TJ IOI 2017 Programming Round

TJ IOI Officers
Thomas Jefferson High School for Science and Technology

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Instructions

These are the official problems for the Thomas Jefferson Intermediate Olympiad in Informatics 2017. This packet contains ten (10) problems, to be completed during the three (3) hour time period. Once your time has expired, you will no longer be allowed to submit solutions.

Accepted languages include Java 8, Python 3, and C/C++. Note that if you submit your code in Java, the name of the class in the file must match the name of the `.java` file.

Each team will be permitted to use one (1) computer, and all code must be written and submitted using the computer provided. If you are experiencing techincal issues during the contest, alert a proctor and we will assist you.

You are permitted to use any printed material that you have brought with you, including the official TJ IOI 2017 Study Guide. You are also permitted to use the electronic documentation provided to you through the contest site. As a team, you may collaborate among each other - however, you may not communicate with any other teams during the contest window for any reason.

You are not permitted to access the internet in any way other than accessing the contest site. No electronic devices other than the computer are permitted to be used, with the exception of a watch. You may **not** intentionally exit the virtual machine for any reason. Breaking any of these rules may be grounds for a disqualification.

Please do not submit any code that is not your own work. We understand that many well-established algorithms do the job effectively, but if you are to use code that you did not write, please cite your sources with a comment. Do **NOT** copy and paste large chunks of code. Ultimately, the goal of TJ IOI is to help students foster a passion for computer science and to learn something new, and violations of personal or academic integrity defeat the purpose of the contest.

Do not turn this page and begin the contest until you are instructed to do so. Good luck and have fun!

A Larry's Race

Larry is attempting to join spring track! To get Larry in shape, Devon has built a robot to chase Larry, traveling 100 meters in T seconds. Given N distances A_i that Larry runs and the time B_i it took for him to run that distance ($1 \leq N \leq 10^5$, $100 \leq A_i \leq 10^5$, $1 \leq B_i, T \leq 10^5$) , determine whether Larry could outrun Devon's robot.

Note: if Devon's robot catches Larry exactly at the finish line, Larry did not outrun it.

INPUT FORMAT:
The first line consists of two integers, N and T. The next N lines each contain an integer A_i representing a distance in meters (A_i is a multiple of 100), and a time B_i representing the time it took Larry to run that distance in seconds.

OUTPUT FORMAT:
For each input, if Larry outran Devon's robot, output "SPEEDRACER" (without quotes). Otherwise, output "POTATO" (without quotes).

SAMPLE INPUT:

```
3 22
1600 352
800 150
3200 840
```

SAMPLE OUTPUT:

```
SPEEDRACER
POTATO
SPEEDRACER
```

B Lunchbox Hunt

Alex has decided to go on a treasure hunt to find Devon's hidden lunchbox somewhere inside the school. Fortunately for Alex, Devon left behind a set of instructions specifying the location of his lunchbox. The instructions consist of a starting location (x_0, y_0) and N $(1 \leq N \leq 10^6)$ queries. Each query consists of a direction specified by the characters 'N', 'S', 'E', and 'W', and a non-negative distance. Help Alex find the coordinates of the location of Devon's lunchbox.

INPUT FORMAT:
The first line will contain three integers N, x_0, and y_0. The following N lines will describe a query consisting of a character ('N', 'S', 'E', 'W') and a non-negative integer distance. 'N' corresponds to traveling in the positive y direction, etc.

OUTPUT FORMAT:
The output should consist of two integers separated by a space. The first integer is the final x coordinate and the second integer is the final y coordinate.

SAMPLE INPUT:

```
4 6 -2
N 3
S 5
W 2
W 1
```

SAMPLE OUTPUT:

```
3 -4
```

C Singing Low

Devon enjoys singing, and wants to see how low he can sing. Devon begins at note N ($1 \leq N \leq 10^6$), and would like to sing note 0. In one step, Devon may sing between 1 and K notes lower than his current note (so if K is 3 and he is on note 5, he can sing either 3, 2, or 1 notes lower than his current note, taking him to notes 2, 3, or 4, respectively). However, Devon's note cannot decrease by any given amount more than once (so if he went from note 5 to note 3 in the previous example by going down 2 notes, he would not be able to go to 1 as this would again decrease by 2 notes). Please help Devon calculate the smallest value of K that will allow him to get to note 0.

