Problem A. ICPC, Hajimaruyo ♪

Memory limit: 512 MB

Problem brought to you by NTHU Fun Programming Club.

After final exam, Akarin and other girls are at Yui's room making cake. The cake has many layers, and it looks like this from the side:

...(((((((())))))))()....

That is, the cake can be perfectly described by a bracket sequence.

Now they are ready to distribute the cake. Since Akarin is the protagonist(!?), she will take the first share. Kyouko, the smart guy of the group, has an idea: since Akarin is a regular girl, she should take a **subsegment** of the cake that is a **regular bracket sequence**; in addition, because Akarin has been so nice to others, she should take a share as big as possible.

But exactly how much cake should Akarin take? The cake is going cold and no one is in the mood to solve this problem, so Kyouko has come to you for help.

subsegment: a consecutive part of the original sequence. An empty sequence or the whole original sequence are also considered subsegments.

regular bracket sequence: A bracket sequence is called regular if it is possible to obtain correct arithmetic expression by inserting characters «+» and «1» into this sequence. For example, sequences «(())()», «()» and «((()(()))» are regular, while «)(», «(()» and «(()))(» are not.

Input

Each input file contains only one testcase, each containing 2 lines: the first line contains one integer N, which is the size of the cake. The second line contains a bracket sequence S of length N, consisting of only '(' and ')', that describes the layers of the cake.

$1 \leq N \leq 10^6$

Output

For each testcase, output one integer: the maximum length of a regular subsegment of the cake.

Examples

Standard Input	Standard Output
10 ()(())(((	6
5 ()(()	2

Note

For the first example, one longest subsegment can be obtained from S_1 to S_6, which is shown as the underlined part:

<u>()(())</u>(((

For the second example, one longest subsegment is $S_1...S_2$, obviously no longer regular subsegments exist.

Problem B. Traveling on the Binary Search Tree

Memory limit: 512 MB

Binary Search Tree (BST) is a basic data structure in computer science. BST is a rooted binary tree whose internal nodes each stores a key greater than all the keys in the node's left subtree and less than those in its right subtree.

To insert data to the BST, here is a simple algorithm referred for you. **If the data already in BST, the operation must be ignored.**

```
void insert(Node*& root, int key, int value) {
  if (!root)
    root = new Node(key, value);
  else if (key == root->key)
    return ; // data ignored
  else if (key < root->key)
    insert(root->left, key, value);
  else  // key > root->key
    insert(root->right, key, value);
}
```

However, different orders to insert data may result in different tree structures. Given some data sorted by the order they are inserted to the tree, can you print out the inorder traversal of the BST ?

Inorder traversal means that for each node, you should visit left subtree first, then print the value of the node. Finally, visit right subtree.

Input

The input contains only one test case. The first line contains an integer n, which means how many data will be inserted to Binary Search Tree.

Each of the next n lines contains one integer, which represents the data inserted to the BST.

- $0 < n \leq 200000$
- $0 \leq \text{data} \leq 10000$

Output

Print the result of the inorder traversal. After printing an integer, a newline should be printed immediately.

Example

Standard Input	Standard Output
4 2 3 2 1	1 2 3

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Problem C. Re:Zero — Starting Lighting in Another World

Memory limit: 512 MB

With unknown reason, Subaru enters a magic world. To survive in the unfamiliar world. Subaru becomes a servant, working in a magic mansion for Roswaal L. Mathers.

The mansion is a four floors building. Each floor contains 4 rooms. It looks like a 4×4 matrix. Every night, Subaru needs to light up all room because Roswaal L. Mathers does not like darkness. However, it is not easy to finish this mission.

Use $m[i][j]$ to represent the lamp status of the j-th room in the i-th floor ($0 \leq i, j < 4$). If Subaru reverts the lamp switch in $m[i][j]$(meaning make it up to down or down to up), the switches in adjoining rooms ($m[i+1][j]$, $m[i-1][j]$, $m[i][j+1]$, $m[i][j-1]$) will also be reverted with magical reasons. Therefore it is ridiculous for Subaru to open all switchs. Of course, there is only and exactly one lamp in a room.

To save Subaru's energy, given initial state of all rooms, can you calculate the minimum steps to light up all rooms?

Input

Only one testcase in a input file.

There are 4 lines, and each line contains 4 integers. Each integer is 0 or 1. It represents the initial status of the lamp in a room. 0 means the switch is down and 1 is up.

Output

Print the minimum steps to light up all rooms. If it is required more than 10 steps (10 not included), Subaru will withdraw his job. Please output -1 in this case.

