

The 2024 ICPC China Shaanxi National Invitational Programming Contest

Contest Session

May 19, 2024



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This problem set should contain 13 (thirteen) problems on 13 (thirteen) numbered pages.

Please inform a runner immediately if something is missing from your problem set.

Problem A. Guess The Tree

There is a full binary tree with n levels(so it has exactly $2^n - 1$ nodes). Each node has an integer ID from 1 to $2^n - 1$, and the $2^n - 1$ IDs form an arrangement from 1 to $2^n - 1$, but you don't know. You need to find the IDs of the $2^n - 1$ nodes using at most 4800 queries.

Input

The first line contains one integer $n(1 \leq n \leq 10)$, the levels of the full binary tree.

To ask a query, you need to pick two nodes with IDs $u, v(1 \leq u, v \leq 2^n - 1)$, and print the line of the following form:

```
> "? u v"
```

After that, you will receive:

```
> "t"
```

The lowest common ancestor's ID of u and v .

You can ask at most 4800 queries.

If you have found the structure of the tree, print a line of the following form:

```
"! f1 f2 f3 f4 ... f_{2^n-1}"
```

f_i means the i -th node's father's ID. If it has no father, then $f_i = -1$.

After printing a query or the answer for a test case, do not forget to output the end of line and flush the output. Otherwise, you will get the verdict 'Idleness Limit Exceeded'. To do this, use:

`fflush(stdout)` or `cout.flush()` in C++;

`System.out.flush()` in Java;

`stdout.flush()` in Python.

The interactor in this task is not adaptive.

Output

None

Example

standard input	standard output
2	? 1 2
3	? 2 3
3	? 1 3
3	! 3 3 -1

Note

In this case, the tree's root is 3, it's two sons are 1 and 2.

For any query `"? a b"`,if $a \neq b$, the jury will return answer 3.

So we found the tree's root is 3 .

Problem B. Turn Off The Lights

Kitty has n^2 lights, which form an $n \times n$ matrix.

One day, Kitty found that some of these lights were on, and some were off. Kitty wants to turn them all off.

To achieve her goal, Kitty can perform three types of operations:

- (1) Choose a row, reverse the state of this row. It means if a light of this row is on, after this operation, it is now off. If a light of this row is off, after this operation, it is now on.
- (2) Choose a column, reverse the state of this column. It means if a light of this column is on, after this operation, it is now off. If a light of this column is off, after this operation, it is now on.
- (3) Choose exactly one light, reverse the state of this light. **This operation can only be performed not more than k times.**

For the current state, help Kitty achieve her goal within $3n$ operations.

Input

The first line contains two integers $n(1 \leq n \leq 1000), k(0 \leq k < n)$, indicating as described above.

Then n lines follow, each line has exactly n numbers, 0 represents that the light is turned off at this time, while 1 represents the opposite.

The y -th number of the $(x + 1)$ -th line in input means the light at coordinate (x, y) .

Output

If Kitty can not achieve her goal, print -1 in a single line.

Otherwise, print $M(0 \leq M \leq 3n)$ in the first line, indicating the number of operations she needs to perform.

The next M lines, each line contains 2 integers x, y , separated by white space.

If $1 \leq x \leq n, 1 \leq y \leq n$, it means Kitty will reverse the light at coordinate (x, y) .

If $x = 0, 1 \leq y \leq n$, it means Kitty will reverse all lights at coordinates $(z, y) 1 \leq z \leq n$.

If $1 \leq x \leq n, y = 0$, it means Kitty will reverse all lights at coordinates $(x, z) 1 \leq z \leq n$.

If there are multiple answers, print any of them.

Example

standard input	standard output
2 0 0 1 1 0	2 0 2 2 0
3 1 1 0 0 0 1 0 0 0 1	-1

Problem C. Fix the Tree

You are given a tree consisting of n vertices. Each vertex i of this tree has a value w_i assigned to it. Now the vertex u will be broken. Once it's broken, vertex u and all edges with one end at vertex u will be removed from the tree.

To make the tree connected, you can do the following operation any number of times(possibly zero) in any order:

- First choose two vertices u and v from the tree;
- Then pay $w_u + w_v$ coins, and add an edge between vertices u and v ;
- At last, replace $w_u + 1$ with w_u , replace $w_v + 1$ with w_v .

Your task is to calculate the minimum number of coins to be paid.

