CPro Assignment 2

Monsoon 2022

December 9, 2022

Problem 1

Time limit: 1 second

Problem Description

The CPro assignment-2 for students at IIIT-H has 8 problems. Bob finds the first 5 problems easy and believes that he can finish them in X minutes each. On the other hand, he thinks that the last 3 problems are a little difficult and that it would take him Y minutes each to solve these questions.

Can you figure out the total number of minutes Bob will take to finish the entire assignment?

Input Format

The first line of input contains a single integer denoting the number of test-cases T. Then T lines follow:

For each test-case, the first and only line of input contains two space separated-integers X and Y

Input constraints

- $1 \leq T \leq 10^5$
- $1 \leq X \leq Y \leq 10^5$

Output Format

For each test-case: output on a single line the total number of minutes Bob will take to finish the entire assignment

Sample Input

```
4
2 3
10 20
1 2
1 4
```

Sample Output

```
19
110
11
17
```

Note

Explanation for sample input 1:

- For the first test-case, given $X = 2$ and $Y = 3$, we can see that the number of minutes spent by Bob on this assignment would be 10 for the first 5 questions and 9 for the last 3 giving a total of 19 minutes spent.

Problem 2

Time limit: 1 second

Problem Description

Mr.Dinesh has A packets of milk, B packets of sugar, and C packets of Oreo. We need exactly 1 packet of milk, 1 packet of sugar, and 2 packets of Oreo biscuits to make a glass of double Oreo shake.

Could you help Mr.Dinesh calculate how many glasses of Double Oreo shakes he can prepare with the supplies at hand?

Input Format

The first line of input contains a single integer denoting the number of test-cases T. Then T lines follow: For each test-case, the first line of input contains three space separated integers M, S, O denoting the number of milk, sugar and Oreo packets Mr.Dinesh currently has.

Input constraints

- $1 \leq T \leq 10^5$
- $0 \leq M, S, O \leq 10^9$

Output Format

For each test-case: output on a single line the number of glasses of Double Oreo shakes Mr.Dinesh can prepare.

Sample Input

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

Sample Output

```
2
1
0
```

Note

Explanation for sample input 1:

- For the first test-case, Mr.Dinesh can prepare 2 glasses of Double Oreo shake. Doing so, a packet of sugar remains but the quantity of other ingredients are insufficient to prepare a third glass of the drink.
- Note that the answer can be 0. Such is the case in the third test-case where Mr.Dinesh lacks enough ingredients to prepare even a single glass of double Oreo shake.

Problem 3

Time limit: 1 second

Problem Description

You and your friend were sitting on the first and last bench respectively during the RA quiz. Recently, you got hold of an array that consists of the marks of all N students seated for the RA quiz (from the first seat to the last seat in the same order). You want to maximize the sum of marks you and your friend get by potentially modifying the array. However, you don't want to raise suspicion. So, you both decide to perform a single operation on the array of the form:

- **Cyclically shifting the array to the right by any amount**

Here, a right cyclic shift by one unit on the array $A = \{A_1, A_2, A_3, A_4\}$ would transform the array unto $A = \{A_4, A_1, A_2, A_3\}$. Similarly, a right cyclic shift by some k units is equivalent to shifting it by one unit for k times.
Note that after a cyclic shift, the scores of you and your friend are still given by the values present at the first and last place of the array respectively. Only the values in those places may be different from the original array due to the shift operation.

By right cyclic shifting the array by any amount **at most once**, find the maximum sum of marks you and your friend can achieve.

Input Format

The first line of input contains a single integer denoting the number of test-cases T. Then, $2T$ lines follow:

For each test-case:
The first line contains a single integer N that denotes the size of the array A.
The second line contains N space-separated integers $A_1, A_2, \ldots, A_N$ describing the array A that holds the marks of all the students.

Input constraints

- $1 \leq T \leq 10^5$
- $2 \leq N \leq 10^5$
- $0 \leq A_i \leq 10^9$
- It is guaranteed that the sum of N across all test-cases does not exceed 10^5.

Output Format

For each test-case: output on a single line the maximum sum of marks you and your friend can get by right cyclically shifting the array by any amount at most once.

Sample Input

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

Sample Output

```
6
3
```

Note

Explanation for sample input 1:

- For the first test-case of the first sample: notice that by right shifting array cyclically by 1 unit, you obtain the array $A = \{3, 1, 2, 3\}$, where you and your friend both have 3 marks.

  We can show that the sum $3 + 3 = 6$ is the maximum sum possible.

- For the second test-case of the first sample: the sum is already maximized and hence the array doesn't require any cyclic shifts.

Problem 4

Time limit: 1 second

Problem Description

You just received your CPro quiz marks. The marks may be described as an array A of size N where each element is either a 1 or a -1 denoting the score received for that question. However you aren't satisfied with your total score (which is the sum of all elements of the array).
You want your total score to be 0 and so, you make a request to a TA. The TA proposes two types of operations that can be performed on the array:

- Convert any element with the value 1 into a -1
- Convert any element with the value -1 into a 1

You now wonder what is the minimum number of such operations required to obtain a total score of 0. If it is impossible to obtain a total score of 0, then output -1 instead.

