Problem A. White Square

Memory limit: 1024 MB

You are given an $n \times n$ 2D array A, where each entry is a 1×1 unit square. There are k different positions painted black. Find the area of the largest square in A that is all white.

Input

There will be only one testcase per input file.

The first line contains two positive integers: n, k, separated by a single space.

And then there are k more lines, the ith of which has two positive integers: x_i and y_i, meaning that the position at row x_i and column y_i is painted black.

- $1 \leq n \leq 10^5$
- $1 \leq k \leq \min(10^5, n^2)$

Output

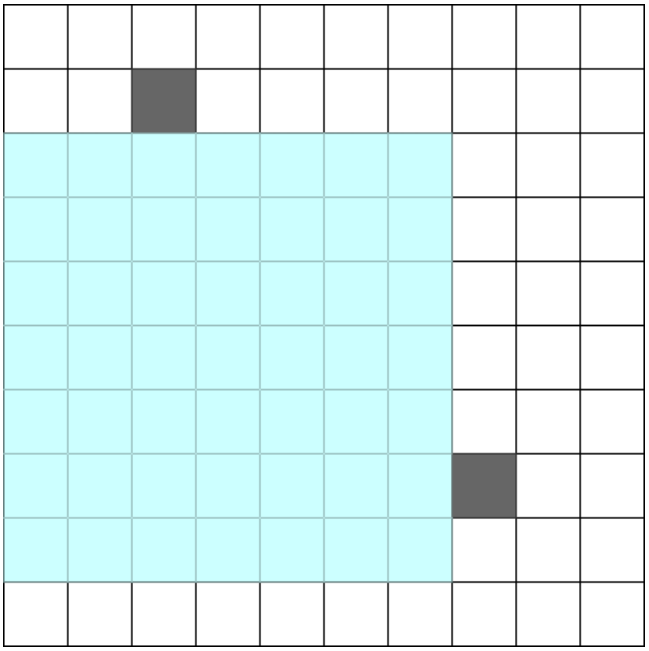
Output a single integer, that is the answer.

Examples

Standard Input	Standard Output
3 1 1 1	4
10 2 2 3 8 8	49

Note

The 2D array for example 2 and the largest white square (colored in blue).



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Problem B. Tankuku

Memory limit: 1024 MB

On June 4th, Tankuku plans to destroy some cities in NTHU land.

There are three parts of NTHU land: red, blue and green. Red part has n_1 cities $r_1, r_2, ..., r_{n_1}$, blue part has n_2 cities $b_1, b_2, ..., b_{n_2}$, and green part has n_3 cities $g_1, g_2, ..., g_{n_3}$. Two cities are connected by a bidirectional road if and only if they are in different parts.

Since Tankuku is living in red part, she can start from any city r_s in red part, travelling to some cities and back to r_s. She will not visit any city twice, except for r_s, which is visited at the start and the end. Also, she must visit as least 1 city other than r_s. How many different routes can Tankuku take? Find the answer mod 998244353. (Two routes are considered different if the sequences of cities visited are different.)

Input

There will be only one testcase per input file.

In each testcase, there is only one line, containing three positive integers: n_1, n_2, n_3, separated by a single space.

- $1 \leq n_1, n_2, n_3 \leq 300$

Output

Output a single integer, the answer mod 998244353.

Example

Standard Input	Standard Output
1 1 1	4
1 2 1	9

Note

4 routes for example 1:

- $r_1 \to g_1 \to r_1$
- $r_1 \to b_1 \to r_1$
- $r_1 \to g_1 \to b_1 \to r_1$
- $r_1 \to b_1 \to g_1 \to r_1$

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Problem C. Oppai Madoka

Memory limit: 1024 MB

Some chaotic events happened causing a decrease in Madoka's oppai, and the world is at risk. Thankfully, you can spend some QBs to restore the order of the universe.

