Escuela Colombiana de Ingeniería Julio Garavito **20 de Septiembre de 2023 Parcial Práctico 01**
Tiempo Límite: 180 Minutos
Profesor Encargado: Rodrigo Humberto Gualtero Martínez
Nombre del estudiante:
Número de Carné:

Este examen contiene 7 páginas (incluida esta sección introductoria) en donde encontrarás 4 preguntas.

Cantidad máxima de puntos posible: **10**.
Puntaje para máxima calificación: **6**.

Recomendaciones

Tome 5 minutos para leer todos los enunciados, defina una estrategia de solución y proceda a resolver el examen. Recuerde que no está permitido el uso de material externo al suministrado por el profesor, el uso de teléfonos celulares está prohibido. No podrá dejar el lugar del examen a menos de haber terminado el mismo.

Cualquier violación a las recomendaciones anteriormente mencionadas o cualquier otra incluida en el reglamento estudiantil de la **Escuela Colombiana de Ingeniería Julio Garavito** acarreará la anulación del presente examen y desencadenará los procesos correspondientes.
Recuerde que para que un ejercicio tenga validez debe realizar el COLAB correspondiente. Ver aqui

Tabla de puntaje (Para uso exclusivo del calificador)

Pregunta	Puntos	Resultado
1	1	
2	3	
3	3	
4	3	
Total:	10	

1. (2 puntos) **A- Power Sum**

Encuentre el número de maneras en las que un entero *x*, puede ser expresado c´omo la suma de *N-ésimas* potencias de números naturales (únicos). $(a_0)^n + (a_1)^n + ... (a_k)^n ... = x$, Por ejemplo:

1. Si $x = 13$ y $N = 2$, las combinaciones de secuencias de enteros únicos elevados al cuadrado que suman 13 son solo una: $2^2 + 3^2$.

Input

La entrada consiste en una serie consecutiva de casos, cada caso corresponde a dos líneas de entrada, con enteros *x* y *n* respectivamente.

La entrada termina cuando se llega a una línea vacía o EOF.

Output

imprima el número de posibles combinaciones para secuencias de nu´meros naturales únicos elevados a la *enésima* potencia que suman *x*

Sample Input

10
2
100
2
100
3

Sample Output

1
3
1

2. (3 puntos) **B- Davis' Staircase**

Davis has a number of staircases in his house and he likes to climb each staircase 1,2, or 3 steps at a time. Being a very precocious child, he wonders how many ways there are to reach the top of the staircase.

Given the respective heights for each of the ***s*** staircases in his house, find and print the number of ways he can climb each staircase, module $10^{10}+7$ on a new line.

Example

n = 5

The staircase has steps. Davis can step on the following sequences of steps:

1 1 1 1 1
1 1 1 2
1 1 2 1
1 2 1 1
2 1 1 1
1 2 2
2 2 1
2 1 2
1 1 3
1 3 1
3 1 1
2 3
3 2

There are 13 possible ways he can take these 5 steps and $13 \text{ modulo } 10000000007 = 13$

Input

```
STDIN   Function
-----   --------
3       s = 3 (number of staircases)
1       first staircase n = 1
3       second n = 3
7       third n = 7
```

Output

```
1
4
44
```

3. (3 puntos) **Equal**

Christy is interning at HackerRank. One day she has to distribute some chocolates to her colleagues. She is biased towards her friends and plans to give them more than the others. One of the program managers hears of this and tells her to make sure everyone gets the same number.

To make things difficult, she must equalize the number of chocolates in a series of operations. For each operation, she can give $1, 2$ or 5 pieces to all but one colleague. Everyone who gets a piece in a round receives the same number of pieces.

Given a starting distribution, calculate the minimum number of operations needed so that every colleague has the same number of pieces.

Example

$arr = [1, 1, 5]$

arr represents the starting numbers of pieces for each colleague. She can give 2 pieces to the first two and the distribution is then $[3, 3, 5]$. On the next round, she gives the same two 2 pieces each, and everyone has the same number: $[5, 5, 5]$. Return the number of rounds, 2.

Function Description

Complete the equal function in the editor below.

equal has the following parameter(s):

- int arr[n]: the integers to equalize

Returns

- int: the minimum number of operations required

Input Format

The first line contains an integer t, the number of test cases.

Each test case has 2 lines.

- The first line contains an integer n, the number of colleagues and the size of arr.

- The second line contains n space-separated integers, $arr[i]$, the numbers of pieces of chocolate each colleague has at the start.

Constraints

$1 \leq t \leq 100$

$1 \leq n \leq 10000$

The number of chocolates each colleague has initially < 1000.

5

Sample Input

```
STDIN       Function
-----       --------
1           t = 1
4           arr[] size n = 4
2 2 3 7     arr =[2, 2, 3, 7]
```

Sample Output

```
2
```

Explanation

Start with $[2, 2, 3, 7]$

Add 1 to all but the 3rd element $\rightarrow [3, 3, 3, 8]$

Add 5 to all but the 4th element $\rightarrow [8, 8, 8, 8]$

Two operations were required.

Sample Input 1

```
1
3
10 7 12
```

Sample Output 1

```
3
```

Explanation 1

Start with $[10, 7, 12]$

Add 5 to the first two elements $\rightarrow [15, 12, 12]$

Add 2 to the last two elements $\rightarrow [15, 14, 14]$

Add 1 to the last two elements $\rightarrow [15, 15, 15]$

Three operations were required.

4. (3 puntos) **Closest Numbers**

Sorting is useful as the first step in many different tasks. The most common task is to make finding things easier, but there are other uses as well. In this case, it will make it easier to determine which pair or pairs of elements have the smallest absolute difference between them.

Example

$arr = [5, 2, 3, 4, 1]$

Sorted, $arr' = [1, 2, 3, 4, 5]$. Several pairs have the minimum difference of 1: $[(1, 2), (2, 3), (3, 4), (4, 5)]$. Return the array $[1, 2, 2, 3, 3, 4, 4, 5]$.

Note

As shown in the example, pairs may overlap.

Given a list of unsorted integers, arr, find the pair of elements that have the smallest absolute difference between them. If there are multiple pairs, find them all.

Function Description

Complete the closestNumbers function in the editor below.

closestNumbers has the following parameter(s):

- int arr[n]: an array of integers

Returns

- int[]: an array of integers as described

Input Format

The first line contains a single integer n, the length of arr.

The second line contains n space-separated integers, $arr[i]$.

Constraints

- $2 \leq n \leq 200000$
- $-10^7 \leq arr[i] \leq 10^7$
- All $a[i]$ are unique in arr.

Output Format

Sample Input 0

```
10
-20 -3916237 -357920 -3620601 7374819 -7330761 30 6246457 -6461594 266854
```

Sample Output 0

```
-20 30
```

Explanation 0

(30) - (-20) = 50, which is the smallest difference.

Sample Input 1

```
12
-20 -3916237 -357920 -3620601 7374819 -7330761 30 6246457 -6461594 266854 -520 -470
```

Sample Output 1

```
-520 -470 -20 30
```

Explanation 1

(-470) - (-520) = 30 - (-20) = 50, which is the smallest difference.

Sample Input 2

```
4
5 4 3 2
```

Sample Output 2

```
2 3 3 4 4 5
```

Explanation 2

Here, the minimum difference is 1. Valid pairs are (2, 3), (3, 4), and (4, 5).

"El software es como la magia: es invisible pero tiene el poder de transformar el mundo."
- Bill Gates