But you don't know which vertex u is, so you need to find the answer for each $1 \leq u \leq n$. Please answer all the queries independently.

Input

The first line contains a single integer $n(2 \leq n \leq 10^6)$ — the number of vertices in this tree.

The next line contains n numbers, the i -th number is $w_i(1 \leq w_i \leq n)$.

The next $n - 1$ lines contain a description of the tree's edges. The i -th of these lines contains two integers u_i and $v_i(1 \leq u_i, v_i \leq n)$ — the numbers of vertices connected by the i -th edge.

It is guaranteed that the given edges form a tree.

Output

Print n integers, the i -th integer is the answer when $u = i$.

Example

standard input	standard output
6 1 1 1 1 1 1 1 2 1 3 1 4 2 5 2 6	4 4 0 0 0 0
4 1 2 3 4 1 2 1 3 1 4	12 0 0 0
7 1 2 3 4 5 6 7 1 2 1 3 2 4 2 5 3 6 3 7	5 12 16 0 0 0 0

Problem D. Make Them Straight

There is a sequence a of non-negative integers of length n , the i -th element of it is $a_i(1 \leq i \leq n)$.
A sequence is defined as 'good' if and only if there exists a non negative integer $k(0 \leq k \leq 10^6)$ that satisfies the following condition:
 $a_i = a_1 + (i - 1)k$ for all $1 \leq i \leq n$.
To make this sequence 'good', for each $i(1 \leq i \leq n)$, you can do nothing, or pay b_i coin to replace a_i with any non-negative integer.
The question is, what is the minimum cost to make this sequence 'good'.

Input

The first line contains an integer $n(1 \leq n \leq 2 \times 10^5)$, described in the statement.
The second line contains n integers $a_1, ..., a_n(0 \leq a_i \leq 10^6)$.
The third line contains n integers $b_1, ..., b_n(0 \leq b_i \leq 10^6)$.

Output

One integer, the answer.

Example

standard input	standard output
5 1 4 3 2 5 1 1 1 1 1	2
5 1 4 3 2 5 1 9 1 1 1	3

Problem E. Dumb Robot

You have a dumb robot, and you are going to let it play games with n robots.

There is a matrix A with three rows and three columns in the game. We call the number of row i and column j of this matrix $A_{i,j}$. The game goes like this:

Two players each choose an integer from $[1,3]$ at the same time. We call the number your robot chooses i , and the number the other robot chooses j . The score is $A_{i,j}$. In game i , your robot will play this game with the i -th robot. The i -th robot has a probability of choosing 1 as $p_{i,1}$, a probability of choosing 2 as $p_{i,2}$, and a probability of choosing 3 as $p_{i,3}$.

Your goal is to make the expected value of the score not negative in each game. But your robot is very dumb, so it will choose 1 with probability q_1 , 2 with probability q_2 , and 3 with probability q_3 , and you don't know the value of q_1, q_2, q_3 .

We all know that $q_1 + q_2 + q_3 = 1$. If q_1, q_2, q_3 are chosen uniformly at random from a set of all possible cases, please calculate the probability that you will reach your goal.

Input

The first line contains one integer $n(1 \leq n \leq 10^4)$.

Each of the next 3 lines contains 3 integers, the j -th integer in the i -th of these lines is $A_{i,j}(-20 \leq A_{i,j} \leq 20)$.

Each of the next n lines contains 3 real numbers, the j -th number in the i -th of these lines is $p_{i,j}$. It is guaranteed that $p_{i,1} + p_{i,2} + p_{i,3} = 1$ and $0 \leq p_{i,j}$.

Output

Output the answer to the problem. It is guaranteed that the answer will never be 0.

Your answer is considered correct if its absolute or relative error does not exceed 10^{-2} . Formally, let your answer be a , and the jury's answer be b . Your answer is accepted if and only if $\frac{|a-b|}{\max(1,|b|)} \leq 10^{-2}$.

Example

standard input	standard output
1 1 1 1 -1 2 1 0 -3 2 0.1 0.6 0.3	0.748252
8 1 3 -2 0 0 2 -2 2 1 0.1 0.3 0.6 0 0 1 0.5 0.2 0.3 0 0 1 1 0 0 0 0 1 0.33 0.33 0.34 0.16 0.16 0.68	0.111111

Note

In example 1, for example, $(q_1 = 1, q_2 = 0, q_3 = 0)$ is ok. In this case, Your robot will always choose 1, so no matter what number will robot 1 choose, the score will always be 1, which is enough to reach your goal.

