Lethbridge Collegiate Programming Contest 2018

September 29, 2018

Division I
Contest Problems

A: Buzzy Beez
B: HonkMobile
C: Tying Strings
D: Errands
E: Pick Up
F: Catch

This contest contains six problems over 14 pages. Good luck.

For problems that state "*Your answer should have an absolute or relative error of less than* 10^{-6}", your answer, x, will be compared to the correct answer, y. If $|x - y| < 10^{-6}$ or $\frac{|x-y|}{|y|} < 10^{-6}$, then your answer will be considered correct.

Definition 1

For problems that ask for a result modulo m:
If the correct answer to the problem is the integer b, then you should display the unique value a such that:

- $0 \le a < m$
  and
- $(a - b)$ is a multiple of m.

Definition 2

A string $s_1 s_2 \cdots s_n$ is lexicographically smaller than $t_1 t_2 \cdots t_\ell$ if

- there exists $k \le \min(n, \ell)$ such that $s_i = t_i$ for all $1 \le i < k$ and $s_k < t_k$
  or
- $s_i = t_i$ for all $1 \le i \le \min(n, \ell)$ and $n < \ell$.

Definition 3

- Uppercase letters are the uppercase English letters $(A, B, \ldots, Z)$.
- Lowercase letters are the lowercase English letters $(a, b, \ldots, z)$.

Problem A
Buzzy Beez

While working, Howard is distracted by a buzzing sound. He goes outside to check what is causing all this noise! Sitting outside his house is a bee. Howard thinks to himself, *I can't be the only person on my street distracted by this bee!* So, instead of going back to work, Howard decides to follow the bee to find out which houses get bothered by the bee.

The bee flies in a direction until it stops. While flying, it bothers every house that it passes as well as the house that it stops at. The bee flies and stops several times.

Which houses were bothered by the bee?

Input

The first line of input contains three integers n ($1 \leq n \leq 200\,000$), which is the number of houses on Howard's street, h ($1 \leq h \leq n$), which is Howard's house number (where the bee starts), and m ($0 \leq m \leq 200\,000$) which is the number of times the bee moves. The houses are numbered $1, \ldots, n$.

The next m lines describes the bees movements. Each of these lines contains a single integer d ($-n < d < n$), which describes how the bee flies on this move. If the bee starts this move at house a, it flies to the house $a + d$ and bothers all house numbers between a and $a + d$ (inclusive). It is guaranteed that $1 \leq a + d \leq n$.

Output

Display if each house was bothered. For each house (in order), display a single character. If the house was not bothered, display `.` (dot). If the house was bothered, display `B` if the bee is currently there and `Z` otherwise.

Sample Input 1	Sample Output 1
5 3 2 -1 2	.ZZB.

Sample Input 2	Sample Output 2
3 3 1 -2	BZZ

Sample Input 3	Sample Output 3
10 5 3 -4 5 2	ZZZZZZZB..

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Problem B
HonkMobile

Howard is standing in front of the vending machine. He exclaims, "Think about all the cola beverages I could extract from you if only I could save money." Suddenly, his HonkMobile app alerts him that his parking is about to expire. "Maybe I can save money on parking!"

HonkMobile provides several pricing options. For example, the image provides three pricing options. Howard can stay for two hours by paying \$7 (by taking the two-hour option) or he can stay for five hours by paying \$18 (by taking the one-hour option once and the two-hour option twice).

Howard knows how many hours he needs to stay and needs to buy at least that many hours from his app. What is the minimum price that Howard could pay?

Input

The first line of input contains two integers n ($1 \le n \le 1\,000$), which is the number of hours Howard needs to stay, and k ($1 \le k \le 1\,000$), which is the number of pricing options that HonkMobile provides.

The next k lines describe the pricing options. Each of these lines contains two integers h ($1 \le h \le 1\,000$), which is the number of hours this option provides, and p ($1 \le p \le 1\,000\,000$), which is the price of this option.

Output

Display the lowest cost that Howard could pay.