Input Format

The first line of input contains a single integer denoting the number of test-cases T. Then, $2T$ lines follow:

For each test-case:
The first line contains a single integer N that denotes the number of questions.
The second line contains N space-separated integers $A_1, A_2, \ldots, A_N$ describing the array A that describes the score obtained for each question.

Input constraints

- $1 \leq T \leq 10^5$
- $1 \leq N \leq 10^5$
- $A_i \in \{-1, 1\}$
- It is guaranteed that the sum of N across all test-cases does not exceed 10^5.

Output Format

For each test-case: output on a single line the minimum number of operations required to make the total score 0. Print -1 if it is impossible to do so.

Sample Input

```
2
4
1 1 1 1
2
-1 1
```

Sample Output

```
2
0
```

Note

Explanation for sample input 1:

- For the first test-case: Changing the first and second indices into a -1 gives the array $A = \{-1, -1, 1, 1\}$ which has a total score of 0. This takes two operations.

  We can show that there is no way of obtaining a score of 0 in less than 2 operations for this test-case.

- For the second test-case: Since the total score is already 0, you are satisfied and hence require no operations to be done.

Problem 5

Time limit: 1 second

Problem Description

You are to select an elective for the arts credit at IIIT-H. For this, you ask your friends for recommendations. You have N friends and M possible electives. Each friend recommends an elective A_i that they want you to select.

Find out if there exists some elective X that has strictly the highest number of recommendations. If so, output it. However, if there are multiple electives with the highest number of recommendations, print "-1" (without quotes).

Input Format

The first line of input contains a single integer denoting the number of test-cases T. Then, $2T$ lines follow:

For each test-case:
The first line of each test-case contains two space separated integers N, M that denote the number of friends and electives respectively.
The second line contains N space-separated integers $A_1, A_2, \ldots, A_N$ describing recommendations of each of the N friends.

Input constraints

- $1 \leq T \leq 10^5$
- $1 \leq N, M \leq 10^5$
- $1 \leq A_i \leq M$
- It is guaranteed that the sum of N and the sum of M across all test-cases does not exceed 10^5.

Output Format

For each test-case: output on a single line the answer to the test-case.

Sample Input

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

Sample Output

```
3
-1
```

Note

Explanation for sample input 1:

- For the first test-case of the first sample: notice that the elective "3" has 2 recommendations which makes it the highest recommended elective. As there is no other electives from 1 through 3 that have the same number of recommendations, we output "3" as the answer.
- For the second test-case of the first sample: both electives 1 and 2 share the spot for the highest number of recommendations. Hence, we output -1.

Problem 6

Time limit: 1 second

Problem Description

You find yourself in DSM class. Since you're bored, you decide to look for your friends. You first notice that the classroom appears as a grid of size $N \times M$ that is, a grid with N rows and M columns. You represent the classroom as a $N \times M$ binary matrix (a matrix consisting of only 0s and 1s) where, a cell with '1' denotes a friend and '0' otherwise. You are currently on cell (R, C) (cell at row R and column C).

You now want to find out the friend whose Manhattan distance from you is the minimum possible. If there are no such friends, then output -1 instead. However, if there are multiple friends at the same minimum distance, then print the row and column of the one who is lexicographically smallest.

Manhattan distance between two cells (a, b) and (c, d) is defined as $|a - c| + |b - d|$.
A cell (a, b) is lexicographically smaller than the cell (c, d) if either of the following is true:

- $a < c$
- $a = c$ and $b < d$

Input Format

The first line of input contains a single integer denoting the number of test-cases T. The description of each test-case follows:

For each test-case:
The first line of each test-case contains four space separated integers N, M, R, C. Here, N and M denote the number of rows and columns respectively in the classroom. R, C denotes the row and column where you are seated.
Then, N lines follow where the i^{th} line describes the i^{th} row of the classroom. It contains M space-separated integers where the j^{th} integer being '1' denotes that the student at the cell (i, j) is a friend and '0' otherwise.

Input constraints

- $1 \leq T \leq 2.5 \times 10^5$
- $1 \leq N, M \leq 500$
- $1 \leq R \leq N$, $1 \leq C \leq M$
- $0 \leq A_i \leq 1$
- $A[R][C] = 0$
- It is guaranteed that the sum of $N \times M$ across all test-cases does not exceed 2.5×10^5.

Output Format

For each test-case: output two space-separated integers, denoting the row and column of the lexicographically smallest friend who is at a minimum Manhattan distance to you. If such a friend doesn't exist, print -1 instead.

