

Problem A. Bridge

Input file: **standard input**
Output file: **standard output**
Time limit: 2 seconds
Memory limit: 512 megabytes

There are n countries numbered from 1 to n in Erathia. Each country can be regarded as a chain with $m + 1$ nodes numbered from 1 to $m + 1$. Initially, node (a, b) is connected with node $(a, b + 1)$ by a street where node (a, b) denotes the b -th node of the a -th country. There are no bridges between any two countries at first.

You need to process q queries of the following two types.

- 1 $a\ b$ ($1 \leq a < n, 1 \leq b \leq m$). Build a bridge between node (a, b) and node $(a + 1, b)$. It is guranteed that at any time, **each node is connected with at most one bridge**.
- 2 a ($1 \leq a \leq n$). A hero will walk through Erathia. This hero starts from $(a, 1)$. If the hero is at (x, y) and there is a unvisited bridge connected to him, he passes it, or he goes to $(x, y + 1)$. Once he arrived the $(m + 1)$ -th node of any conutry, he stops. Please note that “unvisited bridge” is **independently** judged for each query.

Your task is to print which country the hero is in at last for the second kind of query. It can be proved that the hero's route is always unique under these constraints.

Input

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

Each of the following q lines represents a query with format described above.

Output

For each query of type 2, output a line with an integer representing the answer.

Example

| standard input | standard output |
|----------------|-----------------|
| 3 4 13 | 2 |
| 2 2 | 2 |
| 1 1 3 | 1 |
| 2 1 | 3 |
| 2 2 | 3 |
| 2 3 | 1 |
| 1 2 4 | 2 |
| 2 1 | 3 |
| 2 2 | 2 |
| 2 3 | 1 |
| 1 2 1 | |
| 2 1 | |
| 2 2 | |
| 2 3 | |

Problem B. Cells Coloring

Input file: standard input
Output file: standard output
Time limit: 1 second
Memory limit: 512 megabytes

You are given an $n \times m$ grid. Some of the cells are obstacles, the others are empty. Choose a non-negative integer k and color all empty cells with $k + 1$ colors $0, 1, 2, \dots, k$. You can not color two cells in the same row or same column with the same **non-zero** color.

You are given two non-negative integers c and d . For a coloring plan, define z as the number of the cells with color 0. Define the cost of the plan is $ck + dz$.

Find the minimum cost.

Input

The first line contains four integers n, m ($1 \leq n, m \leq 250$), c and d ($0 \leq c, d \leq 10^9$).

The i -th line of the next n lines contains a string of m characters. The j -th character is '*' if the cell in the i -th row and the j -th column is an obstacle. The j -th character is '.' if the cell in the i -th row and the j -th column is empty.

Output

Output a line with a single number, representing the answer.

Examples

| standard input | standard output |
|---------------------------------|-----------------|
| 3 4 2 1 .*** *..* **.. | 4 |
| 3 4 1 2 .*** *..* **.. | 2 |

Problem C. Clone Ranran

Input file: `standard input`
Output file: `standard output`
Time limit: 1 second
Memory limit: 512 megabytes

Ranran needs to prepare a contest! A contest is made of c problems, and Ranran can do one of the following two things:

- Clone himself in a minutes. That is, after a minutes, there will be one more Ranran.
- Prepare a problem in b minutes. That is, after b minutes, there will be one more problem.

Note that a cloned Ranran can also do the two things above. A Ranran cannot do the two things at the same time.

Ranran wants to prepare the contest as fast as possible. But he is very lazy, so he asks you to find the minimum number of minutes to prepare the contest.

You need to answer T queries independently.

Input

The first line contains an integer T ($1 \leq T \leq 10^5$).

Each of the next T lines contains three integers a , b and c ($1 \leq a, b, c \leq 10^9$), representing a query.

Output

For each test case, output a line with a single integer representing the answer.

Example

| standard input | standard output |
|------------------|-----------------|
| 5 | 1 |
| 1 1 1 | 7 |
| 2 3 3 | 45 |
| 9 9 9 | 44 |
| 3 26 47 | 21860 |
| 1064 822 1048576 | |

Problem D. Contests

Input file: **standard input**
Output file: **standard output**
Time limit: 2 seconds
Memory limit: 512 megabytes

There are n contestants and they take part in m contests. You are given the ranklist of each contest. The ranklist of the k -th contest is a sequence a_k , indicating that the $a_{k,i}$ -th contestant's rank is i .

