National Taiwan University
Team Ranking Contest 2016

- There are 10 problems and 24 pages.
- Please use stdin for input, and stdout for output.
- The time limit and memory limit of each problem are on the judge system.

Table 1: Problem List

ID	Name
A	Energetic Inc.
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A. Energetic Inc.

Problem ID: energetic

Energetic Inc. has many sub-companies, each sub-company has its own manager and employees; and each employee might lead other employees. To be more clearly, we can denote each sub-company as a rooted tree, with each node is an employee and the root is the manager of the sub-company.

RMeow is the CEO of Energetic Inc., the motto of RMeow is "Keep energetic every day!". To follow her motto, RMeow will perform an operation in the beginning of every day.

One kind of operations is RMeow can change the structure of Energetic Inc., the method of changing structure is to change the leader of an employee. For example, suppose SmallMeow is an employee in sub-company G, and the current leader of SmallMeow is BigMeow. RMeow can change the leader of SmallMeow from BigMeow to another employee BigBigMeow. Notice that if BigBigMeow not belongs to sub-company G, SmallMeow and all SmallMeow's followers would belong to another sub-company after this change(very energetic!).

Another operation is pay raising, RMeow will choose an employee and raise his and all his followers' wage. That is, if RMeow raise SmallMeow's wage by val, all employees belongs to the sub-tree rooted by SmallMeow will be raised wage by val. Notice the wage of each employee is daily wage, and the pay would give to each employees in the end of each day.

However, RMeow is poor in calculation, she wants to know how much money she has already paid to a certain sub-company from the first day to the end of some day. Note the employees belong to any sub-company might change(the structure changing operation), while RMeow only cares how much she has paid to a sub-company.

In summary, every day RMeow will perform exactly one operation either structure changing or pay raising. RMeow can ask questions at any time. Since RMeow wants to know the answer of her questions as soon as possible, the input has been encrypted by the answer of RMeow's questions, see Input for more details.

Input

The first line contains two integers n, m indicating the number of employees(including managers) and the number of operations plus queries, respectively.

The second line contains n integers $wage_i$, denote the wage of each employees in the beginning of day 1.

The third line contains n integers $leader_i (1 \leq i \leq n)$, denote the leader of employee i is $leader_i$. Specially, if i is the manager of a sub-company, $leader_i = 0$.

Then follows m lines, each line contains either an operation or a query. Each line would contain three integers enc_{op}, enc_x, enc_y, which has been encrypted by the following rule:

Suppose the answer of the latest query is Q, then we set $enc_{op} = op + Q \bmod 3$, $enc_x = x + Q \bmod 100109$, $enc_y = y + Q \bmod 100109$. If no query has appeared, let $Q = 0$.

Meaning of op, x, y is shown as follows:

- If $op = 0$, RMeow performs pay raising operation on employee x with value y.
- If $op = 1$, RMeow performs structure changing operation, changes the leader of employee x to employee y.
- If $op = 2$, RMeow asks a question that how much money she has given to sub-company that managed by employee x from the first day to the end of day y.

Since RMeow would perform exactly one operation every day, the d-th operation is performed on day d. The first operation is performed in the beginning of day 1.

- $1 \leq n, m \leq 100000$
- $1 \leq i \leq n$
- $0 \leq wage_i \leq 2048$
- $0 \leq leader_i \leq n$
- $0 \leq op \leq 2$

- $1 \leq x \leq n$
  - If $op = 0, 0 \leq y \leq 2048$
  - If $op = 1, 1 \leq y \leq n$, and x would never be a manager
  - If $op = 2, 1 \leq y \leq$ number of operations has been performed, and x is a manager

The input data satisfy the structure of Energetic Inc. would always be a valid forest.

Output

For each query, output the answer.

Explanation

In the sample, RMeow needs to pay to the sub-company managed by employee 1 from day 1 to day 5 is $7, 7, 28, 28, 5$. And RMeow needs to pay to the sub-company managed by employee 5 from day 1 to day 5 is $369, 373, 352, 352, 375$.

Sample Input 1	Sample Output 1
12 13 1 1 2 3 5 8 13 21 34 55 89 144 0 1 2 2 0 5 5 6 6 9 9 9 0 12 0 2 1 1 0 12 8 0 378 370 2 370 371 1 19 16 2 750 745 1 743 742 2 745 749 0 743 745 2 47 45 1 1099 1098 2 1447 1451	7 369 14 742 42 1094 1446 75

B. Fish

Problem ID: fish

Fcrh is the king of stringology. Fcrh likes to eat ~~cebrusfs~~ fish. So he decides to take a lucky string s, and eat a fish looks like $F(s)$. WTF (What The Fish) is $F(s)$? It is a string of length $|s|-1$. The i-th character of $F(s)$ will be > (<) if the i-th suffix of s is lexicographically larger (smaller) than $i+1$-th suffix of s, respectively.

