Problem 5: Grid Fill
4+4 Points

Problem ID: `grid`

Rank: `2+2`

Introduction

Big Ben is building skyscrapers! However, after building two, he realized they were sideways. He has to fix the orientation of the buildings, but he erased the schematics for the bottom tower. He knows that the bottom tower was designed to be as harmonious as possible—meaning each floor's height was very close to its horizontal neighbors and the floor directly above it.

Problem Statement

Consider the following arrangement of integers:

$\mathbf{A_1}$	$\mathbf{A_2}$	$\ldots$	$\mathbf{A_N}$
b_1	b_2	$\ldots$	$b_\mathbf{N}$

Given $\mathbf{N}$ integers $\mathbf{A_1}, \mathbf{A_2}, \ldots, \mathbf{A_N}$, find values for $b_1, b_2, \ldots, b_\mathbf{N}$ that minimize the sum of absolute differences of all adjacent cells. If there are multiple arrangements of b that yield the same minimal sum, you output any of them.

For example, consider the following arrangement:

1	3	3	7
6	7	6	9

The sum of absolute differences in this arrangement is:

$$\begin{aligned} \text{Top Row:} &\quad (|1-3| + |3-3| + |3-7|) \\ \text{Bottom Row:} &+ (|6-7| + |7-6| + |6-9|) \\ \text{Between Rows:} &+ (|1-6| + |3-7| + |3-6| + |7-9|) \end{aligned}$$

which evaluates to $6 + 5 + 14 = 25$. Note that this is not necessarily the optimal arrangement for this example.

Input Format

The first line of the input contains a single integer $\mathbf{T}$ denoting the number of test cases.

For each test case:

- The first line contains a single integer $\mathbf{N}$, denoting the number of floors in the towers.
- The second line contains $\mathbf{N}$ space-separated integers $\mathbf{A_1}\ \mathbf{A_2}\ \ldots\ \mathbf{A_N}$, denoting the heights of the top tower.

Output Format

For each test case, output a single line containing $\mathbf{N}$ space-separated integers $b_1\ b_2\ \ldots\ b_N$ representing the reconstructed heights of the bottom tower. If there are multiple valid arrays that minimize the total sum of absolute differences, you may output any of them.

Constraints

$1 \leq \mathbf{T} \leq 10$
$1 \leq \mathbf{A}_i \leq 10^9$
$1 \leq b_i \leq 2 \cdot 10^9$

Main Test Set

$1 \leq \mathbf{N} \leq 3$

Bonus Test Set

$1 \leq \mathbf{N} \leq 10^5$

Sample Test Cases

Main Sample Input [Download]

```
1
3
1 5 1
```

Main Sample Output [Download]

```
1 1 1
```

Note that this is one of many possible correct outputs. If there are multiple solutions, you may output any of them.

Main Sample Explanations

For test case #1, the first row is given as `1 5 1`. If we choose to fill the second row with `1 1 1`, we can calculate the sum of adjacent differences as follows:

- Top Row: $|1-5|+|5-1|=4+4=\mathbf{8}$
- Bottom Row: $|1-1|+|1-1|=0+0=\mathbf{0}$
- Between Rows: $|1-1|+|5-1|+|1-1|=0+4+0=\mathbf{4}$

The total sum is $8+0+4=12$. There is no configuration of the second row that yields a strictly smaller total sum, making `1 1 1` a valid optimal answer.

Bonus Sample Input [Download]

```
1
4
1 2 3 4
```

Bonus Sample Output [Download]

```
1 2 3 4
```

Note that this is one of many possible correct outputs. If there are multiple solutions, you may output any of them.

Bonus Sample Explanations

For test case #1, the first row is `1 2 3 4`. If we make the second row identical to the first row (`1 2 3 4`), the total breaks down as follows:

- Top Row: $|1-2|+|2-3|+|3-4|=1+1+1=\mathbf{3}$
- Bottom Row: $|1-2|+|2-3|+|3-4|=1+1+1=\mathbf{3}$
- Between Rows: $|1-1|+|2-2|+|3-3|+|4-4|=\mathbf{0}$

The total sum is $3+3+0=6$, which is the minimum possible sum. Note that other arrays might also achieve this minimum sum of 6 (such as `2 2 3 3`), and outputting any of those alternate optimal arrays would also be accepted.