Problem 4: Water Bottles
4+3=7 Point(s)

Problem ID: `bottles`
Rank: `2+3`

Introduction

Berkeley students living in some parts of the Foothill residential complex source most potable water from a communal water dispenser. This problem is inspired by an everyday technique we use to reduce the awkwardness of delaying people behind us in line! The real dispenser outputs 2 liters per minute, but we'll say 1 per minute for this problem to make things simpler.

Problem Statement

$\mathbf{N}$ students numbered 1, ..., $\mathbf{N}$ are lined up at a water dispenser that dispenses water at a constant rate of 1 liter per minute. The i^{th} student has an empty bottle with capacity $\mathbf{C}_i$ liters that they begin to fill immediately after the previous student has finished (formally, the i^{th} student begins refilling when all j^{th} students for which $j < i$ finish refilling).

We define the *wait time* of a student as the **total** time they have to wait until their bottle **finishes** refilling. The students ask you to reorder the line into a new permutation (a_1, ..., $a_\mathbf{N}$) of the students' numbers such that the students' total wait time is minimized.

For the bonus test set only, the students also require a tiebreaker: If multiple permutations result in the minimum total wait time, choose any permutation that minimizes the number of students moved to a new position. Formally, minimize the number of indices i for which $a_i \neq i$. If there are multiple permutations that accomplish this, you may choose any.

Input Format

The first line of the input contains an integer $\mathbf{T}$, denoting the number of test cases that follow. For each test case:

- The first line contains a positive integer $\mathbf{N}$ denoting the number of students in line.
- The second line contains a sequence of $\mathbf{N}$ positive integers $\mathbf{C}_1$, ..., $\mathbf{C}_\mathbf{N}$, denoting the bottle capacities in liters.

Output Format

For each test case, output the following two lines:

- On the first line, output the minimum total wait time in minutes.
- On the second line, output $\mathbf{N}$ integers a_1, ..., $a_\mathbf{N}$ ($1 \le a_i \le \mathbf{N}$) where a_i is the new index of the i^{th} student from the front of the original line. If there are multiple permutations that satisfy all criteria, you may output any.

Constraints

$1 \le \mathbf{T} \le 100$

Main Test Set

$1 \le \mathbf{N} \le 10^3$
The sum of $\mathbf{N}$ across all test cases in a test file does not exceed 10^3.
$1 \le \mathbf{C}_i \le 10^3$
All capacities $\mathbf{C}_i$ **are distinct**.
There is guaranteed to exist exactly one optimal permutation for each test case.

Bonus Test Set

$1 \le \mathbf{N} \le 10^5$
The sum of $\mathbf{N}$ across all test cases in a test file does not exceed 10^5.
$1 \le \mathbf{C}_i \le 10^9$
The capacities $\mathbf{C}_i$ **are not guaranteed to be distinct**.

Sample Test Cases

Main Sample Input *Download*

```
1
3
5 1 2
```

Main Sample Output *Download*

```
12
2 3 1
```

Main Sample Explanations

The optimal permutation rearranges the line into the order (2, 3, 1).

1. Student 2 is first in the new line. They have a 1 L bottle and spend 1 minute refilling it.
2. Student 3 is second. They have to wait 1 minute and then spend 2 minutes refilling their own bottle, finishing after 3 minutes.
3. Student 1 is third. They have to wait 3 minutes and then spend 5 minutes refilling their own bottle, finishing after 8 minutes.

The total wait time is (1 + 3 + 8) min = 12 minutes, and it can be shown that no other permutation results in a total less than or equal to than 12 minutes.

Bonus Sample Input *Download*

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

Bonus Sample Output *Download*

```
7
3 2 1
13
3 4 1 2
```

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 permutations (2, 3, 1) and (3, 2, 1) both achieve the minimum total wait time of 7 minutes. However, (2, 3, 1) moves three students while (3, 2, 1) moves only two, so (3, 2, 1) is preferred.

For test case #2, the permutation (3, 4, 1, 2) moves all students and results in a total wait time of 13 minutes, which can be shown to be the minimum. There are also three other permutations that result in a total wait time of 13 minutes and move all students: (3, 4, 2, 1), (4, 3, 1, 2), and (4, 3, 2, 1). The tiebreaker is thus inconclusive—any of these permutations are acceptable.