Dungeons Game

Robert is designing a new computer game. The game involves one hero, n opponents and $n+1$ dungeons. The opponents are numbered from 0 to $n-1$ and the dungeons are numbered from 0 to n. Opponent i ($0 \le i \le n-1$) is located in dungeon i and has strength $s[i]$. There is no opponent in dungeon n.

The hero starts off entering dungeon x, with strength z. Every time the hero enters any dungeon i ($0 \le i \le n-1$), they confront opponent i, and one of the following occurs:

- If the hero's strength is greater than or equal to the opponent's strength $s[i]$, the hero wins. This causes the hero's strength to **increase** by $s[i]$ ($s[i] \ge 1$). In this case the hero enters dungeon $w[i]$ next ($w[i] > i$).

- Otherwise, the hero loses. This causes the hero's strength to **increase** by $p[i]$ ($p[i] \ge 1$). In this case the hero enters dungeon $l[i]$ next.

Note $p[i]$ may be less than, equal to, or greater than $s[i]$. Also, $l[i]$ may be less than, equal to, or greater than i. Regardless of the outcome of the confrontation, the opponent remains in dungeon i and maintains strength $s[i]$.

The game ends when the hero enters dungeon n. One can show that the game ends after a finite number of confrontations, regardless of the hero's starting dungeon and strength.

Robert asked you to test his game by running q simulations. For each simulation, Robert defines a starting dungeon x and starting strength z. Your task is to find out, for each simulation, the hero's strength when the game ends.

Implementation details

You should implement the following procedures:

```
void init(int n, int[] s, int[] p, int[] w, int[] l)
```

- n: number of opponents.
- s, p, w, l: arrays of length n. For $0 \le i \le n-1$:
  - $s[i]$ is the strength of the opponent i. It is also the strength gained by the hero after winning against opponent i.
  - $p[i]$ is the strength gained by the hero after losing against opponent i.
  - $w[i]$ is the dungeon the hero enters after winning against opponent i.
  - $l[i]$ is the dungeon the hero enters after losing against opponent i.
- This procedure is called exactly once, before any calls to `simulate` (see below).

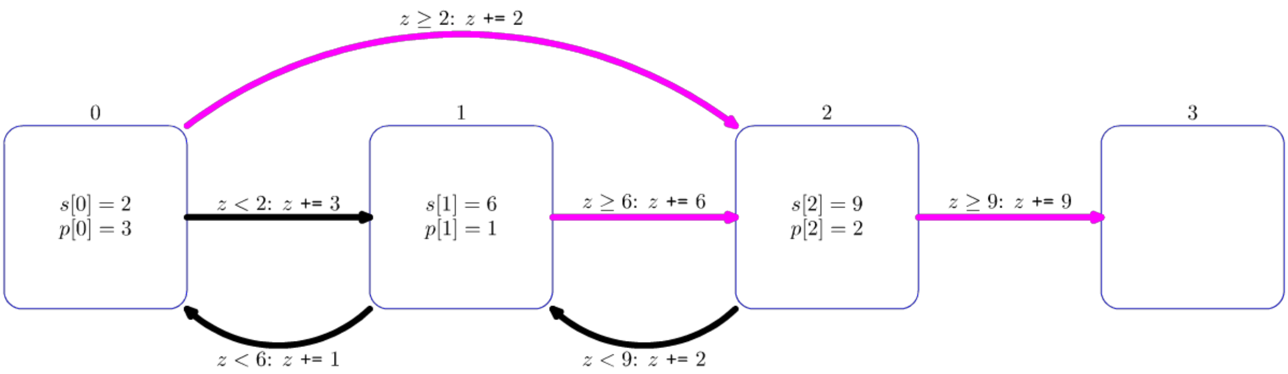
```
int64 simulate(int x, int z)
```

- x: the dungeon the hero enters first.
- z: the hero's starting strength.
- This procedure should return the hero's strength when the game ends, assuming the hero starts the game by entering dungeon x, having strength z.
- The procedure is called exactly q times.

Example

Consider the following call:

```
init(3, [2, 6, 9], [3, 1, 2], [2, 2, 3], [1, 0, 1])
```



The diagram above illustrates this call. Each square shows a dungeon. For dungeons 0, 1 and 2, the values $s[i]$ and $p[i]$ are indicated inside the squares. Magenta arrows indicate where the hero moves after winning a confrontation, while black arrows indicate where the hero moves after losing.

Let's say the grader calls `simulate(0, 1)`.

The game proceeds as follows:

Dungeon	Hero's strength before confrontation	Result
0	1	Lose
1	4	Lose
0	5	Win
2	7	Lose
1	9	Win
2	15	Win
3	24	Game ends

As such, the procedure should return 24.

Let's say the grader calls `simulate(2, 3)`.

The game proceeds as follows:

Dungeon	Hero's strength before confrontation	Result
2	3	Lose
1	5	Lose
0	6	Win
2	8	Lose
1	10	Win
2	16	Win
3	25	Game ends

As such, the procedure should return 25.

Constraints

- $1 \le n \le 400\ 000$
- $1 \le q \le 50\ 000$
- $1 \le s[i], p[i] \le 10^7$ (for all $0 \le i \le n-1$)
- $0 \le l[i], w[i] \le n$ (for all $0 \le i \le n-1$)
- $w[i] > i$ (for all $0 \le i \le n-1$)
- $0 \le x \le n-1$
- $1 \le z \le 10^7$

Subtasks

1. (11 points) $n \le 50\ 000$, $q \le 100$, $s[i], p[i] \le 10\ 000$ (for all $0 \le i \le n-1$)
2. (26 points) $s[i] = p[i]$ (for all $0 \le i \le n-1$)
3. (13 points) $n \le 50\ 000$, all opponents have the same strength, in other words, $s[i] = s[j]$ for all $0 \le i, j \le n-1$.
4. (12 points) $n \le 50\ 000$, there are at most 5 distinct values among all values of $s[i]$.
5. (27 points) $n \le 50\ 000$
6. (11 points) No additional constraints.

Sample grader

The sample grader reads the input in the following format:

- line 1: $n\ \ q$
- line 2: $s[0]\ \ s[1]\ \ \ldots\ \ s[n-1]$
- line 3: $p[0]\ \ p[1]\ \ \ldots\ \ p[n-1]$

- line 4: $w[0] \ w[1] \ \ldots \ w[n-1]$
- line 5: $l[0] \ l[1] \ \ldots \ l[n-1]$
- line $6+i$ ($0 \leq i \leq q-1$): $x \ z$ for the i-th call to `simulate`.

The sample grader prints your answers in the following format:

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