Examples

Standard Input	Standard Output
1 1 0 0 1 1 1 0 1 1 1 1 1 1 1 1	1
1 0 1 0 0 1 0 0 0 0 1 1 1 0 0 1	4

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Problem D. Fortune Telling

Memory limit: 512 MB

Kasuga Ayumu has recently learned C++, and since her fortune telling by chopsticks has been hacked by Chiyo, she soon invented another fortune telling using random numbers in C++.

The process goes as follows: first, you choose a very big positive integer $K = X^Y$, then Ayumu will let her randgen.exe run all day. The program will generate n very big integers ${x_1}^{y_1}...{x_n}^{y_n}$. Then you multiply these n integers to get M.

If M is divisible by K, then congradulations! Life favors you today. If not divisible, then it is suggested that you stay at home.

Ayumu tries this a few times on herself, and the outcome is not very desirable. So she modifies the rules slightly: the minimum positive integer H such that K divides $M \times H$ will measure your luck today. The greater the H is, then badder your luck today.

It doesn't take long for Ayumu to find out that C++ can't process these big numbers, so she gives you K and the random numbers ${x_1}^{y_1}...{x_n}^{y_n}$. Please help her find $H \mod 998244353$.

Input

There will be only one testcase per input file.

The first line contains three positive integers: X, Y, n, and then there will be n more lines, the ith of which has two positive integers: x_i and y_i.

$1 \leq X \leq 10^{12}$

$1 \leq Y \leq 10^{12}$

$1 \leq n \leq 10^6$

$1 \leq x_i \leq 10^{12}$ for $i = 1...n$

$1 \leq y_i \leq 10^{12}$ for $i = 1...n$

Output

Output a single integer that is the answer.

Examples

Standard Input	Standard Output
108 1 2 2 2 3 2	3
2 7 1 2 1	64
9 4 1 10 7	6561

Note

For the first example testcase, we have

$M = 2^2 \times 3^2 = 36$,

$K = 108^1 = 108$,

we have to output the positive integer H such that

$K|(H * M)$, and H is the smallest possible.

For this testcase, $H = 3$.

For the second example, we have

$M = 2^7$ and $K = 2$, so clearly $H = 64$.

For the third example,

$M = 10^7$ and $K = 9^4 = 6561$,

so clearly $H = 6561$ is the answer.

Due to the enormous input range, please be careful about the modular arithmetic.

Problem E. Erina and Ribbon

Memory limit: 512 MB

Erina is a cute rabbit girl, she and her friend, Ribbon, are best partners to defend the peace of the Rabi-ribi island. To defeat the members of Rabbit lovers, Usagi PRPR Club (UPRPRC), Erina and Ribbon learned many powerful skills to combat enemies.

Erina and Ribbon already learned n skills separately (totally $2n$ skills). If they stay alone, all n skills can be used at the same time. However, Erina and Ribbon usually stay together. Some skills have conflicting effects. Using inappropriate skill together will make them into trouble. Therefore, some skills can not be used at the same time.

Given all inappropriate skill pairs, can you find out the maximum number of skills that Erina and Ribbon can use at the same time? If (a, b) is an inappropriate skill pair, it means only one of them can be used.

Input

There will be only one testcase per input file.

The first line contains two positive integers: n, m. It means that there are n skills for each of them, and there are m inappropriate skill pairs.

Each of the next m lines contains an inappropriate skill pairs (a, b). It means that Erina's a-th skill and Ribbon's b-th skill can not be used at the same time.

- $1 \leq n \leq 500$
- $0 \leq m \leq n \times (n-1)/2$
- skills id is 0-based

Output

Output a single integer that is the maximum number of skills can be used at the same time.

Examples

Standard Input	Standard Output
3 3 0 0 0 2 2 2	4

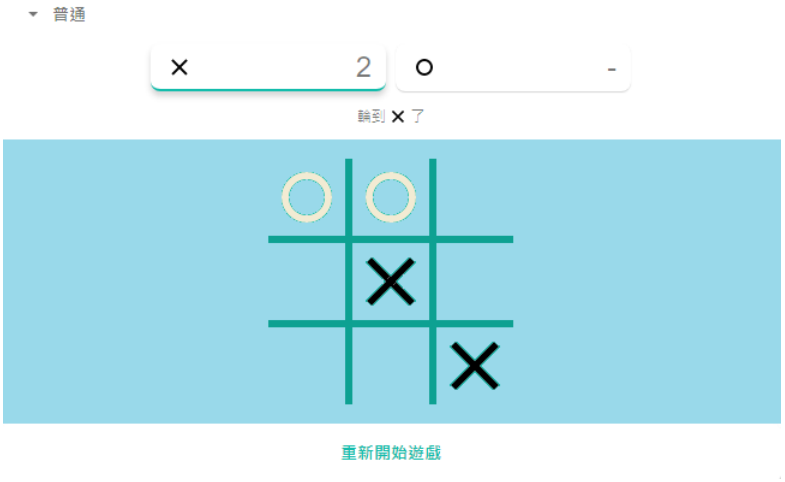
Note

Select Erina's $0, 1, 2$ and Ribbon's 1 skills for example case.