Sample Input 1	Sample Output 1
2 3 1 4 2 7 3 13	7

Sample Input 2	Sample Output 2
5 3 1 4 2 7 3 13	18

Sample Input 3	Sample Output 3
1 1 2 100	100

Sample Input 4	Sample Output 4
99 3 3 3 5 7 13 11	86

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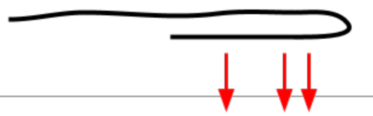
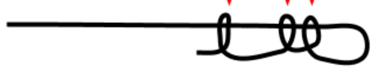
Problem C
Tying Strings

Howard would like to show the world how he ties his shoelaces. It is quite simple. First, he takes his shoelace (which is ℓ cm long) and puts it in a straight line (Step 1 below). Then, he folds the last k cm ($2k \le \ell$) of the shoelace over itself (Step 2). Finally, for each of the k cm, he may or may not twist the shoelace (Step 3). Now, he wants you to *tie a string* (that is, a sequence of letters) in the same way that he *ties a shoelace*.

To *tie a string* of length ℓ, reverse the last k characters ($2k \le \ell$) of the string and line it up with the last k characters of the remaining part of the string. At each of the k overlapped locations, you may either twist the string (that is, take the character from the reversed part of the string) or not twist the string (that is, take the character from the original string). The first $\ell - 2k$ characters remain the same.

	Tying Shoelaces	Tying Strings
Step 1		`A B C D E F G H I J K L M N`
Step 2		`A B C D E F G H I` `        N M L K J`
Step 3		`A B C D N F L K I`

There are many ways to tie a string for each integer value of k ($1 \le k \le \frac{\ell}{2}$). Over all such possibilities, what is the lexicographically smallest string that could result from tying a given string?

Input

The input consists of a single line containing a single string which contains between 2 and 1 000 lowercase letters, inclusive.

Output

Display the lexicographically smallest string that could result from tying the string.

Sample Input 1	Sample Output 1
`howard`	`doa`

Sample Input 2	Sample Output 2
`hqzaydercwo`	`howard`

Sample Input 3	Sample Output 3
`lcpctwentyeighteen`	`lcechgeet`

Sample Input 4	Sample Output 4
`lethbridgecollegiateprogrammingcontest`	`leehbocdgecmalegiae`

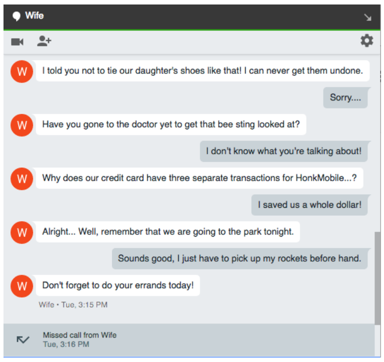
Sample Input 5	Sample Output 5
`bbbaaa`	`aaa`

Sample Input 6	Sample Output 6
`acacacbbbbbb`	`ababab`

Sample Input 7	Sample Output 7
`aabbab`	`aab`

Sample Input 8	Sample Output 8
aaaccccbb	aaabbc

Problem D
Errands



Howard, at his weekly bridge night, gets a call from his wife. *Oh no!* He thinks, *I forgot to do all my errands!* He ignores the call and runs to his vehicle.

Howard knows all the locations and streets of the city. A street connects two different locations. A street can be traveled, in either direction, from one endpoint to the other. It is possible to get from any location to any other location using some sequence of streets. Each errand takes one minute to complete and must be completed at a specific location. All of the errands must be done in order.

Help Howard by telling him the minimum number of minutes it will take him to finish all of his errands.

Input

The first line of input contains three integers n ($1 \leq n \leq 100\,000$), which is the number of locations in the city, m ($0 \leq m \leq 200\,000$), which is the number of streets in the city, and k ($1 \leq k \leq 10$), which is the number of errands Howard must run. The locations are numbered $1, \ldots, n$ and Howard starts at location 1.

