Pan African Olympiad in Informatics Team Selection Test 2025

Omar and the Plane

Time limit: 2 seconds **Memory limit: 512 MB**

Omar is seated at the worst seat in the plane from Madrid to Santa Cruz; right next to the loo. Each time a person passes, an awful stench spreads to his seat, making the air impossible to breathe. Fortunately, Raouf was gracious enough to provide him with an infinite supply of masks and perfume.

During the flight, exactly N people pay a visit to the loo, such that the ith person goes at time $T[i]$, for all $0 \leq i < N$. Each time someone enters the loo, Omar can choose to either use perfume, shielding him from the stench for 1 minute at a cost of P Bolivianos, or use a mask that protects him for M minutes - before it becomes rife with the toilet's odor - at a cost of Q Bolivianos. Omar isn't very proactive, so he only ever decides to use perfume or put on a mask at any of the $T[i]$ minutes.

Given the values of N, P, Q, M and all $T[i]$, Compute the minimal cost needed to protect Omar from the smell throughout the flight. Moreover, describe any one of the possible optimal strategies for Omar.

Problem Description

You are given an array $T[i]$ of N integers. At every $S[i]$ you can choose to place a 0 to do nothing, a 1 to cover the minute $T[i]$ or a 2 to cover M minutes starting from $T[i]$. Knowing each 1 has a cost of P and each 2 has a cost of Q, find the minimum cost, hereby referred to as C, needed to cover all of the minutes in T and output a setting of $S[i]$ that achieves said minimum cost.

Input

Input is formatted as follows:

```
N M P Q
T[0] T[1] T[2] ...  T[N-1]
```

Output

Output is expected as follows:

```
C
S[0] S[1] S[2] ...  S[N-1]
```

Constraints

- $1 \leq N \leq 2 * 10^5$
- $1 \leq P, Q, M \leq 10^9$
- For all $0 \leq i < N - 1$, $T[i] < T[i + 1]$ and $1 \leq$T[i] $\leq 10^{16}$

Subtasks

In this problem, 50% of the points are awarded if your program correctly determines the value of C for all test cases but fails to generate an optimal strategy for any one of them; this is denoted by a "Partially Correct" verdict. However, If your program unsuccessfully determines C for any of the test cases you will be given a "Wrong Answer" verdict and awarded no points.

Subtask	Points	Constraints
1	4	$N = 1$
2	6	$Q = 2NP$
3	12	$N \leq 14$
4	18	$N \leq 2000$
5	10	$M = 2$
6	22	$T[i] = i + 1$ for all $0 \leq i < N$
7	28	No additional constraints

Examples

Example 1

```
5 2 1 2
1 2 4 5 6
```

Output:

```
5
1 1 1 1 1
```

Example 2

```
8 10 2 5
1 3 4 5 7 8 11 12
```

Output:

```
7
1 2 0 0 0 0 0 0
```

Explanation

In the first test case, $N = 5$, $M = 2$, $P = 1$ and $Q = 2$. Omar can choose to just use perfume every time someone visits the bathroom and attain a minimum cost of $1 + 1 + 1 + 1 + 1 = 5$ Bolivianos. This is optimal because Omar covers each person at a cost of 1 Bolivianos per minute, which is still the case if he decides to cover two people over two minutes with the mask.

In the second test case, $N = 8$, $M = 10$, $P = 2$ and $Q = 5$. Omar can protect himself for 1 minute when the first person enters, and then for 10 minutes as soon as the second person enters, spending a total of $2 + 5 = 7$ Bolivianos.