Problem F. Tic-tac-toe

Memory limit: 512 MB

Tic-tac-toe is a paper-and-pencil game for two players, X and O, who take turns marking the spaces in a 3×3 grid. The first player use X to start he game. The player who succeeds in placing three of their marks in a horizontal, vertical, or diagonal row is the winner.



Games played on three-in-a-row boards can be traced back to ancient Egypt, where such game boards have been found on roofing tiles dating from around 1300 BCE. Tic-tac-toe was also used by MIT students to demonstrate the computational power of Tinkertoy elements. The Tinkertoy computer, made out of (almost) only Tinkertoys, is able to play tic-tac-toe perfectly. It is currently on display at the Museum of Science, Boston.

Given a Tic-tac-toe board, can you distinguish current board state? If the game already finished, show X win, O win or Tie. If the game is on going, show Not yet. If the game state is impossible, show Cheating!

Input

There are many testcases ($\leq 10^5$) in a input file.

Each testcase contains an 3×3 Tic-tac-toe board which contains 3 lines and each line contains 3 character. The character is one of 'X', 'O', '.', which represents the steps of X, O, and empty position.

Output

For each testcase, output current game state in a line.

Examples

Standard Input	Standard Output
.X. X.X OOO ... XXX O.O ... .X. ..X ... .X. ... OXX XOO OXX	O win X win Cheating! Not yet Tie

Problem G. Maki's Array

Memory limit: 512 MB

Maki is the Composer of the music group "us". She has just finished a new song, and the music sheet can be represented by an integer array A of size n. There are k notes on Maki's piano, so each integer in A lies within the range $[1, k]$.

However, after a few listenings, Maki thinks the song is not catchy enough. She supposes that the song would sound catchier, if **the occurrences of the number with the most occurrences are greater**. Formally, let $O(x)$ be the count of different positions i in A such that $A[i] = x$, then she wants to maximize $\max_{x=1...k} O(x)$.

But since Maki has already spent many hours writing the song, she doesn't want to change it too drastically, so she wants to do the following operation at most once:

l r y: add an (possibly negative) integer y to $A[l], A[l+1]..., A[r]$. $1 \leq l \leq r \leq n$.

Since Maki is a tomato, not a programmer, she asks for your help to find what is the maximum achievable $\max_{x=1...k} O(x)$.

Input

Each input file contains only one testcase.

The first line of each testcase contains 2 integers n, k.

The next line contains n integers $A[1], A[2], ..., A[n]$.

$1 \leq n \leq 10^5$

$1 \leq k \leq 10^3$

Output

Output one integer, that is the maximum achievable $\max_{x=1...k} O(x)$.

Examples

Standard Input	Standard Output
5 5 1 5 5 4 4	4
2 10 10 10	2

Note

For the first Example, Maki can choose to add -1 to the subarray $A[2]...A[3]$, so that the array becomes $[1, 4, 4, 4, 4]$; it can be seen that $O(4) = 4$, which is the maximum achievable maximum occurrence.

For the second Example, Maki obviously shouldn't do anything, because $O(10)$ is already n and no greater numbers can be achieved.

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Problem H. Lost Soul

Memory limit: 512 MB

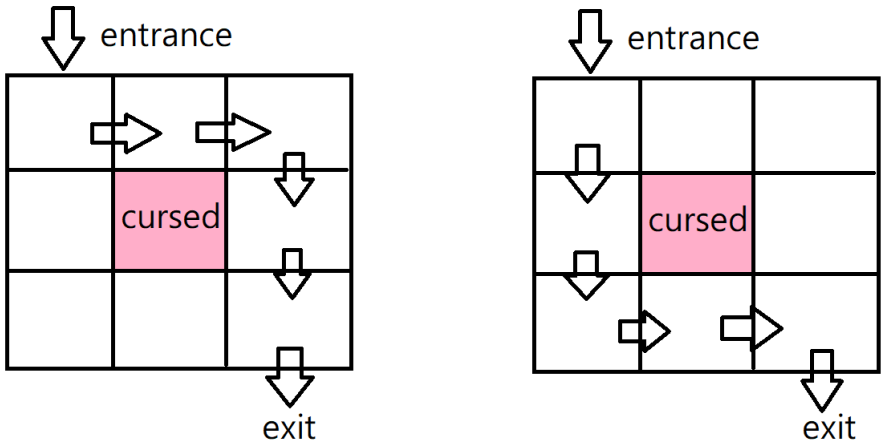
Chief Sunmoon needs your help to enter a maze to find his lost soul. On the door is a screen for you to enter the password.