SolarPea and PolarSea are two of the n contestants. SolarPea wants to prove that he is stronger than PolarSea.

Define x is l -stronger than y , if and only if there exists a sequence b of length $l + 1$, such that $b_1 = x$, $b_{l+1} = y$, and for all $1 \leq i \leq l$, b_i has a smaller rank than b_{i+1} in at least one contest.

There are q queries. In the i -th query, SolarPea is contestant x and PolarSea is contestant y . Please find the minimum positive number l such that SolarPea is l -stronger than PolarSea.

Input

The first line contains two integers n ($2 \leq n \leq 10^5$) and m ($1 \leq m \leq 5$).

The i -th of the next m lines contains n integers $a_{i,1}, a_{i,2}, \dots, a_{i,n}$. It is guaranteed that a_i is a permutation of $1, 2, \dots, n$.

The next line contains an integer q ($1 \leq q \leq 10^5$).

Each of the next q lines contains two integers x and y ($1 \leq x, y \leq n, x \neq y$), representing a query.

Output

For each query, output a number l representing the answer. If there is no legal l , output -1 .

Example

| standard input | standard output |
|----------------|-----------------|
| 6 2 | 1 |
| 1 3 2 5 4 6 | 2 |
| 2 1 4 3 6 5 | 5 |
| 4 | 3 |
| 1 4 | |
| 5 3 | |
| 6 1 | |
| 5 2 | |

Problem E. Find Maximum

Input file: `standard input`
Output file: `standard output`
Time limit: 1 second
Memory limit: 512 megabytes

We define a function $f(x)$ over all non-negative integer x as follows:

$$f(x) = \begin{cases} 1 & (x = 0) \\ f(\frac{x}{3}) + 1 & (x > 0 \wedge x \bmod 3 = 0) \\ f(x - 1) + 1 & (x > 0 \wedge x \bmod 3 \neq 0) \end{cases}$$

Calculate $\max_{x=l}^r f(x)$.

You need to answer T queries independently.

Input

The first line contains a single integer T ($1 \leq T \leq 10^4$).

Each of the next T lines contains two integers l and r ($1 \leq l \leq r \leq 10^{18}$), representing a query.

Output

Output T lines. The i -th line contains a single integer, representing the answer to the i -th query.

Example

| standard input | standard output |
|----------------|-----------------|
| 10 | 3 |
| 1 2 | 3 |
| 1 3 | 4 |
| 1 4 | 5 |
| 1 5 | 3 |
| 2 3 | 4 |
| 2 4 | 5 |
| 2 5 | 4 |
| 3 4 | 5 |
| 3 5 | 5 |
| 4 5 | |

Problem F. Hotel

Input file: **standard input**
Output file: **standard output**
Time limit: 1 second
Memory limit: 512 megabytes

You are doing volunteer work for a programming competition in an ancient hotel. Unfortunately, the hotel provides no phone signal or tap water since it can be dated back to the Qin Dynasty, and you have to assign the contestants to the hotel rooms manually instead of using the internet apps. Fortunately, the hotel has sufficient rooms, and you have taken a computer that lets you do some computation locally.

There are n teams, each with exactly 3 contestants. There are 2 types of rooms in the hotel, the single room and double room, which can receive at most 1 and 2 contestants, respectively. To avoid embarrassing contestants, if two contestants are assigned to a double room, they must come from the same team and have the same gender.

The cost of each room of the same type is the same, but different types may have different costs. Your program needs to calculate the minimum price the host has to pay. The teams are waiting in the registration hall now, and the competition finance officer relies on you to save costs and make a fortune by the residual value. Be quick, or the finance officer will sue you for violating his reputation!

Input

The first line of input contains three integers n , c_1 and c_2 ($1 \leq n, c_1, c_2 \leq 1\,000$), denoting the number of teams, the cost of a single room and a double room respectively.

In the following n lines, each line contains a string S with exactly 3 uppercase English letters. The letters in a string denote the genders of the contestants in one team and will be represented by A to Z, respecting the diversity of human beings.

Output

The output should contain a single integer, denoting the minimum cost of hotel allocation for contestants.

Examples

| standard input | standard output |
|--|-----------------|
| 3 1 3 MMM MMM FFF | 9 |
| 3 3 1 ABC DEF GHI | 9 |
| 10 438 438 WWW SOU PUN ETC OME CFI NAL GOO DHO TEL | 12264 |

Problem G. Perfect Word

Input file: `standard input`
Output file: `standard output`
Time limit: 1 second
Memory limit: 512 megabytes

You are given n strings and required to find the length of the longest *perfect word*.