For example, if $s =$ `fcrh`, $F(s)$ would be ><>, since `fcrh` $>$ `crh`, `crh` $<$ `rh`, and `rh` $>$ `h`.

Given the lucky string s, please find $F(s)$ (and feed it to Fcrh).

Input

The input only contains one line with the lucky string s.

- $2 \leq |s| \leq 5 \times 10^6$
- s consists of only lowercase English letters.

Output

Output a single line with $F(s)$.

Sample Input 1	Sample Output 1
fcrh	>< >

Sample Input 2	Sample Output 2
baaananaaaa	><<<><>>>>

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C. Flee

Problem ID: flee

Andy is a happy ant living on a plane. Every morning, Andy leaves its ant hole and wanders around for food. In the evening, Andy walks back to the ant hole and rests. Life is perfect.

One day, Andy is seeking food near its ant hole just as usual. Andy does not notice that a catastrophe is generated covertly until a horrible sound blasted across the sky. It's a deadly tornado!!

Andy is scared, and runs back immediately to its ant hole. Andy notices that the deadly tornado has a fixed shape and moves with constant velocity $\vec{u}$ (The tornado doesn't rotate). If the tornado hits Andy before Andy runs back to ant hole, Andy will die tragically for sure. Please help Andy to find out the best way to escape as fast as possible.

Input

The first line contains two integers x_A, y_A, indicating the coordinate where Andy is at the beginning. The second line contains two integers x_B, y_B, indicating the coordinate of Andy's ant hole.

The third line contains a number n, following n lines, where the i-th line of these n lines consists of two integers x_i, y_i ($0 \leq i < n$). The deadly tornado is a simple polygon with n vertexes $(x_0, y_0), (x_1, y_1), \cdots, (x_{n-1}, y_{n-1})$, in clockwise or counterclockwise order, at the time Andy start to flee.

The last line contains three decimal numbers v, u_x, u_y, where v is the maximum speed of Andy, and $\vec{u} = (u_x, u_y)$ is the velocity of the tornado.

Note that Andy will NOT die if it just touches the boundary of tornado. Also, it's guaranteed that Andy is not in the interior of the tornado at the beginning.

- $3 \leq n \leq 30$
- $-1000 \leq x_A, y_A, x_B, y_B, x_i, y_i \leq 1000$
- $1 \leq |\vec{u}|, v \leq 100$
- $|\vec{u}| < 0.9v$

Output

Output a single number T as the least time Andy should spend to return to his ant hole without hit by the deadly tornado.

Your answer will be considered correct if its absolute or relevant error does not exceed 10^{-4}.

Sample Input 1

```
0 1
20 1
3
4 4
14 4
9 8
5 0 -4
```

Sample Output 1

```
4.000000
```

Sample Input 2

```
0 0
20 0
3
4 4
14 4
9 8
5 0 -4
```

Sample Output 2

```
4.018795
```

D. Hidden Mama Mia

Problem ID: hmm

Markov is a good kid with full of curiosity. He likes to hide some sequences and let his mom find it.

Recently, Markov learned about the *arithmetic progression*, which is a sequence of numbers $x_1, x_2, \ldots, x_k$ with common difference $\Delta = x_2 - x_1 = x_3 - x_2 = \cdots = x_k - x_{k-1}$. He quickly gathers tons of arithmetic progressions and feels good to write all of his discovery down on a paper. But soon, Markov wants to hide all his discoveries from his mom. If his mom found the papers, she may discard all of the numbers and tell Markov not to waste ink: "You only need to store x_1, k and Δ, not to write down all of them!"

Markov decides to write down a sequence a of n positive integers $a_1, a_2, \ldots, a_n$, and his sequences perfectly shuffled and hidden in a as consecutive subsequences. Can you help Markov's Mama to count, in how many number of pairs (l, r) with $l < r$, so that the consecutive subsequence $\{a_l, \ldots, a_r\}$ form a set of arithmetic progression?

Input

The first line contains one integer n. Then n integers follows.

- $2 \leq n \leq 10^5$
- $1 \leq a_i \leq 10^9$

Output

Output only one number in one line indicating the answer.

Sample Input 1

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

Sample Output 1

```
10
```

Sample Input 2

```
10
10 2 8 4 6 5 7 3 9 1
```

Sample Output 2

```
27
```

Sample Input 3

```
5
1000000000 1 1000000000 1 1000000000
```

Sample Output 3

```
4
```

E. Juelyst

Problem ID: juelyst

Juelyst is an arising hearthstone-like tactics card game developed by Kakaen Cooperation. As in hearthstone, you'll need to draw cards from your deck and consumes crystals to play those cards.