Sample Input

```
3
3 4 2 3
0 1 0 0
0 0 0 0
1 0 0 0
2 3 1 1
0 0 1
0 1 1
2 2 1 1
0 0
0 0
```

Sample Output

```
1 2
1 3
-1
```

Note

Explanation for sample input 1:

- For the first test-case: we observe that the friend at the cell $(1, 2)$ is at a Manhattan distance of $|1 - 2| + |2 - 3| = 2$ which is less than the Manhattan distance to any other friend.
- For the second test-case: both the friends at cells $(1, 3)$ and $(2, 2)$ are at a Manhattan distance of 2 from the cell $(1, 1)$. So, we output the lexicographically smallest cell which is, $(1, 3)$.
- For the third test-case: since there are no friends in the classroom, the answer is -1

Problem 7

Time limit: 1 second

Problem Description

In order to revise for the upcoming RA exam, you and your friends decide to explore the Cartesian plane. There are N people in total (including you). Each person decides to occupy some point on the plane with their X and Y coordinates described by the pair of integers (X_i, Y_i). It is given that none of the N people lie on either of X and Y axes. Further, no two people are standing at the same point.

You wonder if can remove at-most K people such that among the remaining people, all of them are on one-side of either the X-axis **or** the Y-Axis. Output "YES" (without quotes) if it is possible and "NO" (without quotes) otherwise.
Note that removing all the N people is a valid move and the output in such a case would be "YES" (the rationale behind this is that if no people remain, then the statement is vacuously true).

Input Format

The first line of input contains a single integer denoting the number of test-cases T. Then, the description of each test-case follows:

For each test-case:
The first line contains two space-separated integers N, K that denotes the number of people and the maximum number of people you are allowed to remove respectively.
Then, N lines follow. The i^{th} line contains two space-separated integers X_i, Y_i describing the X and Y coordinate respectively of the i^{th} person.

Input constraints

- $1 \leq T \leq 10^5$
- $1 \leq N \leq 10^5$
- $0 \leq K \leq N$
- $-10^9 \leq X_i, Y_i \leq 10^9$
- $X_i \neq 0, Y_i \neq 0$
- It is guaranteed that the sum of N across all test-cases does not exceed 10^5.

Output Format

For each test-case: output "YES" (without quotes) if it is possible to remove at most K people such that among the remaining, all of them lie are on one-side of either the X-axis **or** Y-axis and "NO" (without quotes) otherwise.

Sample Input

```
2
4 1
1 -1
10 1
-1 3
1 -5
2 0
-1 1
2 -3
```

Sample Output

```
YES
NO
```

Note

Explanation for sample input 1:

- For the first test-case: We are allowed to remove at most 1 person. If we remove the third person who stands at $(-1, 3)$, then among all the remaining people, $\{(1, -1), (10, 1), (1, -5)\}$ all of them lie on the positive side of the X-axis.

  Note that among the people remaining, there are people on either side of the Y-axis. But, this is of no consequence since satisfying the condition for just one axis is sufficient.

- For the second test-case: We are not allowed to remove anyone. There are people lying on either side of both X and Y axes. Hence, we output "NO".

Problem 8

Time limit: 1 second

Problem Description

Having finished the assignment, you and your friends decide to go to JC to chill. You spend a total of Rs. A at JC and now you want to split the bill among you and your $N-1$ friends. That is, each person needs to pay $\frac{A}{N}$ towards the bill. Call this quantity as S.
Your friend claims to be a talented mathematician and so proposes that the digit C does not appear in the decimal representation of S written correctly upto a 10^{100} **places after the decimal point**.

Output -1 if he is indeed correct. Otherwise, output the first position of occurrence of the digit C **after** the decimal point where the positions after the decimal point are numbered starting from 1.
Note that it is of no consequence whether or not the digit C occurs before the decimal point.

Input Format

The first line of input contains a single integer denoting the number of test-cases T. Then, T lines follow:

For each test-case, the first and only line of input contains three space separated integers A, N, C.

Input constraints

- $1 \leq T \leq 10^5$
- $1 \leq A, N \leq 10^5$
- $0 \leq C \leq 9$
- It is guaranteed that the sum of A and the sum of N across all test-cases won't exceed 10^5.

Output Format

For each test-case: output -1 if your friend is correct. If not, output the first position after the decimal point where the digit C occurs. Note that the numbering of the positions after the decimal point starts with 1.

Sample Input

```
3
2 3 6
1 2 0
2 1 2
```

Sample Output

```
1
2
-1
```

Note

Explanation for sample input 1:

- For the first test-case: The decimal representation of $S = \frac{2}{3} = 0.666\ldots$
  So, the digit 6 occurs at the first position after the decimal point and hence we output 1.
- For the second test-case: The decimal representation of $S = \frac{1}{2} = 0.50000\ldots$
  So, the digit 0 occurs at the second position after the decimal point and hence we output 2.

- For the third test-case: The decimal representation of $S = \frac{2}{1} = 2.000\ldots$
  So, the digit 2 never occurs **after** the decimal point and hence the answer is -1.