A string t is called a *perfect word*, if and only if every non-empty substring of t appears in the given strings.

A string s is called a substring of t if and only if it can be obtained by removing several (possibly zero) characters from the beginning or end of t .

Input

The first line contains a single integer n ($1 \leq n \leq 10^5$).

Each of the next n lines contains a string consisting of lowercase English letters.

It is guaranteed that the total length of the given strings is no more than 10^5 .

Output

Output an integer, representing the length of the longest perfect word.

Example

| standard input | standard output |
|------------------------|-----------------|
| 4 a t b ab | 2 |

$$2^{2^{2^{2^{2^{2^{2^2}}}}}}}$$

Example

| standard input | standard output |
|-----------------|-----------------|
| 4 | 0010 |
| 4 3 0 1 | &&^& |
| 1 0 1 0 | 0 0 1 1 |
| 4 1 0 3 | 0011 |
| 1 0 1 0 | ^^&^ |
| 8 0 2 6 | 0 1 0 1 |
| 1 5 5 7 1 5 5 7 | 10100000 |
| 8 0 0 8 | ^^ ^^^^ |
| 1 5 5 7 1 5 5 7 | 1 5 5 7 1 5 5 7 |
| | 00000000 |
| | ^^^^^^^^ |
| | 1 5 5 7 1 5 5 7 |

Note

$$\begin{aligned}
 & \Pi_{\binom{2^2}{2_2}} \left[\begin{array}{c} \int_{2_2}^{2^2} \left[\begin{array}{cc} 2 & 2 \end{array} \right] \Pi_{2_2^{2^2}} \\ \underline{\underline{\Sigma_2^2}} \end{array} \right] \frac{\frac{2^2}{2_2} \int_{\Sigma_2^2}^{2^2} \Sigma_2^2}{\left[\begin{array}{cc} 2^2 & 2_2 \\ \binom{2}{2} & \int_2^2 \end{array} \right] \binom{\Sigma_2^2}{2_2}} \\
 & \Pi \left[\begin{array}{c} \binom{2}{2} 2^{2^2} \left[\begin{array}{cc} 2 & 2 \end{array} \right] \\ 2^2 \underline{\underline{2^{2^2} \Sigma_2^2}} \end{array} \right] \frac{\left[\begin{array}{cc} 2^2 & \Sigma_2^2 \\ 2_2 & 2_2 \end{array} \right]}{\int_{2_2} \left[\begin{array}{cc} 2 & 2 \end{array} \right] \Sigma_{2_2}^{\frac{2}{2_2}}} \\
 & \frac{2^{2^2} 2^{2^2 \frac{2}{2_2}} \binom{2}{2} 2^{2^2} \left[\begin{array}{cc} 2 & 2 \end{array} \right]}{2^{2^2 \frac{2}{2_2}} \binom{2}{2} 2^{2^2} \left[\begin{array}{cc} 2 & 2 \end{array} \right]}
 \end{aligned}$$

Problem I. Square Grid

Input file: **standard input**
Output file: **standard output**
Time limit: 4 seconds
Memory limit: 512 megabytes

Given a square grid, its lattice points labeled from $(0, 0)$ to (n, n) , and a number t .

You need to answer q queries in this format: given $A = (x_0, y_0)$ and $B = (x_1, y_1)$, how many ways are there to move from A to B in exactly t steps so that in each step you move from a lattice point to one of its neighbors (up, down, left, right). Calculate the answer modulo 998 244 353.

Input

The first line contains three integers n ($1 \leq n \leq 10^5$), t ($1 \leq t \leq 10^9$) and q ($1 \leq q \leq 3 \times 10^5$).

Each of the following q lines contains four integers x_0, y_0, x_1 and y_1 ($0 \leq x_0, y_0, x_1, y_1 \leq n$), representing a query.

Output

For each query, output a line containing one integer, representing the answer to the query modulo 998 244 353.

Examples

| standard input | standard output |
|---|---|
| 2 5 3 0 0 1 2 1 1 2 1 0 0 2 2 | 30 64 0 |
| 5 20 5 0 0 5 5 1 1 4 4 2 2 3 3 2 3 2 3 1 2 5 2 | 615136704 443203969 899931333 464755094 679729107 |

Problem J. Strange Sum

Input file: `standard input`
Output file: `standard output`
Time limit: 1 second
Memory limit: 512 megabytes

Given a sequence a_1, a_2, \dots, a_n .