There are n non-negative integers $a_1, ..., a_n$, and they are in the range $[0, 2^k)$. Initially, you have m QBs, by spending one QB, you can do the following move once: choose one integer x in the range $[0, k)$, and change some integer a_i to $(a_i \oplus 2^x)$, where $\oplus$ denotes the xor operator.

To maximize Madoka's oppai, you must maximize the following value $f = \sum_{i<j} a_i \oplus a_j$, that is, the sum of xor of every pair (a_i, a_j), where $i < j$.

To save the world, find out what is the max f that can be achieved using at most m QBs.

Input

There will be only one testcase per input file.

The first line contains three positive integers: n, m, k.

The second line contains n non-negative integers $a_1, ..., a_n$ separated by a single space.

- $1 \le n \le 10^5$
- $1 \le m \le 10^5$
- $1 \le k \le 20$
- $0 \le a_i < 2^k$ for each a_i

Output

Output a single integer, the maximum achievable f.

Examples

Standard Input	Standard Output
2 2 3 7 7	6
3 2 3 0 0 0	12

Note

Example 1 explanation:

By spending 2 QBs, we can change a_1 to 1, the resulting f is $1 \oplus 7 = 6$.

Example 2 explanation:

By spending 2 QBs, we can change a_1 to 6, the resulting f is $6 \oplus 0 + 6 \oplus 0 + 0 \oplus 0 = 12$.

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Problem D. Syaro's Tree

Memory limit: 1024 MB

Syaro is a poor boy, dressing as girl. She is doing many things to make money, one of them is selling herbs.

Syaro's herb is a tree T (an acyclic, connected graph), the nodes are labelled from $1, .., n$, the ith node has weight w_i, and tree T is rooted at node 1. The price of subtree T' is $\prod_{v \in T'} w_v$, that is, the product of every node's weight in the subtree.

Since the prices of herbs fluctuate a lot, Syaro may want to change some of the nodes' weights. There are two kinds of operations:

- $(1, u)$: output the price of subtree rooted at $u \mod 998244353$
- $(2, u, x)$: change the weight of node u to x

Please help poor boy Syaro make money!

Input

Each input file contains only one testcase.

The first line of each testcase has 2 integers n, q, the number of nodes and the number of operations.

The next line has n integers $w_1, ..., w_n$, separated by a single space.

Then there are $n - 1$ lines, each having two integers u, v, meaning there is an edge (u, v) in the tree.

Then there are q lines of operations, each of one of the two kinds:

- 1 u
- 2 u x

The input constrains:

- $2 \leq n \leq 10^5$
- $1 \leq q \leq 10^5$
- The weight of every node is always a positive integer $\leq 10^6$

Output

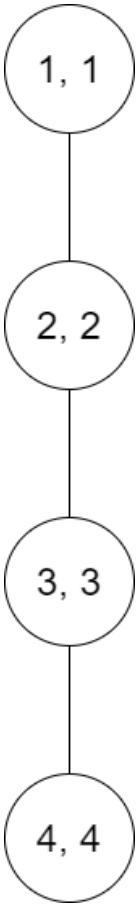
For every operation of the first kind, output the corresponding answer.

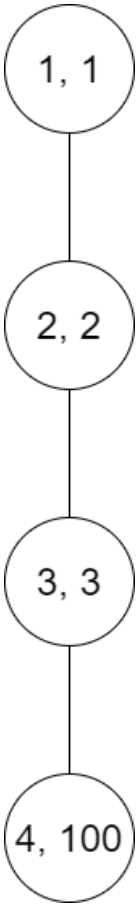
Examples

Standard Input	Standard Output
4 6 1 2 3 4 1 2 2 3 3 4 1 1 1 2 1 3 1 4 2 4 100 1 1	24 24 12 4 600
7 6 8 8 8 8 8 8 8 1 2 1 3 2 4 2 5 3 6 3 7 1 1 2 7 1 1 2 1 3 2 3 10 1 3	2097152 512 64 80
10 3 10 10 10 10 10 10 10 10 10 10 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8 9 9 10 1 1 2 10 1000000 1 5	17556470 175564700

Note

The following picture shows the tree in example 1 before and after the 5-th operation, which changes the weight of node 4 to 100. Inside the nodes are two integers u, w_u, the label and weight of the node.