Problem F. XOR Game

Alice and Bob are playing a game against each other.

In front of them are a multiset $\{a_i\}$ of non-negative integers and a single integer x . Each number in a is 0 or $2^i (0 \leq i < k)$ before the game.

This game will be a turn-based game, and Alice will go first. In one person's turn, he or she will choose an integer from a . Let this number be p . Then this person will choose whether or not to make $x \leftarrow x \oplus p$, then remove p from a . Here, operation \oplus means bitwise xor.

Alice wants to make x as big as possible, and Bob wants to make x as small as possible.

You are a bystander who wants to know the final value of x . However, the size of a is a huge number. Formally, there are b_i numbers whose values are 2^i in a for all $0 \leq i < k$, and z numbers whose values are 0. But you still want to challenge this impossible problem.

If Alice and Bob are smart enough, please output the final value of x .

Statement updated

z is the number of numbers whose values are 0.

Input

The first line contains two integers $k, z (1 \leq k \leq 10^5, 0 \leq z \leq 10^9)$.

The next line contains k integers, the i -th integer is $b_{i-1} (0 \leq b_{i-1} \leq 10^9)$.

Output

Output the answer in binary format. Note that you should output exactly k digit from high to low even though this number has leading 0s.

Example

standard input	standard output
1 0 3	1
2 0 2 1	11
2 0 2 2	00

Problem G. The Last Cumulonimbus Cloud

Every April, the city is always shrouded under cumulonimbus clouds.

This city is connected by n buildings and m two-way streets. In order to facilitate people’s travel, any two buildings can directly or indirectly reach each other through the streets. At the same time, no street connects the same building, and there is at most one street that connects each pair of buildings.

The pace of life in this city is very slow because the city layout is not very bulky.

Specifically,if we consider this city as an undirected graph G ,it is guaranteed that for any non empty subgraph in this graph,there is at least one building inside it that connects up to 10 streets within the subgraph.

The rain is not stopping, and the number of cumulonimbus clouds is constantly increasing. At the beginning, there are a_i cumulonimbus clouds above the i -th building, but in the following q days, one of the following two events will occur every day:

- 1 x v v cumulonimbus clouds have been added over the x -th building.
- 2 x you need to report how many cumulonimbus clouds are in total over all buildings directly connected to building x .

Input

The first line contains three integers $n,m,q(1 \leq n \leq 3 \times 10^5, 1 \leq m \leq 3 \times 10^6, 1 \leq q \leq 2 \times 10^6)$.

Each of the next m lines contains two integers $x,y(1 \leq x,y \leq n, x \neq y)$, which represents a street connecting the x -th and y -th buildings.

Each of the next n lines contains an integer $a_i(0 \leq a_i \leq 100)$.

Each of the next q lines contains two or three integers, if the first integer is 1, it represents a first type of event, and the next two integers represent $x,v(0 \leq v \leq 100)$. If the first integer is 2, it represents a second type of event, the next integer represents x .

Output

Several rows, each representing a query result for a second type of event.

Example

standard input	standard output
4 6 10	8
2 4	7
2 3	17
4 3	20
3 1	19
4 1	26
2 1	25
0	
7	
1	
6	
2 4	
2 2	
1 3 3	
2 1	
1 1 9	
2 4	
2 2	
1 3 6	
2 4	
2 2	

Problem H. Holes and Balls

You are given n balls, the i -th ball's value is p_i . It's guaranteed that p_1, p_2, \dots, p_n is a permutation of $1, 2, 3, \dots, n$.

There is also a rooted tree of n vertices, each of the vertices is a hole, and each hole can only hold one ball. The tree's root is the first vertex.

Now you need to fill the holes with the balls.

You need to throw each ball in order of 1 to n in the following steps:

- 1. Throw the ball into vertex 1.
- 2. Let the vertex where the ball is be p .
- 3. If the p -th vertex has already been filled with other balls, you need to choose a vertex x and throw the ball into the x -th vertex, then return to step 2. You need to guarantee that the x -th vertex is the p -th vertex's son and at least one vertex in the subtree of the x -th vertex is not filled.
- 4. Otherwise, the ball will fill the p -th vertex.

