Freshmen Programming Contest

Contest Problem Set

May 1, 2019

A Alternative Blockchain Algorithms

B Balloon Party

C Circus Tent

D Darts

E Encryptastrophy

F Forest Run

G Game Night

H Hurry the Hedgehog

Problem A
Alternative Blockchain Algorithms
Time limit: 5 seconds

To reduce the amount of fraud in banking, the Financial Problems Committee (FPC) opted to use a blockchain, as they are a modern banking committee. For every account, a blockchain is kept with all the transactions that have been applied to it.

The FPC determined encryption and "proof of work" to be cumbersome and not worth the hassle, so the blocks are trimmed down to contain only the bare essentials needed to track back to the beginning from any block in the chain. Despite this, accidents still happen, so a reference back to the parent node is included to verify the continuity of the chain.

Your job is to verify the blockchain and return the balance on the account.

A block is bad if the parent id of the block does not match the preceding block. Your program should also check if the account does not have a transaction that might cause it to become negative.

The first block (aka "genesis block") should always have parent id 0.

Input

- One line containing one integer $1 \leq N \leq 10^6$, the number of blocks on the chain

- N lines containing three integers each: $1 \leq i \leq 10^6$, the block id; $1 \leq p \leq 10^6$, the parent id; $-10^6 \leq m \leq 10^6$ the amount transferred to/from the account.

All transactions can be assumed to not cause integer under- or overflows. Block ids can be assumed unique.

Output

If a transaction will result in the balance on the account being lower than 0, return `NO_MONEY`. If a block is bad, return `INVALID`. Otherwise, output the amount of money on the account as an integer.

Sample Input 1	Sample Output 1
2 1 0 5 2 1 -4	1

Sample Input 2	Sample Output 2
5 1 0 5 2 1 -1 3 4 -1 4 3 -1 5 4 -1	INVALID

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Problem B
Balloon Party
Time limit: 4 seconds


A balloon animal. Source: PixStix on thingiverse.

The Floating Poodle Company (FPC) is planning on selling balloon animals on festivals. To make these animals float, they are going to fill them with helium. Since they have run out of helium canisters, they are going to store their helium below the ceilings of the party tents from which they sell the balloons.

Because of environmental laws, they are not allowed to spill any helium. This means that they must be careful not to put too much of it into any of the party tents, since if the helium level drops below any part of the edges of the ceiling, this surplus of helium will be blown away and contaminate the atmosphere. They have asked you to calculate the maximum amount of helium they can fit inside one of the tents.

Input


A party tent. Source: Wikimedia Commons.

- One line with two integers: $1 \leq w \leq 1000$ and $1 \leq l \leq 1000$: the width and length of the tent.
- l lines, each with w integers in the range $[1, 1000]$. Each of these integers describes the height above the ground of a 1×1 section of tent ceiling. For this assignment, assume that every one of these sections is completely horizontal.

Output

The maximum amount of helium that the company can fit below the ceiling of the tent.

Sample Input 1	Sample Output 1
3 3 1 1 1 1 2 1 1 1 1	1

Sample Input 2	Sample Output 2
4 5 1 2 3 2 2 3 2 3 2 4 2 2 3 2 5 2 2 3 2 1	6

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Problem C
Circus Tent
Time limit: 1 second

This year, the city of Delft will host the Fiery Pyrotechnical Circus (FPC). The main feature of the FPC is an amazing fire show in a huge cylindrically shaped circus tent, which has a different size every year.

A non-cylindrical circus tent. Source: EmojiOne.

The size of the circus tent depends on how much space the performed acts will need, but there should always be a ring of five meters wide reserved for the seats of the audience around the inner ring. Of all the acts, only the maximum needed diameter of the inner ring and maximum needed height of the tent will need to be considered; all the performed acts that need less space will then also fit in the tent.

Since fire-resistant tent canvas is quite expensive, they want to order exactly enough canvas for the tent to be built. You are given the task to calculate how much tent canvas will be needed to build this year's tent for the FPC.

Input

The input consists of one line with two floating-point numbers.
The first number is the necessary diameter d of the inner ring of the circus tent in meters (with $1 \leq d \leq 10^{15}$).
The second number is the necessary height h of the circus tent in meters (with $1 \leq h \leq 10^{15}$).

Output

The surface area of the tent canvas in square meters. Your answer should have an absolute or relative error of at most 10^{-6}.

Sample Input 1	Sample Output 1
`10 5`	`628.31853071795870`

Sample Input 2	Sample Output 2
`4.2 3.1415`	`298.51193482924464`

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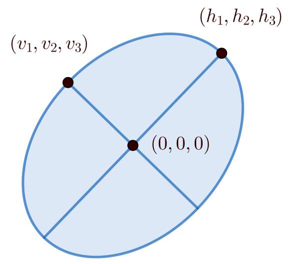
Problem D
Darts
Time limit: 5 seconds



The board

You have joined a project called 'Flying Projectile Coding', which attempts to create a smart machine learning AI that will throw darts at a slightly modified dart board. Before the live testing of this AI, you have decided to train it in a simulation, because that is way faster and cheaper.