INPUT FORMAT:
The first line will contain the integer N, the note that Devon begins on.

OUTPUT FORMAT:
The output should consist of one integer, K, the lowest value which will allow Devon to reach note 0.

SAMPLE INPUT:

```
8
```

SAMPLE OUTPUT:

```
4
```

D Pencils

In order to prepare for his math test tomorrow, Alex has gathered N ($1 \leq N \leq 10^5$) pencils in front of him. However, his pencil bag only has room for K pencils ($1 \leq K \leq N$). Each of his pencils has an integer length in the range of 1 to 1000, inclusive. Because Alex's math test is really hard, he needs to write a lot if he wants to get a good grade, and so Alex wants to choose the longest K pencils to place into his pencil bag. Please help Alex pass his math test!

INPUT FORMAT:
The first line of input contains two integers N and K. The next N lines describe the length of the pencils.

OUTPUT FORMAT:
Output a single integer, the sum of the K longest pencils.

SAMPLE INPUT:

```
7 3
1
4
5
3
8
14
2
```

SAMPLE OUTPUT:

```
27
```

E Puck Puck Moose

Not only does Larry do no work, but he distracts those around him that are trying to be productive! Larry invites Alex and his $N-2$ friends (Unfortunately, Larry has no friends) to form a circle of N people ($1 \leq N \leq 10$), in order to play Alex's favorite game, Puck Puck Moose. Some of the people in the circle do not get along, however, and Alex and Larry must accommodate their friends. Given the pairs of people who do not want to sit next to each other, determine the number of possible ways that the N people can sit down in the circle.

Note: A circle is rotationally symmetric, so any configuration that can be rotated into another is considered the same configuration.

INPUT FORMAT:
The first line of input contains two integers, N and K ($1 \leq K \leq \binom{N}{2}$), where N is the number of people in the circle, numbered from 0 to $N-1$, and K is the number of pairs to follow. The next K lines consist of two integers, denoting the indices of the two people that do not want to sit next to each other. Note that order does not matter (i.e., if 0 and 1 are a disallowed pair, 0 may not be neither to the left nor the right of 1.

OUTPUT FORMAT:
Output a single integer, the number of ways that the people can sit down in a circle, such that no pair that does not want to sit next to each other is together. If no configurations are possible, print 0.

SAMPLE INPUT:

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

SAMPLE OUTPUT:

```
2
```

F Larry's Candy Fest

It's Larry's lucky day! While shopping at the supermarket, Larry found a massive blowout sale on candy. Unfortunately, after purchasing a large amount of N different kinds of candy ($1 \leq N \leq 10^5$), he realized that the receipt of length M ($1 \leq M \leq 10000$) has no spaces in it! Larry wants to eat healthy, however, so he wants to know how much sugar is in the candy he will eat. Help Larry figure out how much sugar he will consume after he eats all of the candy.

Note: It is guaranteed that no candy name is a prefix of another candy name.

INPUT FORMAT:
The first line of input contains the integer N, the number of different kinds of candy. The next N lines contain the name of the candy, a string of length M ($1 \leq M \leq 100$) given in all capital letters, followed by the amount of sugar in that candy, separated by a space. The final line will contain the receipt, a string of capital letters.

OUTPUT FORMAT:
Output a single integer, the amount of sugar that Larry will consume.

SAMPLE INPUT:

```
4
KITKAT 20
TWIX 28
REESES 8
SNICKERS 9
TWIXTWIXKITKATREESESTWIXSNICKERSTWIX
```

SAMPLE OUTPUT:

```
149
```

G Larryopoly

Larry, being rich, decides to invent his own currency. He creates N ($1 \leq N \leq 1000$) different types of bills, each with a unique dollar value d_i ($1 \leq d_i \leq 1000$). Niki decides to use this currency. Niki wants to feel rich, so he wants to maximize the number of bills he can hold. However, Niki refuses to take more than one bill of each kind. Niki will ask M times ($1 \leq M \leq 10^6$) if he can hold X ($1 \leq X \leq 1000$) amount of value in Larry's currency and if so, how many bills that will take.

INPUT FORMAT:
The first line of input contains two integers N and M, where N is the number of bills and M is the number of queries. The next N lines each contain one integer, denoting the value of that bill, followed by M lines, each consisting of a query in the form of a value X.