After throwing all the balls, let a_i express the value of the ball in the i -th vertex.

You need to find the minimum lexicographical order of $\{a_n\}$.

We define dep_i as the number of vertices on the path from the i -th vertex to the tree's root(the first vertex). Specially, for any two vertices $x < y$, it's guaranteed that $dep_x \leq dep_y$.

Input

The first line contains a single integer $n(1 \leq n \leq 5 \times 10^5)$ - the number of vertices in this tree.

The next line contains n numbers, the i -th number is $p_i(1 \leq p_i \leq n)$. It's guaranteed that p_1, p_2, \dots, p_n is a permutation of $1, 2, 3, \dots, n$.

The next $n - 1$ lines contain a description of the tree's edges. The i -th of these lines contains two integers u_i and $v_i(1 \leq u_i, v_i \leq n)$ - the numbers of vertices connected by the i -th edge.

It is guaranteed that the given edges form a tree.

And for any vertices $x < y$, it's guaranteed that $dep_x \leq dep_y$.

Output

Output n integers, the minimum lexicographical order of $\{a_n\}$.

Example

standard input	standard output
5 3 1 5 4 2 1 2 2 3 3 4 4 5	3 1 5 4 2
9 9 2 6 3 5 7 1 4 8 1 2 1 3 2 4 2 5 3 6 3 7 4 8 4 9	9 2 1 3 6 4 8 5 7

Problem I. Smart Quality Inspector

Ella has a factory. One day, her factory is facing a product quality inspection. Her factory has N production lines. Among the N production lines, $N - K$ of them are qualified, and the other K lines are unqualified. The fine of the i -th($1 \leq i \leq K$) unqualified line is i Yuan. There are M quality inspectors here. For the j -th($1 \leq j \leq M$) quality inspector, he will inspect from the l_i -th line to the r_i -th line and find the unqualified production line with the largest fine among them, then impose this fine on Ella. Ella does not want to receive so many fines, so she decides to renumber the N production lines to receive the least amount of fines. Please help her.

In simple terms:

You have a sequence A of length N , $A = [1, 2, 3, \dots, K, 0, 0, 0, \dots, 0]$. Here N, K are given. There are M pairs of integers, each pair consists of two numbers l_i, r_i . You need to rearrange sequence A to minimize the following:

$$\sum_{i=1}^M \max_{j=l_i}^{r_i}(A_j)$$

Input

The first line contains three integers $N, K, M(1 \leq K \leq N \leq 20, 1 \leq M \leq 10^5)$, described in the statement. Then M lines, the i -th line of them contains two integers $l_i, r_i(1 \leq l_i \leq r_i \leq N)$.

Output

An integer indicates the answer.

Example

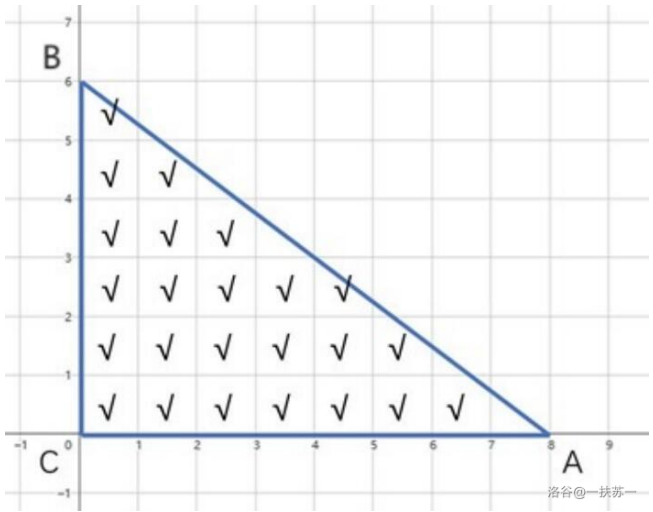
standard input	standard output
4 4 3 1 2 3 4 1 4	10

Problem J. Triangle

There are three points $A(a, 0)$, $B(0, b)$, $C(0, 0)$ in the plane rectangular coordinate system. Define the size of triangle ABC as the number of squares that belong to it.

For integers x, y , one square is defined by four points (x, y) , $(x + 1, y)$, $(x, y + 1)$, $(x + 1, y + 1)$. We consider a square to belong to a triangle if half or more of it is inside the triangle.