In this project, you are tasked with assessing the AI's performance. Since it is still in the early stages of its development, you are only interested in whether it hit the board or not. Also, for now, you just assume that gravity is negligible, so darts fly in straight lines.

Input

- One line with an integer: $1 \leq n \leq 10^5$: the number of darts that have been thrown.
- Two lines with three floating-point numbers each: $-10 \leq h_1, h_2, h_3 \leq 10$ and $-10 \leq v_1, v_2, v_3 \leq 10$. The dart board is mounted at $(0, 0, 0)$ and is shaped like an ellipse with perpendicular axes (h_1, h_2, h_3) and (v_1, v_2, v_3).
- n lines with six floating-point numbers each: $-100 \leq p_1, p_2, p_3 \leq 100$ and $-10 \leq d_1, d_2, d_3 \leq 10$. This line indicates that a dart is thrown from position (p_1, p_2, p_3) in direction (d_1, d_2, d_3).

Output

The number of darts that hit the board.

Sample Input 1	Sample Output 1
3 2.0 0.0 0.0 0.0 1.0 0.0 0.0 0.0 2.0 2.0 1.0 4.0 0.0 0.0 -2.0 2.0 1.0 4.0 0.0 0.0 2.0 2.0 0.0 0.0	1

Sample Input 2	Sample Output 2
6 1.0 1.0 0.0 1.0 -1.0 1.0 0.0 0.0 1.0 0.0 0.0 -1.0 0.0 0.0 1.0 1.0 1.0 0.0 0.0 0.0 1.0 1.0 -1.0 1.0 1.0 -1.0 -1.0 -1.0 1.0 8.0 1.0 -1.0 -1.0 1.0 -1.0 8.0 -1.0 1.0 1.0 1.0 -1.0 -8.0	3

Problem E
Encryptastrophy
Time limit: 1 second

Alice and Bob are deeply in love, they sometimes like to swap out messages in class because they can't get enough of each other. In order to make sure no-one but them reads these messages, they get together and devise an encryption scheme that is theirs only: Despite what people are saying, security through obscurity *does* work, right?

To keep things simple, They first map every letter of the alphabet a-z to the numbers 0 to 25.

To encrypt and decrypt, a modular addition cipher is used, which defines the encryption function E and decryption function D as such:

$$E(k,p) = p + k \mod 26$$
$$D(k,c) = c - k \mod 26$$

$$c_i = E(k_i, p_i)$$
$$p_i = D(k_i, c_i)$$

Where p is the plaintext, c is the ciphertext and k is the key.

In order to avoid having to send long keys, they define the key as follows:

$$k_i = p_{i-1}$$

With k_0 being predetermined by Bob and Alice.

They feel this is secure and chat away all day long, without a worry in the world.

Eve however, has devised a plan. While spying on them, she's always picked up the last letter of every message that they've sent. She's now bent on figuring out what these messages say.

Input

- One line with one integer: $1 \leq n \leq 10^3$, the length of the ciphertext string
- One line with the ciphertext string
- One line with the last letter of the plaintext string

Output

The plaintext string

Sample Input 1	Sample Output 1
8 ftzjzcmi u	iloveyou

Sample Input 2	Sample Output 2
``10 ulpwzkkfco d```	helloworld

Problem F
Forest Run
Time limit: 6 seconds

Forrest Gump wants to participate in the annual Forest Run. As usual, the forest where this event takes place contains many trees. However, the forest for this year's run is special. The hiking trails are also shaped like trees; this means that each entrance into the forest branches off into multiple trails, these trails will never form a cycle, and entrances into the forest do not have incoming trails from another entrance. In order to finish the Forest Run, every path from every entrance to every trail end and back must be run.

All intersections in the forest (including the entrances) are numbered, starting from one. Every trail between two intersections is one kilometer long. You can neglect the distance between the entrances to the forest.

Can you calculate the full distance that Forrest must run in order to complete the Forest Run?

Input

- One line with two integers: $1 \leq n \leq 10^6$, the number of intersections in the forest, and $1 \leq e \leq n$, the number of entrances into the forest.
- One line with e integers: these are the numbers of the intersections that are the entrances to the forest.
- n lines, one for each intersection i. Each line has one integer $0 \leq c_i \leq n - 1$, indicating the number of trails exiting intersection i, followed by c_i integers which are the numbers of the intersections that the trails exiting intersection i lead to.

Output

- One line containing one integer, which is the amount of kilometers that Forrest must run.

(Examples on the next page.)