1, 1
2, 2
3, 3
4, 4


1, 1
2, 2
3, 3
4, 100

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Problem E. Muse Music Start

Memory limit: 512 MB

Maki is the Composer of the music group "Muse". She just finished a song, which can be represented as an integer array $A = [a_1, ..., a_n]$ of size n. There are m keys on Maki's piano, so each integer in A is in $[1, m]$.

She considers a song dramatic if one can choose an integer k, and divide A into non-empty subsegments $S_1, ..., S_k$ from left to right, such that:

1. In each subsegment, every integer appears at most once.

2. For any i such that $1 < i < k$, subsegment S_i has length m.

In one move, she can assign some position in A any integer in $[1, m]$. Help Maki calculate the minimum number of moves she needs to make the song dramatic.

Input

Each input file contains only one testcase.

The first line of each testcase has 2 integers n, m.

The next line has n integers $a_1, ..., a_n$.

- $1 \leq n \leq 2 \times 10^5$
- $2 \leq m \leq n$

Output

Output one integer, that is the minimum number of moves required to make the song dramatic.

Examples

Standard Input	Standard Output
5 3 1 1 1 1 1	2
5 5 1 2 3 4 4	0
10 5 1 1 3 5 4 1 3 2 5 4	1
6 2 1 2 2 2 2 1	1

Note

For example 1, one can change the array to $[1, 1, 2, 3, 1]$ using 2 moves, so that there is a valid division $[1|, 1, 2, 3|, 1]$.

For example 2, there is already a valid division $[1, 2, 3, 4|, 4]$.

For example 3, by changing a_2 to 2, there is a division: $[1, 2, 3|, 5, 4, 1, 3, 2|, 5, 4]$.

For example 4, by changing a_3 to 1, there is a division: $[1, 2|, 1, 2|, 2, 1]$.

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Problem F. ZaHuei2

Memory limit: 1024 MB

Ragu Rabbit, a very rare species of rabbit, is known for the special pattern on its back. The Ragu Rabbits use positive integers to encode the patterns. In the Ragu Rabbit's religious, if a rabbit asks another what the pattern is on its back, hunters will capture them and turn them into stew meat, so most rabbits never knew its pattern during the whole life. However they know that when rabbits with pattern a and pattern b give birth to a baby rabbit, its pattern must be either $|a+b|$ or $|a-b|$.

Papa rabbit, Mama rabbit and Baby rabbit are a family. They come up with a game to help them figure out their pattern without asking the others. They game goes in rounds. In each round, the rabbits will either answer "I figure out my pattern is p" or skip the round, meaning that they still cannot figure out their pattern. The rabbits have very high pride, they will answer when they are hundred percent sure about their pattern.

For example, if Papa rabbit has pattern 1, Mama rabbit has pattern 1, Baby rabbit has pattern 2, the game may go as the following:

- Round1: Papa and Mama rabbits skip the round, since they cannot be sure bout their patterns. Baby rabbits figures out that it must have pattern 2, since pattern is an positive integer thus can only be $1+1=2$. Baby rabbit answers in round 1.
- Round2: Papa and Mama rabbits figure out their patterns. They answer in round 2.

Given the patterns of Papa rabbit, Mama rabbit, and Baby rabbit. Please calculate what is the minimum rounds for each rabbit to figure out its pattern.

Input

The first line is an integer N, being the number of test cases.

In each test case, there is a single line containing three positive integers a, b, c, being pattern of Papa rabbit, Mama rabbit, Baby rabbit, respectively.

- $1 \leq N \leq 2000$
- $1 \leq a, b, c \leq 10^{18}$
- $c = |a+b|$ or $|a-b|$

Output

For each test case, output the answer in one line.

