

# Round 1C 2022 - Code Jam 2022

## Squary

### PROBLEM

### ANALYSIS

#### Problem

Addition and squaring do not commute. That is, the square of the sum of all elements of a list of integers is not necessarily equal to the sum of the squares of those same elements. However, this is true for some lists; one example is  $[3, -2, 6]$ , because  $(3 + (-2) + 6)^2 = 49 = 3^2 + (-2)^2 + 6^2$ . Let us call these lists *squary*.

$$\left( \begin{matrix} 3 \\ 6 \end{matrix} + (-2) \right)^2 = \begin{matrix} 3^2 \\ 6^2 \end{matrix} + (-2)^2$$

Given a (not necessarily squary) list of relatively small integers, we want to know whether it is possible to add at least 1 and at most  $K$  more elements such that the final list is squary. Each added element must be an integer between  $-10^{18}$  and  $10^{18}$ , inclusive, and these do not have to be distinct from each other or from the initial list's elements.

#### Input

The first line of the input gives the number of test cases,  $T$ .  $T$  test cases follow. Each test case is described in two lines. The first line contains two integers  $N$  and  $K$ , the number of elements of the initial list and the maximum number of elements you may add, respectively. The second line contains  $N$  integers  $E_1, E_2, \dots, E_N$ , representing the  $N$  elements of the initial list.

#### Output

For each test case, output one line containing Case # $x$ :  $y$ , where  $x$  is the test case number (starting from 1). If it is possible to add at least 1 and at most  $K$  elements (each an integer between  $-10^{18}$  and  $10^{18}$ , inclusive) to the initial list such that the square of the sum of its elements equals the sum of the squares of its elements,  $y$  should be  $z_1 z_2 \dots z_r$ , where  $1 \leq r \leq K$  and the  $z_i$  values are the additional elements. If there is no way to accomplish this,  $y$  should be IMPOSSIBLE.

#### Limits

Memory limit: 1 GB.  
 $1 \leq T \leq 100$ .  
 $1 \leq N \leq 1000$ .  
 $-1000 \leq E_i \leq 1000$ , for all  $i$ .

#### Test Set 1 (Visible Verdict)



Time limit: 5 seconds.  
 $K = 1$ .



#### Test Set 2 (Visible Verdict)

Time limit: 10 seconds.  
 $2 \leq K \leq 1000$ .

#### Sample

*Note: there are additional samples that are not run on submissions down below.*

Sample Input	 
4 2 1 -2 6 2 1 -10 10 1 1 0 3 1 2 -2 2	

Sample Output	 
Case #1: 3 Case #2: IMPOSSIBLE Case #3: -1000000000000000000 Case #4: 2	

In Sample Case #1, we can end up with the example list given in the problem statement.

In Sample Case #2, we have to add exactly one element. If we call that element  $x$ , the sum of the entire list is  $x$  and its square is  $x^2$ . The sum of the squares of all elements, on the other hand, is  $x^2 + 10^2 + (-10)^2 = x^2 + 200 \neq x^2$ , so the case is impossible.

In Sample Case #3, any integer in the  $[-10^{18}, 10^{18}]$  range is a valid answer.

In Sample Case #4, notice that the input might contain duplicate elements, and that it is valid to create even more duplicates with the elements you choose to add.

Additional Sample - Test Set 2

The following additional sample fits the limits of Test Set 2. It will not be run against your submitted solutions.

Sample Input

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```
3
3 10
-2 3 6
6 2
-2 2 1 -2 4 -1
1 12
-5
```

Sample Output

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```
Case #1: 0
Case #2: -1 15
Case #3: 1 1 1 1 1 1 1 1 1 1
```

In Case #1 of the additional samples, we are given the example list from the problem statement, which is already squary, but we need to add at least one element to it. Adding a 0 keeps the list squary.

In Case #3 of the additional samples, we present one of multiple possible valid answers. Notice that it is permissible to add fewer than **K** elements; here **K** is 12 but we have only added 11 elements.

