Codeforces Round #443 (Div. 1)

A. Short Program

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

Petya learned a new programming language CALPAS. A program in this language always takes one non-negative integer and returns one non-negative integer as well.

In the language, there are only three commands: apply a bitwise operation AND, OR or XOR with a given constant to the current integer. A program can contain an arbitrary sequence of these operations with arbitrary constants from 0 to 1023. When the program is run, all operations are applied (in the given order) to the argument and in the end the result integer is returned.

Petya wrote a program in this language, but it turned out to be too long. Write a program in CALPAS that does the same thing as the Petya's program, and consists of no more than 5 lines. Your program should return the same integer as Petya's program for all arguments from 0 to 1023.

Input

The first line contains an integer n ($1 \le n \le 5 \cdot 10^5$) — the number of lines.

Next n lines contain commands. A command consists of a character that represents the operation ("&", "|" or "^" for AND, OR or XOR respectively), and the constant x_i $0 \le x_i \le 1023$.

Output

Output an integer k ($0 \le k \le 5$) — the length of your program.

Next k lines must contain commands in the same format as in the input.

Examples

input
3 | 3 ^ 2 | 1
output
2 | 3 ^ 2

input
3 & 1 & 3 & 5
output
1 & 1

input
3 ^ 1 ^ 2 ^ 3
output
0

Note

You can read about bitwise operations in https://en.wikipedia.org/wiki/Bitwise_operation.

Second sample:

Let x be an input of the Petya's program. It's output is $((x\&1)\&3)\&5 = x\&(1\&3\&5) = x\&1$. So these two programs always give the same outputs.

B. Teams Formation

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

This time the Berland Team Olympiad in Informatics is held in a remote city that can only be reached by one small bus. Bus has n passenger seats, seat i can be occupied only by a participant from the city a_i.

Today the bus has completed m trips, each time bringing n participants. The participants were then aligned in one line in the order they arrived, with people from the same bus standing in the order of their seats (i. e. if we write down the cities where the participants came from, we get the sequence a_1, a_2, ..., a_n repeated m times).

After that some teams were formed, each consisting of k participants form the same city standing next to each other in the line. Once formed, teams left the line. The teams were formed until there were no k neighboring participants from the same city.

Help the organizers determine how many participants have left in the line after that process ended. We can prove that answer doesn't depend on the order in which teams were selected.

Input

The first line contains three integers n, k and m ($1 \le n \le 10^5$, $2 \le k \le 10^9$, $1 \le m \le 10^9$).

The second line contains n integers a_1, a_2, ..., a_n ($1 \le a_i \le 10^5$), where a_i is the number of city, person from which must take seat i in the bus.

Output

Output the number of remaining participants in the line.

Examples

input
4 2 5 1 2 3 1
output
12

input
1 9 10 1
output
1

input
3 2 10 1 2 1
output
0

Note

In the second example, the line consists of ten participants from the same city. Nine of them will form a team. At the end, only one participant will stay in the line.

C. Tournament

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

Recently a tournament in k kinds of sports has begun in Berland. Vasya wants to make money on the bets.

The scheme of the tournament is very mysterious and not fully disclosed. Competitions are held back to back, each of them involves two sportsmen who have not left the tournament yet. Each match can be held in any of the k kinds of sport. Loser leaves the tournament. The last remaining sportsman becomes the winner. Apart of this, the scheme can be arbitrary, it is not disclosed in advance.

Vasya knows powers of sportsmen in each kind of sport. He believes that the sportsmen with higher power always wins.

The tournament is held every year, and each year one new participant joins it. In the first tournament, only one sportsman has participated, in the second there were two sportsmen, and so on. Vasya has been watching the tournament for the last n years. Help him to find the number of possible winners for each of the n tournaments.

Input

The first line contains two integers n and k ($1 \le n \le 5 \cdot 10^4$, $1 \le k \le 10$) — the number of tournaments and the number of kinds of sport, respectively.

Each of the next n lines contains k integers $s_{i1}, s_{i2}, \ldots, s_{ik}$ ($1 \le s_{ij} \le 10^9$), where s_{ij} is the power of the i-th sportsman in the j-th kind of sport. The sportsman with higher powers always wins. It's guaranteed that for any kind of sport all of these powers are distinct.

Output

For each of the n tournaments output the number of contenders who can win.