Examples

Standard Input	Standard Output
3 1 1 2 1 3 2 813 2168 1355	2 2 1 3 2 3 5 4 5

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Problem G. FPS Moving

Memory limit: 512 MB

There are many First-Person Shooter game use key ‘wasd‘ let user move the character.

Let’s give the definition of effect when user press ‘wasd‘ :

1. `w` : If the character is at (x, y), he will move to $(x, y-1)$ after this command.
2. `a` : If the character is at (x, y), he will move to $(x-1, y)$ after this command.
3. `s` : If the character is at (x, y), he will move to $(x, y+1)$ after this command.
4. `d` : If the character is at (x, y), he will move to $(x+1, y)$ after this command.

Assume the character at $(0, 0)$ initially. After a moving control sequence about ‘wasd‘, what position the character will be finally?

Input

Each input file contains only one testcase.

The first contain a string about ‘wasd‘. The length of the string is no more than 100.

Output

Output the coordinate of the character will be finally. Please follow the format of the example output.

Examples

Standard Input	Standard Output
wwwwaasd	(-1,-3)

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Problem H. Terraces

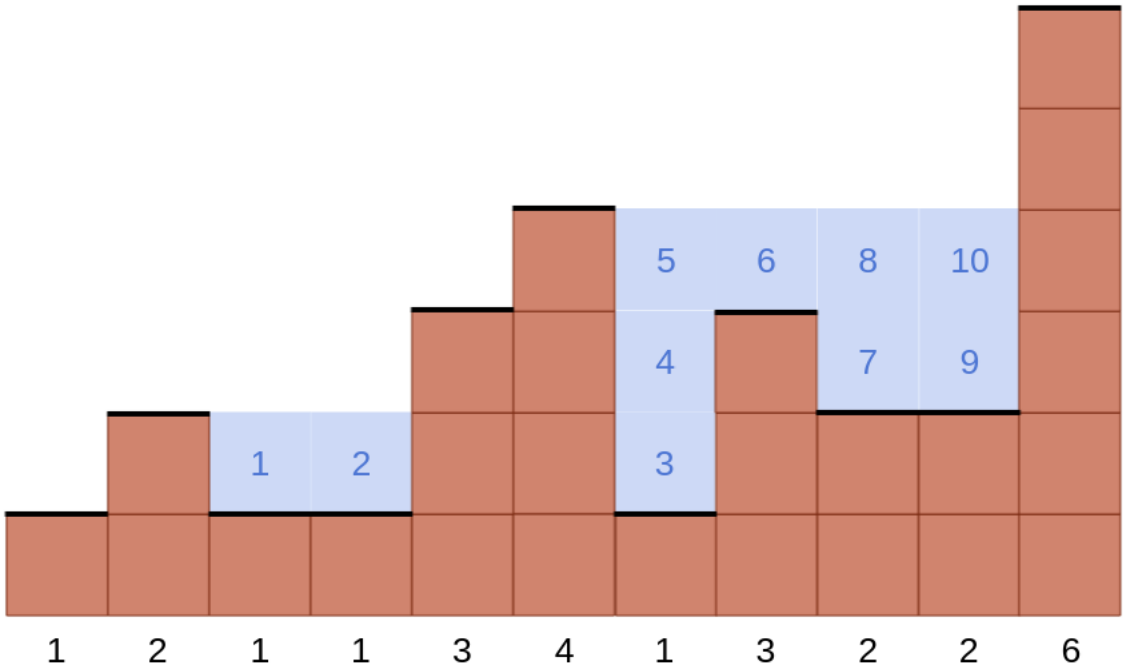
Memory limit: 512 MB

Terraces (梯田) are leveled surfaces built into the landscape for agriculture. Such technique preserves water, soil, and fertilizer, and creates planes from slopes.

A terrace in this problem is described by a sequence of positive integers. For example,

$$\{1, 2, 1, 1, 3, 4, 1, 3, 2, 2, 6\}$$

presents the following terraces:



Begin from the left end, altitude must starts from 1, and the right end must be the highest.