To promote Juelyst, Kakaen had held a worldwide online competition, in which the most talented player, Shik, won the champion and got a chance to add a new card into the game.

Being both a top ICPC competitor and a top Juelyst player, Shik decided to design the card in a way that he may beats his rivals with ICPC skill. The result is the card XOR, which would xor the cost of all cards on your hand by a value. What make things even complex is the value used to xor could be decided by the player when he plays the card.

After adding this card, almost all other players get confused. Nobody knows the best way to decide the xor value, except Shik, of course. However, Shik found it boring to win all the games. As a result, he plans to play the game in a special way:

1. Shik should play the card XOR once he draws it.
2. All others card he played on that turn should be adjacent to each other.
3. Those cards should be played from left to right.
4. The next card played must have its cost higher than the previous.
5. Shik should play as many cards as possible in this turn.

In short, Shik must play the longest consecutive interval of cards which their costs form an increasing sequence after xored considering the crystals he has. Unfortunatly, it came out too hard for Shik to calculate this and play the game simultaneously. He turns to you and hope you may calculate the answer for him regardless of the number of crystals.

Note that Shik is still playing a game, you should answer him as soon as possible.

Input

The first line contains an integer n indicating the number of cards Shik holds excluding XOR. Each of the following n lines contains exactly one integer c_i, the cost of i-th card.

- $1 \leq n \leq 10^6$
- $0 \leq c_i < 2^{64}$

Output

Output a single line with two numbers, the maximum number of **other cards played** and the xor value chosen. Output the smallest value if there exists multiple solutions.

Sample Input 1	Sample Output 1
5 7 0 1 2 3	5 4

F. Lottery

Problem ID: lottery

The department store is on sale! To attract more customers, a lottery is held, and all customer with ticket can draw once. The rule is as follows:

There's a box of balls with numbers 1 to M on them. There are c_i balls with number i on it. Each person draws a ball uniform randomly. If he gets number i, then he get a prize of type i! Then the drawn ball is put back into the box.

Since the number of prize is limited, and there are only q_i prizes of type i, if one gets number i, but type i prize have already been all given out, then he gets a candy instead.

Kelvin is interested on the prize. He have determined values of each prizes, type i prize have value of v_i, and the candy is worth value V. He knows that there would be a total of n people (including Kelvin), each person having exactly one ticket. Now all n people are lining up, Kelvin wonders where in line should he be at to maximize the expected value of things he got?

Input

The first line contains three integers n, M, V.

The next M lines, each line contains three integers q_i, v_i, c_i

- $1 \leq n, M \leq 514$
- $0 \leq V, v_i \leq 10^9$
- $1 \leq c_i \leq 10^6$
- $1 \leq q_i \leq 514$

Output

Output the maximum expected value Kelvin would get if he choose the optimal position in line. Your answer will be considered correct if its absolute or relative error does not exceed 10^{-3}.

Sample Input 1	Sample Output 1
10 2 100 5 50 1 2 200 1	125.000000

Sample Input 2	Sample Output 2
10 2 100 5 200 1 2 50 1	143.750000

G. A Game about Bipartite Matching

Problem ID: matching

You are playing a game about coutructing a n-digit binary number. Initially, all digits of this binary number are zero.

The purpose of this game is change some digits into one such that the number of one is as many as possible. But there are some constraints you have to obey:

1. All digit ones you change into are colorful.
2. All possible colors are numbered from 1 to m.
3. i-th digit can only change into color c_{i1} or c_{i2}.
4. All colors of digit one you change into are distinct.

You may think ”this game is so easy! It’s just a maximum bipartite Matching problem! Isn’t it?”

Yes! It’s really a bipartite matching problem.

In order to avoid you just copy the code from codebook, we ask you output the resulting binary number and add some constraint about this binary number.

Please look output format for detail.

Input

The first line contains two integers n and m, indicating the number of digits and the number of possible colors. In following n lines, the i-th line of these n lines consists of two integer c_{i1}, c_{i2}, indicating two colors i-th digits can change into.

- $1 \leq n, m \leq 5 \times 10^5$
- $1 \leq c_{i1}, c_{i2} \leq m$
- $c_{i1} \neq c_{i2}$

Output

You should output n digits to describe your resulting binary number.

If i-th digit is still zero, the i-th digit you print should be 0. If i-th digit is one and its color is c_{i1}, the i-th digit you print should be 1. If i-th digit is one and its color is c_{i2}, the i-th digit you print should be 2.

If there are multiple solutions with maximum number of digit one, you should choose the solution with largest resulting binary number. (Note that the first digit is the most significant bit)

If there are still multiple solutions, you can output any of them.