In one of his dream, Sunmoon was told that the password is the number of ways for him to traverse the maze from the entrance to the exit, without stepping on the same cell twice.

In another dream, Sunmoon was shown the map of the maze. The maze can be represented by a **2D array** of n rows and m columns, The leftmost cell in the top row is the entrance, while the rightmost cell in the bottom row is the exit. There are some cursed cells which he can not step on, and he knows every cursed cell's position. (It is guaranteed that the entrance and the exit are both not cursed.)

Because of a dark curse, Sunmoon can never face in the north direction, meaning he can only walk in the **left, right, down** directions in the maze.

The pictures below show every valid traversals of a 3×3 map with 1 cursed cell.



Because Sunmoon is a Warrior, not a Sorcerer, he asks you to help him conjure up the answer using the holy algorithmic magic.

Input

There is only one testcase per input file.

The first line contains three integers n, m, k, denoting the size of the maze, and the number of cursed cells.

Then there are k lines, the i-th of which contains two integers r_i, c_i, which is the position of the i-th cursed cell. It is guaranteed that they are all within the maze and the same position will not be given twice or more.

$1 \leq n, m \leq 10^{18}$

$0 \leq k \leq 2 \times 10^5$

Output

Output the answer mod 998244353.

Examples

Standard Input	Standard Output
3 3 1 2 2	2
5 2 1 1 2	8
100000 100000 1 250 250	526358246

Note

Due to the enormous input range, please be careful about the modular arithmetic.

Problem I. Army of Inus

Memory limit: 512 MB

Satania has N dogs, and she knows every dog's power: the ith dog has power D_i, which is a positive integer less than or equal to 10^7. She wants to choose at least M dogs to form an army, and she wants to maximize the "consistency" of this army. The consistency $C(S)$ of a set of dogs S is the number of common positive divisors of the powers of dogs in S.

For example: suppose a set of dogs S has powers $\{12, 36, 108\}$, then $C(S) = 6$, because they have the following common divisors: $\{1, 2, 3, 4, 6, 12\}$.

What is the maximum achievable $C(S)$, given every dog's power?

Input

Each input file contains only one testcase.

The first line of each testcase contains 2 integers N, M : the number of dogs in total and the minimum size of Satania's army.

Next follows another line containing N integers: $D_1...D_N$.

$1 \leq N \leq 10^5$

$1 \leq M \leq N$

$1 \leq D_i \leq 10^7$ for $i = 1...N$

Output

Output one integer that is the maximum $C(S)$ that can be attained.

Examples

Standard Input	Standard Output
4 2 22 12 6 8	4
2 2 73 17	1

Note

For the first example: the optimal choice is D_2 and D_3, which have the following common divisors : $\{1, 2, 3, 6\}$, so the answer is 4.

For the second example, you have to choose all dogs, but they are coprime to each other, so the answer is 1.

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Problem J. Sunmoon's random number generator

Memory limit: 512 MB

Sunmoon is studying a paper about random number generator. A common way is Linear Congruential Generator. This method is one of the oldest and best-known pseudorandom number generator algorithms. The theory behind them is relatively easy to understand, and they are easily implemented and fast, especially on computer hardware which can provide modular arithmetic by storage-bit truncation.

The generator is defined by recurrence relation:

$$X_i = (a + cX_{i-1}) \mod P$$

However, the choice of initial state gives a large influence on output. It is also possible that not all numbers will be generated by this method if the initial state does not satisfy some rules. Although Sunmoon do not understand all parts of the theory now, He is still interested in what is the maximum number generated by Linear Congruential Generator with given initial state. Can you help Sunmoon to find the answer?

Input

There are many testcases in a file, each testcase contains 4 intergers a, r_0, c, P in a line.

- no more than 100 testcases in a file.
- $0 < r_0, P < 10000$
- $0 < a, c \leq 2^{31} - 1$

Output

For each testcase, print the maximum number generated by a random generator with given arguments.

Examples

Standard Input	Standard Output
0 2 2 10 1 3 3 99 7 71 712 7122	8 94 7121

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