For example, when $a = 8, b = 6$, the size of triangle ABC will be 24. The image below shows which squares are counted in the triangle.



Input

The first and only line contains two integers a ($1 \leq a \leq 10^6$) and b ($1 \leq b \leq 10^6$).

Output

Print an integer: the size of triangle ABC .

Example

standard input	standard output
6 8	24
5 5	15
1 999999	500000

Problem K. Yet Another Maximum Matching Counting Problem

There is a two-dimensional plane.

You have a set of points $\{(x_i, y_i)\}$ that satisfies $1 \leq x_i \leq n, 1 \leq y_i \leq m$ (Both x_i and y_i are integers), and there are no two points with the same coordinates.

If two points have the same horizontal or vertical coordinates, we will connect an edge between these two points. This forms a graph.

You need to find the sum of the maximum number of matches in the graphs formed by all possible $2^{nm} - 1$ non empty sets, and output the result modulo 998244353.

Here, the maximum number of matches in a graph is defined as: selecting the most edges so that there are no common vertices between any two edges.

Input

There are multiple testcases in this problem.

The first line contains an integer $T(1 \leq T \leq 100)$, which represents the number of testcases.

Each of the testcases contains two integers $n, m(1 \leq n, m \leq 500)$.

Output

For each of the testcases, print an integer representing the result modulo 998244353.

Example

standard input	standard output
10	0
1 1	1
1 2	10
2 2	241456
4 4	964
3 3	200419152
5 5	448
1 8	985051144
20 20	370696900
100 100	357517517
500 500	

Problem L. Rubbish Sorting

Bob has many pieces of rubbish. One day, he wants to sort them.

For every piece of rubbish, its type is expressed as a positive integer.

He has q operations. For each operation, it is one of the following two operations.

- 1 $s\ x$ He tells you that the piece of rubbish named s has a type of x .
- 2 s He wants to ask you the type of rubbish s .

But his memories are not always accurate.

For each operation 2, s may not have appeared in the previous operation 1s.

We define the similarity of two strings s_1 and s_2 as $\sum_{i=1}^{\min\{|s_1|,|s_2|\}}[s_{1,i} = s_{2,i}]$.

Here all the strings' indexes start at 1.

For a string s , its type is the type of string which has the maximum similarity to s among all the strings that have appeared in the previous operations 1s. Note that if there are multiple strings that all have the maximum similarity to s , the type of s is the minimum type of these strings' type.

Now, he wants you to solve this problem.

Input

The first line contains an integer $q(1 \leq q \leq 3 \times 10^5)$, which is the number of operations.

Next q lines contain operations, one per line. They correspond to the description given in the statement.

It is guaranteed that for every operation 2 there is at least one operation 1 before it.

But some pieces of rubbish will have more than one type, you can consider it as the minimum type you have read.

The rubbish's names only consist of lowercase Latin letters.

$1 \leq |s| \leq 5, 1 \leq x \leq 10^9$

Output

For every operation 2, you should print an integer in a single line that is the rubbish s 's type.

Example

standard input	standard output
4	1
1 aaa 1	2
2 aa	
1 ab 2	
2 bb	

Problem M. Chained Lights

You have n lights in a row. Initially, they are all off.

You are going to press these n lights one by one. When you press light i , light i will switch its state, which means it will turn on if it's off and turn off if it's on, and then for every j satisfied $i|j, i < j \leq n$, press light j once.

For example, if $n = 4$, when you press light 1, light 1 will turn on, and then you will press light 2, 3, 4. Since you pressed light 2, light 2 will turn on and you will press light 4, which will cause light 4 to turn on. After all the operations, lights 1, 2, 3 will be turned on and light 4 is still off.

You will press these n lights and do the operations as mentioned above one by one. After all the operations, you want to know whether light k is on or off.

You can also use the following code to understand the meaning of the problem:

```
void press(int x)
{
    light[x]^=1;
    for (int y=x+x;y<=n;y+=x) press(y);
}
for (int i=1;i<=n;i++) press(i);
```

Input

There are multiple testcases.

The first line contains an integer $T(1 \leq T \leq 10^5)$, which represents the number of testcases.

Each of the testcases contains two integers $n, k(1 \leq k \leq n \leq 10^6)$ in a single line.

Output

For each testcase, if light k is turned on in the end, output YES, otherwise output NO.

Example

standard input	standard output
2	YES
1 1	NO
3 2	