You are going to select zero or more elements of a so that: if you select a_i , then in any interval of length i (formally, in $a[j, j + i - 1]$ for any $1 \leq j \leq n - i + 1$) you can select at most 2 elements.

Calculate the maximal sum of the elements you select.

Input

The first line contains an integer n ($2 \leq n \leq 10^5$).

The second line contains n integers a_1, a_2, \dots, a_n ($-10^9 \leq a_i \leq 10^9$).

Output

Output a single integer denoting the answer.

Examples

| standard input | standard output |
|------------------|-----------------|
| 4 1 4 3 2 | 7 |
| 3 -10 -10 -10 | 0 |

Problem K. Streets

Input file: `standard input`
Output file: `standard output`
Time limit: 2 seconds
Memory limit: 512 megabytes

You are given n vertical lines with x-coordinates x_1, x_2, \dots, x_n and weights a_1, a_2, \dots, a_n and m horizontal lines with y-coordinates y_1, y_2, \dots, y_m and weights b_1, b_2, \dots, b_m .

Call a rectangle good if and only if all of its four edges lie on the given lines. On this basis, define the cost of a good rectangle as the sum of the costs of its four segments. The cost of a segment is the product of its length and the weight of the line it belongs to.

Find the maximum area of good rectangles with cost no more than c . Note that the length and the width of the rectangle can be zero, so the answer always exists.

You need to answer T queries with different c .

Input

The first line contains three integers n, m ($2 \leq n, m \leq 5\,000$) and T ($1 \leq T \leq 100$).

The second line contains n integers x_1, x_2, \dots, x_n ($1 \leq x_1 < x_2 < \dots < x_n \leq 10^5$).

The third line contains n integers a_1, a_2, \dots, a_n ($1 \leq a_i \leq 10^7$).

The fourth line contains m integers y_1, y_2, \dots, y_m ($1 \leq y_1 < y_2 < \dots < y_m \leq 10^5$).

The fifth line contains m integers b_1, b_2, \dots, b_m ($1 \leq b_i \leq 10^7$).

Each of the next T lines contains a single integer c ($1 \leq c \leq 4 \times 10^{12}$), representing a query.

Output

For each query, output one line representing the answer.

Example

| standard input | standard output |
|----------------|-----------------|
| 3 4 20 | 0 |
| 1 3 4 | 0 |
| 3 1 2 | 1 |
| 1 3 4 7 | 1 |
| 4 2 1 2 | 1 |
| 1 | 2 |
| 5 | 2 |
| 6 | 3 |
| 7 | 3 |
| 9 | 4 |
| 10 | 4 |
| 11 | 6 |
| 12 | 6 |
| 15 | 9 |
| 16 | 9 |
| 17 | 12 |
| 22 | 12 |
| 23 | 12 |
| 28 | 18 |
| 30 | 18 |
| 35 | |
| 43 | |
| 47 | |
| 49 | |
| 57 | |

Problem L. Tree

Input file: **standard input**
Output file: **standard output**
Time limit: 2 seconds
Memory limit: 512 megabytes

You are given a tree T with n nodes. The tree is rooted at 1. Define $\text{subtree}(u)$ as the set of nodes in the subtree of u .

Call a subset of nodes S good if and only if S satisfies at least one of the following conditions:

- For all $u, v \in S$ where $u \neq v$, either $u \in \text{subtree}(v)$ or $v \in \text{subtree}(u)$.
- For all $u, v \in S$ where $u \neq v$, both $u \notin \text{subtree}(v)$ and $v \notin \text{subtree}(u)$.

You need to partition all nodes of T into several good subsets. Calculate the minimum number of subsets.

Input

The first line contains a single integer Q ($1 \leq Q \leq 10^5$), denoting the number of test cases.

For each test case, the first line contains an integer n ($1 \leq n \leq 10^6$). The next line contains $n - 1$ integers p_2, p_3, \dots, p_n ($1 \leq p_i < i$), indicating that there is an edge between p_i and i for each $i = 2, 3, \dots, n$.

It is guaranteed that the sum of n over all test cases is no more than 10^6 .

Output

For each test case, output a single integer representing the answer.

Example

| standard input | standard output |
|----------------|-----------------|
| 2 | 3 |
| 7 | 1 |
| 1 1 2 2 2 3 | |
| 5 | |
| 1 2 3 4 | |