

IOI '22 P3 - Radio Towers

Time limit: 2.0s **Memory limit:** 1G

There are N radio towers in Jakarta. The towers are located along a straight line and numbered from 0 to $N - 1$ from left to right. For each i such that $0 \leq i \leq N - 1$, the height of tower i is $H[i]$ metres. The heights of the towers are **distinct**.

For some positive interference value δ , a pair of towers i and j (where $0 \leq i < j \leq N - 1$) can communicate with each other if and only if there is an intermediary tower k , such that

- tower i is to the left of tower k and tower j is to the right of tower k , that is, $i < k < j$, and
- the heights of tower i and tower j are both at most $H[k] - \delta$ metres.

Pak Dengklek wants to lease some radio towers for his new radio network. Your task is to answer Q questions of Pak Dengklek which are of the following form: given parameters L , R and D ($0 \leq L \leq R \leq N - 1$ and $D > 0$), what is the maximum number of towers Pak Dengklek can lease, assuming that

- Pak Dengklek can only lease towers with indices between L and R (inclusive), and
- the interference value δ is D , and
- any pair of radio towers that Pak Dengklek leases must be able to communicate with each other.

Note that two leased towers may communicate using an intermediary tower k , regardless of whether tower k is leased or not.

Implementation Details

You should implement the following procedures:

```
void init(int N, std::vector<int> H)
```

- N : the number of radio towers.
- H : an array of length N describing the tower heights.
- This procedure is called exactly once, before any calls to `max_towers`.

```
int max_towers(int L, int R, int D)
```

- L , R : the boundaries of a range of towers.
- D : the value of δ .
- This procedure should return the maximum number of radio towers Pak Dengklek can lease for his new radio network if he is only allowed to lease towers between tower L and tower R (inclusive) and the value of δ is D .
- This procedure is called exactly Q times.

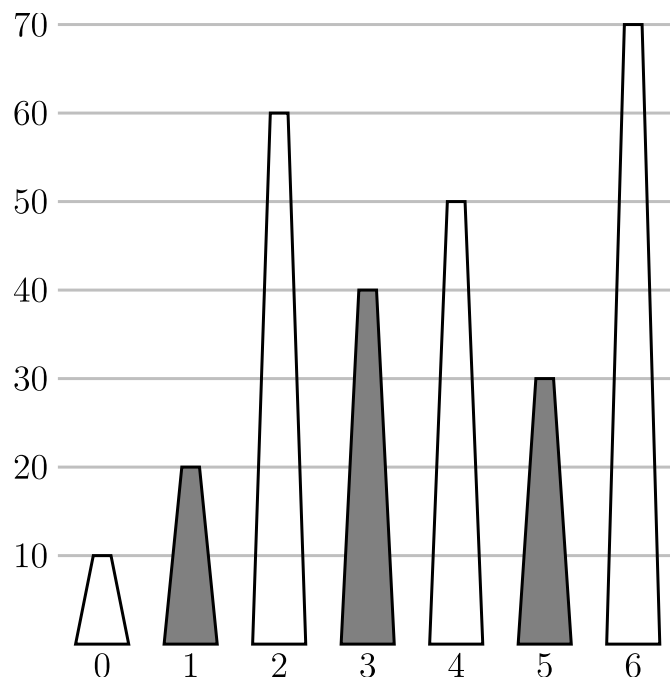
Example

Consider the following sequence of calls:

```
init(7, [10, 20, 60, 40, 50, 30, 70])
```

```
max_towers(1, 5, 10)
```

Pak Dengklek can lease towers 1, 3, and 5. The example is illustrated in the following picture, where shaded trapezoids represent leased towers.



Towers 3 and 5 can communicate using tower 4 as an intermediary, since $40 \leq 50 - 10$ and $30 \leq 50 - 10$. Towers 1 and 3 can communicate using tower 2 as an intermediary. Towers 1 and 5 can communicate using tower 3 as an intermediary. There is no way to lease more than 3 towers, therefore the procedure should return 3.

```
max_towers(2, 2, 100)
```

There is only 1 tower in the range, thus Pak Dengklek can only lease 1 tower. Therefore the procedure should return 1.

```
max_towers(0, 6, 17)
```

Pak Dengklek can lease towers 1 and 3. Towers 1 and 3 can communicate using tower 2 as an intermediary, since $20 \leq 60 - 17$ and $40 \leq 60 - 17$. There is no way to lease more than 2 towers, therefore the procedure should return 2.

Constraints

- $1 \leq N \leq 100\,000$
- $1 \leq Q \leq 100\,000$
- $1 \leq H[i] \leq 10^9$ (for each i such that $0 \leq i \leq N - 1$)
- $H[i] \neq H[j]$ (for each i and j such that $0 \leq i < j \leq N - 1$)
- $0 \leq L \leq R \leq N - 1$
- $1 \leq D \leq 10^9$

Subtasks

1. (4 points) There exists a tower k ($0 \leq k \leq N - 1$) such that
 - for each i such that $0 \leq i \leq k - 1$: $H[i] < H[i + 1]$, and
 - for each i such that $k \leq i \leq N - 2$: $H[i] > H[i + 1]$.
2. (11 points) $Q = 1$, $N \leq 2\,000$
3. (12 points) $Q = 1$
4. (14 points) $D = 1$
5. (17 points) $L = 0$, $R = N - 1$
6. (19 points) The value of D is the same across all `max_towers` calls.
7. (23 points) No additional constraints.

Sample Grader

The sample grader reads the input in the following format:

- line 1: $N\ Q$
- line 2: $H[0]\ H[1]\ \dots\ H[N - 1]$
- line $3 + j$ ($0 \leq j \leq Q - 1$): $L\ R\ D$ for question j

The sample grader prints your answers in the following format:

- line $1 + j$ ($0 \leq j \leq Q - 1$): the return value of `max_towers` for question j

Attachment Package

The sample grader along with sample test cases are available [here](#).