The next m lines of input describe the streets of the city. Each of these lines contains three integers u, v ($1 \leq u < v \leq n$), which are the two locations connected by this street, and t ($1 \leq t \leq 1\,000\,000$), which is the number of minutes it takes to drive along this street. It is guaranteed that two locations are connected by at most one street.

The next k lines of input describe the errands in order. Each of these lines contain a single integer ℓ ($1 \leq \ell \leq n$), which is the location of this errand.

Output

Display the minimum number of minutes it will take Howard to finish all of his errands.

Sample Input 1

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

Sample Output 1

```
8
```

Sample Input 2

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

Sample Output 2

```
10
```

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Problem E
Pick Up

Finishing his last errand, Howard phones his wife after ignoring her call earlier. His wife answers, "Did you remember to pick up our daughter from school?" Oh no!

His daughter's school is on the same street as he is, exactly k kilometres away. Knowing how late Howard is, he needs to get to the school as fast as possible. To speed up his travel, he grabs a rocket from his trunk and straps it to the back of his car. He calculates that pushing the button will cause the rocket to activate and propel him one kilometre.

At each minute, Howard has exactly two choices. He can push the `Go` button or he can strap another rocket to the back of his car. Each additional rocket doubles the distance traveled when activating the rockets. He may use each rocket as many times as he wishes.

Tell Howard a sequence of actions which cause him to stop exactly at the school in the fastest amount of time.

Input

The input consists of a single line containing a single integer k ($1 \leq k \leq 1\,000\,000$), which is the number of kilometres away the school is.

Output

Display a sequence of actions which causes Howard to stop exactly at the school in the fastest possible time. The format follows the sample output. If there are multiple solutions, any of them will be accepted.

Sample Input 1	Sample Output 1
`1`	`Go`

Sample Input 2	Sample Output 2
`2`	`Go` `Go`

Sample Input 3	Sample Output 3
`3`	`Go` `Go` `Go`

Sample Input 4	Sample Output 4

`4`	`AddRockets`
	`AddRockets`
	`Go`

Sample Input 5	Sample Output 5

`5`	`Go`
	`AddRockets`
	`Go`
	`Go`

Sample Input 6	Sample Output 6

`6`	`AddRockets`
	`Go`
	`AddRockets`
	`Go`

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Problem F
Catch

Although normally avoiding physical activities, Howard was convinced by his daughter to play catch in the park.

Howard, his wife and his daughter are at the park and they want to pass around a baseball. Because of the way that Howard throws (from physical limitations), he always throws the ball exactly the same distance. Because he taught his daughter how to throw, she also always throws the ball exactly the same distance each time. Because his wife does not want Howard to feel different, she always throws the ball exactly the same distance each time. These three distances are not necessarily the same. The distance that each person throws is their *throwing distance*.

Knowing that Howard always passes to his wife, his wife always passes to his daughter and his daughter always passes to him, where should they stand such that they can all play without moving?

Input

The input consists of a single line containing three integers h ($1 \le h \le 1\,000$), which is Howard's throwing distance, w ($1 \le w \le 1\,000$), which is his wife's throwing distance, and d ($1 \le d \le 1\,000$), which is his daughter's throwing distance.

Output

Display `Yes` if there is a place where Howard, his wife and his daughter should stand and play catch and `No` otherwise.

If there is a possible placement, display one such placement by displaying the position of Howard, his wife and his daughter, in that order. Each position must be given as their x-coordinate and y-coordinate (these positions must have absolute value at most $10\,000$). Your answer should have an absolute or relative error of less than 10^{-6}. That is, your solution will be considered correct if the distance between each person and the person they are throwing to is within 10^{-6} of the thrower's throwing distance.

Sample Input 1	Sample Output 1
3 5 4	Yes 1 1 1 4 5 1

Sample Input 2	Sample Output 2
1 2 10	No

Sample Input 3	Sample Output 3
1 1 1	Yes 0.57735026919 0 -0.28867513459 -0.5 -0.28867513459 0.5

Sample Input 4	Sample Output 4
2 2 2	Yes 0 -1.15470053838 -1 0.57735026919 1 0.57735026919

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