In this problem, you are to solve who much water is required to fill the given terrace structure.

Input

There is only one test case per input file.

The first line contains an positive integer N, $1 \leq N \leq 10,000$, which is the length of the sequence.

In the following line, N positive integers H_i denote the altitudes of the terraces. Each h_i must not grater than 1,000.

Output

Output how much water is required to fill the terraces.

Examples

Standard Input	Standard Output
11 1 2 1 1 3 4 1 3 2 2 6	10

Note

This is actually a very simple problem. You could scan the sequence from the left to right, and keep the highest altitude you have ever saw.

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Problem I. Josephus Matching

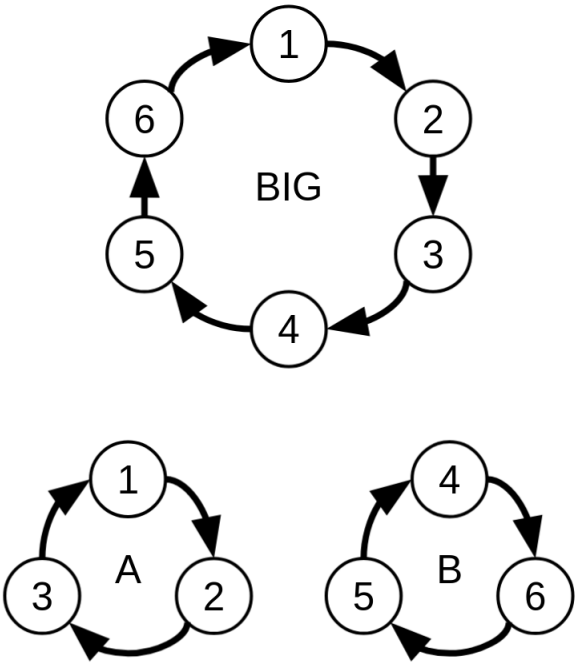
Memory limit: 64 MB

Josephus permutation is a classical problem in computer science. You will have more fun in this problem.

At the beginning, N (N must be even) people with IDs 1 to N stand in a big circle and wait to be chosen. Start from the 1st person (ID: 1) in the original circle, the person is moved from the original circle to a small circle A. After skipping the next M person, the chosen one is moved to a small circle B. And after skipping another next M person, the chosen one is moved to the small circle A, standing after the 1st person. After all N chosen steps, these N people are separated into 2 smaller circles with $N/2$ people.

Now, let's do similar processes to the new circle A and B. We pick the first person from each of the 2 cycles, and make them into the first pair. After skipping the next M person in each circle, we also chose the second pair from both cycles.

The case below shows the result of $(N, M) = (6, 2)$:



In this problem, you are asked to find who are in the last pair.

Input

Each input file contains only one test case. The case contains 2 positive integers N ($2 \leq N \leq 100,000$) and M ($0 \leq M \leq 100$), and N must be an even.

Output

Output 2 space separated integers denoting the people's IDs of the last pair.

Examples

Standard Input	Standard Output
4 0	3 4
6 2	3 5
100000 100	15540 15723

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Problem J. Palindrome

Memory limit: 512 MB

If a string is reads the same backward as forward, such as ‘madam‘ or ‘racecar‘, it is a Palindrome.

However, check if a string is palindrome is a simple problem. Let’s try something hard!

If T is substring of string $S = s_1 s_2 s_3 \dots s_n$, it is meaning existing a pair (i, j) such that $T = s_i s_{i+1}, \dots s_j$.

Can you find a palindrome from substrings of giving string?

Because maybe existing many substrings which are palindrome, please print the max possible length of them.

Input

There is a string made from lower case letters. The length of string is no more than 5000.

Output

Please print a integer, which is the max possible length of the palindrome in the input.

Examples

Standard Input	Standard Output
abac	3
cppa	2

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