Sample Input 1

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

Sample Output 1

```
222
```

Sample Input 2

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

Sample Output 2

```
112
```

Sample Input 3

```
4 500000
1 2
2 1
1 2
8 7
```

Sample Output 3

```
1101
```

H. Monkey

Problem ID: monkey

Monkeys love to climb tree, and they also love to sit on it.

There is a big tree in the forest with N node.

K monkeys line up in one row and try to find a spot on the tree from the root of it with following procedure one by one:

1. If the node is empty, the monkey will be very happy and sit on the node.
2. If the node is not empty but it has several child nodes, the monkey will climb to one of the child nodes uniformly randomly.
3. If the node is not empty and it's a leaf, the monkey will be very upset and jump off the tree. It will walk away and never come back.

What is the probability of **all** monkeys will stay on the big tree after they all try to climb it?

Input

The first line contains two integers N, K.

The second line contain $N-1$ integers $a_1, a_2, \cdots, a_{N-1}$ .Integer a_i indicate the parent node of node i. Node 0 is the root of tree.

- $2 \leq N \leq 2000$
- $1 \leq K \leq 2000$
- $0 \leq a_i \leq i-1$

Output

Output the probability of all monkeys will stay on the big tree. If the irreducible fraction of the probability is $\frac{A}{B}$, please output $A \times B^{-1} \bmod 10^9 + 7$.

Sample Input 1	Sample Output 1
3 3 0 0	500000004

Sample Input 2	Sample Output 2
10 10 0 0 0 0 0 0 0 0 0 0	875477769

I. Sinu

Problem ID: sinu

The lecture will begin within 5 minutes. David and his friends hate those couples raburabu-ing during lectures, so they sit strategically to prevent couples sitting together. But couples would not easily give up raburabu-ing during lectures. They team together to against David's team.

You can assume the classroom is a $n \times m$ grid. Each block is occupied by one of Davids, one of couples, or nothing on it. Because the runtime problem is difficult, we assume that two teams move turn by turn. In each turn, the team can move at most one of its members up, down, left or right. That is, move one of its members at (x, y) to one of $(x+1, y), (x-1, y), (x, y+1), (x, y-1)$ or do not move any of its members. Of course, people can not go out of the map.

(0,0)	(0,1)	(0,2)	(0,3)
(1,0)	(1,1)	(1,2)	(1,3)
(2,0)	(2,1)	(2,2)	(2,3)

coordinate of each position for $n = 3, m = 4$

(C	C)	C	
D	D	D	D
			C

only one match

For example, if the initial position is like below, we can find that the couples cannot sit together because David's friends can always copy the movement of them. Sometimes you cannot prevent all couples so you want to make matches as minimum as possible. Because the stand parallel to the y-axis, only $(x, y), (x, y+1)$ count as one match, and $(x, y), (x+1, y)$ do not.

C	D		
		D	C

C's turn

C	D		
		D	
			C

D's turn

C	D		
		D	C

C's turn

You are given n, m and Q initial positions. Help David find out the minimum number of couples matches when he moves first if he wants to minimize it and the other team wants to maximize it.

Input

The first line contains three integers n, m, Q.

The next $Q \times n$ lines, each n line represent one $n \times m$ classroom. Each line contains m characters. Each character is one of 'D', 'C', or '.'. 'D' means the block is occupied by Davids. 'C' means the block is occupied by couples. '.' means the block is occupied by no one.

- $1 \leq n \times m \leq 12$
- $1 \leq Q \leq 10^5$

Output

For each initial position, output a single line with the answer described above.

Sample Input 1	Sample Output 1
3 4 5 C... D..C .... C... DD.. ...C CCC. DD.D ..C. CCC. DD.. ..C. CDDD .CDD ..CC	1 0 1 2 2

J. A Problem Related to Subarray Sum

Problem ID: sum

You are given a zero-based array A of length 10^9 containing only 1 and -1. The number of 1 is not more than 10^7. Please count how many pair of (x, y) satisify $\sum_{i=x}^{y} A_i > 0$ and $0 \leq x \leq y < 10^9$!

Input

The first line contains one integer n, indicating how many segments of A is 1. In following n lines, the i-th line of these n lines consists of two integers l_i, r_i ($0 \leq i < n$), indicating the A_j is 1 for $l_i \leq j \leq r_i$

- $0 < n \leq 10^6$
- $l_i \leq r_i$
- $r_i + 1 < l_{i+1}$ for $0 \leq i < n - 1$
- $0 \leq l_0$
- $r_{n-1} < 10^9$
- $\sum_{i=0}^{n-1}(r_i - l_i + 1) \leq 10^7$

Output

Output only one number in one line indicating the answer.

Sample Input 1	Sample Output 1
1 0 1	4

Sample Input 2	Sample Output 2
1 1 2	5

Sample Input 3	Sample Output 3
2 0 1 3 4	16