Examples

input
3 2 1 5 5 1 10 10
output
1 2 1

input
3 2 2 2 3 3 1 10
output
1 1 3

input
3 2 2 3 1 1 3 2
output
1 1 2

Note

In the first sample:

In the first tournament there is only one sportsman, and he is the winner.

In the second tournament, there are two sportsmen, and everyone can defeat another, depending on kind of sports.

In the third tournament, the third sportsman in the strongest in both kinds of sports, so he is the winner regardless of the scheme.

D. Magic Breeding

time limit per test: 4 seconds
memory limit per test: 1024 megabytes
input: standard input
output: standard output

Nikita and Sasha play a computer game where you have to breed some magical creatures. Initially, they have k creatures numbered from 1 to k. Creatures have n different characteristics.

Sasha has a spell that allows to create a new creature from two given creatures. Each of its characteristics will be equal to the maximum of the corresponding characteristics of used creatures. Nikita has a similar spell, but in his spell, each characteristic of the new creature is equal to the minimum of the corresponding characteristics of used creatures. A new creature gets the smallest unused number.

They use their spells and are interested in some characteristics of their new creatures. Help them find out these characteristics.

Input

The first line contains integers n, k and q ($1 \le n \le 10^5$, $1 \le k \le 12$, $1 \le q \le 10^5$) — number of characteristics, creatures and queries.

Next k lines describe original creatures. The line i contains n numbers a_{i1}, a_{i2}, ..., a_{in} ($1 \le a_{ij} \le 10^9$) — characteristics of the i-th creature.

Each of the next q lines contains a query. The i-th of these lines contains numbers t_i, x_i and y_i ($1 \le t_i \le 3$). They denote a query:

- $t_i = 1$ means that Sasha used his spell to the creatures x_i and y_i.
- $t_i = 2$ means that Nikita used his spell to the creatures x_i and y_i.
- $t_i = 3$ means that they want to know the y_i-th characteristic of the x_i-th creature. In this case $1 \le y_i \le n$.

It's guaranteed that all creatures' numbers are valid, that means that they are created before any of the queries involving them.

Output

For each query with $t_i = 3$ output the corresponding characteristic.

Examples

input
2 2 4 1 2 2 1 1 1 2 2 1 2 3 3 1 3 4 2

output
2 1

input
5 3 8 1 2 3 4 5 5 1 2 3 4 4 5 1 2 3 1 1 2 1 2 3 2 4 5 3 6 1 3 6 2 3 6 3 3 6 4 3 6 5

output
5 2 2 3 4

Note

In the first sample, Sasha makes a creature with number 3 and characteristics $(2, 2)$. Nikita makes a creature with number 4 and characteristics $(1, 1)$. After that they find out the first characteristic for the creature 3 and the second characteristic for the creature 4.

E. Numbers on the blackboard

time limit per test: 2 seconds
memory limit per test: 512 megabytes
input: standard input
output: standard output

A sequence of n integers is written on a blackboard. Soon Sasha will come to the blackboard and start the following actions: let x and y be two adjacent numbers (x before y), then he can remove them and write $x + 2y$ instead of them. He will perform these operations until one number is left. Sasha likes big numbers and will get the biggest possible number.

Nikita wants to get to the blackboard before Sasha and erase some of the numbers. He has q options, in the option i he erases all numbers to the left of the l_i-th number and all numbers to the right of r_i-th number, i. e. all numbers between the l_i-th and the r_i-th, inclusive, remain on the blackboard. For each of the options he wants to know how big Sasha's final number is going to be. This number can be very big, so output it modulo $10^9 + 7$.

Input

The first line contains two integers n and q ($1 \le n, q \le 10^5$) — the number of integers on the blackboard and the number of Nikita's options.

The next line contains n integers $a_1, a_2, \ldots, a_n$ ($-10^9 \le a_i \le 10^9$) — the sequence on the blackboard.

Each of the next q lines contains two integers l_i and r_i ($1 \le l_i \le r_i \le n$), describing Nikita's options.

Output

For each option output Sasha's result modulo $10^9 + 7$.

Examples

input
3 3 1 2 3 1 3 1 2 2 3
output
17 5 8

input
3 1 1 2 -3 1 3
output
1000000006

input
4 2 1 1 1 -1 1 4 3 4
output
5 1000000006

Note

In the second sample Nikita doesn't erase anything. Sasha first erases the numbers 1 and 2 and writes 5. Then he erases 5 and -3 and gets -1. -1 modulo $10^9 + 7$ is $10^9 + 6$.