OUTPUT FORMAT:
Output M lines, where each line contains the minimum number of bills needed to make the value in the corresponding query, or -1 if this is impossible.

SAMPLE INPUT:

```
3 2
2
6
9
8
11
```

SAMPLE OUTPUT:

```
2
2
-1
```

H Cookie Baking

Devon has N large piles of cookies ($1 \leq N \leq 10^5$), where the ith pile ($1 \leq i \leq N$) contains a_i cookies ($1 \leq a_i \leq 10^5$). Alex, on the other hand, wants to steal his cookies, but he brings along a different number of friends each time.

When he steals cookies, he wants to make sure he is able to split the cookies evenly among him and his $X - 1$ friends (X people total). Alex always chooses X to be prime, because he likes prime numbers. Since the door is located next to cookie pile 1, Alex wants to take cookies from the first possible pile (i.e. the minimum value of i), such that he can split the pile's cookies amongst X people evenly.

Since Devon is rich, whenever Alex takes cookies from a pile, he is able to restock the pile with exactly the same number of cookies. This means that the sizes of the cookie piles effectively do not change.

Unfortunately, Devon has caught on. To slow Alex down, he occasionally swaps two piles of cookies. Whenever Alex arrives, help him determine the best pile to take cookies from.

INPUT/OUTPUT FORMAT:

The first line contains N and Q ($1 \leq Q \leq 10^5$). The second line contains N integers representing a_i. The next Q lines contains queries. Each of these lines will start with 'S' or 'T'.

- If the line starts with 'S': two integers x, y ($1 \leq x < y \leq 10^5$) will follow, denoting Devon swapping piles x and y
- If the line starts with 'T': one integer X ($1 \leq X \leq 10^5$, X is prime) will follow. Output the minimum i such that X divides a_i, or output -1 if no such a_i exists.

SAMPLE INPUT:

```
5 9
2 15 49 11 17
T 3
S 3 5
T 7
S 1 4
S 3 4
S 1 2
T 2
T 3
T 13
```

SAMPLE OUTPUT:

```
2
5
3
1
-1
```

I Hungry Hungry Larrys

Devon stands at the top left corner of an $N \times N$ grid ($1 \leq N \leq 4000$), and can move either to the right or down, and would like to reach the bottom right corner. However, a number of Larrys reside on each cell of the grid. Every time Devon moves to a new cell, each Larry on the grid cell that Devon moves to will reach into Devon's wallet and take one dollar. Thankfully, Devon's wallet has an infinite amount of money, but he still would like to lose as little money as possible. It is guaranteed that there are no Larrys on the cell that Devon begins on. Determine the least amount of money that Devon must lose to the hungry hungry Larrys along the way, in order to reach his destination cell.

INPUT FORMAT:
The first line of input contains the integer N, the size of the grid. The next N lines each contain N integers, and together describe the number of Larrys at each location on the grid.

OUTPUT FORMAT:
Output a single integer, the least amount of money that Devon must lose in order to get to his final cell.

SAMPLE INPUT:

```
4
3 2 5 1
2 9 3 0
4 6 1 2
8 2 2 6
```

SAMPLE OUTPUT:

```
19
```

J Grocery Shopping

On the opening day of the Third Floor Grocery Shop, N ($1 \leq N \leq 10^5$) students arrive, where the ith student would like to buy A_i ($1 \leq A_i \leq 100$) items. The grocery shop has a total of M ($1 \leq M \leq 10^5$) checkout stations, and the number of seconds it takes for a student to checkout is exactly equal to the number of items that student purchases.

The grocery management team has devised an unusual plan to facilitate grocery checkouts in a calm (but inefficient) manner: all N students will line up in the order of arrival, and the management team will divide the students into M contiguous segments. Each segment will check out at a different checkout station, and all of the stations may operate at the same time. Please help the management team decide the minimum amount of time necessary to checkout all students if they divide the students optimally.

INPUT FORMAT:
The first line contains N and M. The next N lines contain an integer representing A_i.

OUTPUT FORMAT:
Output minimum amount of time necessary to checkout all students.

SAMPLE INPUT:

```
5 3
1
2
3
4
5
```

SAMPLE OUTPUT:

```
6
```