \leq k \leq n \leq 200\,000$
- $1 \leq q \leq 200\,000$
- $0 \leq r[i] \leq k - 1$ (for all $0 \leq i \leq n - 1$)
- $0 \leq x < y \leq n - 1$
- There exists one or more configurations of **distinct heights** of plants consistent with the array r.

Subtasks

1. (5 points) $k = 2$

2. (14 points) $n \leq 5000, 2 \cdot k > n$
3. (13 points) $2 \cdot k > n$
4. (17 points) The correct answer to each call of `compare_plants` is 1 or -1.
5. (11 points) $n \leq 300, q \leq \frac{n \cdot (n-1)}{2}$
6. (15 points) $x = 0$ for each call of `compare_plants`.
7. (25 points) No additional constraints.

Sample grader

The sample grader reads the input in the following format:

- line 1: $n\ k\ q$
- line 2: $r[0]\ r[1]\ \ldots\ r[n-1]$
- line $3 + i$ $(0 \leq i \leq q-1)$: $x\ y$ for the i-th call to `compare_plants`

The sample grader prints your answer in the following format:

- line $1 + i$ $(0 \leq i \leq q-1)$: return value of the i-th call to `compare_plants`.