Examples

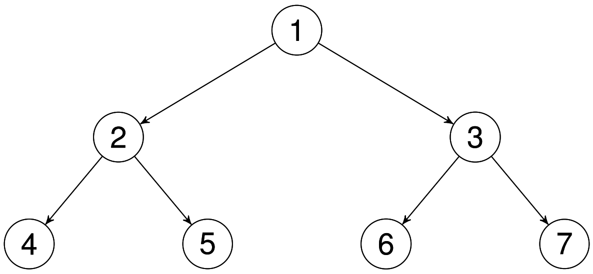


Figure F.1: The paths in the forest of the first sample input. Forrest will have to run the following path: $1 - 2 - 4 - 2 - 1 - 2 - 5 - 2 - 1 - 3 - 6 - 3 - 1 - 3 - 7 - 3 - 1$.

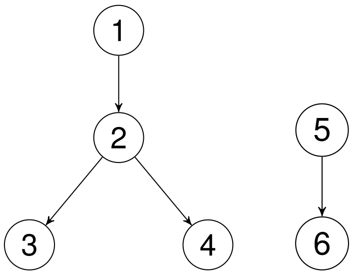


Figure F.2: The paths in the forest of the second sample input. Forrest will have to run the following paths: $1 - 2 - 3 - 2 - 1 - 2 - 4 - 2 - 1$ and $5 - 6 - 5$.

Sample Input 1

```
7 1
1
2 2 3
2 4 5
2 6 7
0
0
0
0
```

Sample Output 1

```
16
```

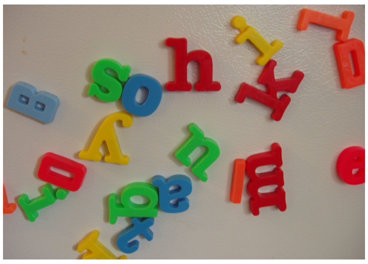
Sample Input 2

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

Sample Output 2

```
10
```

Problem G
Game Night
Time limit: 2 seconds



A collection of fridge magnets. Source: Wikimedia Commons.

Every Saturday, Geronimo is organizing a game night for all his friends. One after the other, his friends keep asking him for his Wi-Fi password. Because Geronimo has many friends and does not want to be continuously disturbed just to share his password, he decides to grab an old box of fridge magnets that have the shape of letters, and spells out the password on the fridge.

Since Geronimo cares about the security of his Wi-Fi network, he wants to change the Wi-Fi password after the game night, to make sure that his password is not shared with strangers who will then use his network. However, that means he also has to update the password displayed on the fridge. The box with fridge magnets is a complete mess, so Geronimo does not want to spend too much time searching through the box for the right letters, especially when a new password contains some letters that were also in the old password.

Given Geronimo's old and new Wi-Fi password, can you calculate how many letters he has to search for in the box to spell out the new password on the fridge?

Input

- One line with one integer: $1 \leq n \leq 10^6$, the length of the passwords. Both passwords have the same length.
- Two lines with each one password of length n. The passwords only contain lowercase letters ('`a`' through '`z`').

Output

One line, containing one integer: the number of letters that cannot be re-used between the two passwords.

Sample Input 1	Sample Output 1
`6` `nanana` `batman`	`3`

Sample Input 2	Sample Output 2
`8` `roasting` `organist`	`0`

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Problem H
Hurry the Hedgehog
Time limit: 5 seconds

Hurry is a Hedgehog, who lives in the Mushroom Kingdom. He is on a mission to save Princess Plum from the evil Donkey Kong. In order to get to the Princess, Hurry must run through a hyperspace network of roads. These roads are dangerous and for every road that he walks between two intersections, he is getting attacked by Space Invaders. Luckily, at some intersections, there is a Super Mushroom that will restore Hurry's health.

Can you find the shortest path through the network of roads, such that you can eat a Super Mushroom at each intersection?

Input

The intersections are numbered between 1 and n, inclusive.
Hurry will need to start at intersection 1 and run to intersection n.
The input is structured as follows:

- One line with three integers: $1 \leq n \leq 10^5$, the number of intersections; $0 \leq m \leq 10^6$, the number of roads; and $1 \leq s \leq n$, the number of Super Mushrooms.
- One line with $\max(0, s-2)$ integers: the indices of the intersections that have a Super Mushroom (intersections 1 and n will always have a Super Mushroom and are not in this list).
- m lines with two integers each, indicating that there is a road between the two intersections with these indices.

Output

One line containing one integer, which is the number of intersections in the path that Hurry will have to run.

Sample Input 1	Sample Output 1
6 6 5 3 4 5 1 2 2 6 1 3 3 4 4 5 5 6	5

Sample Input 2	Sample Output 2
6 6 6 2 3 4 5 1 2 2 6 1 3 3 4 4 5 5 6	3