Problem A. Antiquities of Acre

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Bronze`

Aamer bin Abdullah bin Al-Jarrah Al-Fihri, traveling through the lands of Palestine, explores Acre's labyrinthine alleys and towering walls, immersing himself in a city celebrated for over 4,000 years as a bastion of resilience and cultural diversity. Acre's strategic location on the Mediterranean coast has fostered a rich tapestry of civilizations and architectural marvels.

The country of Banias has N cities and one central bus station. There are M bus colors available in Banias. In the i-th city, there are b_{ij} buses of the j-th color, which can only travel to or from the bus station.

You currently reside in city 1 and wish to have K fun bus trips.

A trip from city u to city v (where u may be equal to v) is considered fun if the bus taken from city u to the bus station is of a different color than the bus taken from the bus station to city v.

The bus used from the bus station to city v is one of the buses belonging to city v.

Determine the number of ways (modulo $10^9 + 7$) to take K fun bus trips starting from city 1.

Two ways are considered different if there is at least one bus (either from city u to the bus station or from the bus station to city v) that is different.

Input

The first line contains one integer N ($2 \leq N \leq 10^5$), the number of cities in Banias.

The second line contains one integer M ($2 \leq M \leq 10$), the number of bus colors in Banias.

The third line contains one integer K ($2 \leq K \leq 10^9$), the number of fun bus trips you want to have.

Then follows N lines. The i-th line contains M integers ($0 \leq b_{ij} \leq 10^9$) for ($1 \leq j \leq M$), which represent the number of buses of the j-th color that the i-th city has.

Output

Output one integer, the number of ways (Mod $10^9 + 7$) you can take K fun bus trips if you started at city 1.

Examples

standard input	standard output
3 2 2 1 0 0 1 1 1	6
1 2 1 1 3	6
2 2 1 1 0 1 0	0

Note

First Example:

The ways are:

1)

Trip 1: City 1 $-(color = 1)->$ Bus Station $-(color = 2)->$ City 2.

Trip 2: City 2 $-(color = 2)->$ Bus Station $-(color = 1)->$ City 1.

2)

Trip 1: City 1 $-(color = 1)->$ Bus Station $-(color = 2)->$ City 2.

Trip 2: City 2 $-(color = 2)->$ Bus Station $-(color = 1)->$ City 3.

3)

Trip 1: City 1 $-(color = 1)->$ Bus Station $-(color = 2)->$ City 3.

Trip 2: City 3 $-(color = 2)->$ Bus Station $-(color = 1)->$ City 1.

4)

Trip 1: City 1 $-(color = 1)->$ Bus Station $-(color = 2)->$ City 3.

Trip 2: City 3 $-(color = 1)->$ Bus Station $-(color = 2)->$ City 2.

5)

Trip 1: City 1 $-(color = 1)->$ Bus Station $-(color = 2)->$ City 3.

Trip 2: City 3 $-(color = 1)->$ Bus Station $-(color = 2)->$ City 3.

6)

Trip 1: City 1 $-(color = 1)->$ Bus Station $-(color = 2)->$ City 3.

Trip 2: City 3 $-(color = 2)->$ Bus Station $-(color = 1)->$ City 3.

Second Example:

There are 4 ways:

2 ways of are going to the bus station using the bus with color 1, then returning with any of the two buses with color 2.

2 ways of are going to the bus station using any of the two buses with color 2, then returning with the bus with color 1.

Third Example:

There are no way to go from the bus station to any city because there is only buses of color 1. Therefore, there are no good trips.

Problem B. Biblical Journeys in Bethlehem

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Orange`

Aamer journeys to Bethlehem, renowned as the birthplace of Jesus Christ and steeped in over 3,000 years of biblical history. Nestled among Judea's hills, Bethlehem's ancient streets echo tales of prophets, pilgrimage, and enduring faith, making it a timeless symbol of spiritual heritage.

You are given an array a of n integers and an integer k. Additionally, there are q queries, each represented by two integers l and r.

For each query, you need to output the count of pairs (i, j) where $l \leq i < j \leq r$ and the bitwise XOR ($\oplus$) of $a[i]$ and $a[j]$ is smaller than or equal to k.

Input

The first line contains a single integer t ($1 \leq t \leq 10^4$) — the number of test cases.

The first line of each test case contains three integers n, k, and q ($2 \leq n, q \leq 2 \times 10^4$, $0 \leq k < 2^{30}$) — the size of the array, the threshold k, and the number of queries, respectively.

The second line contains n integers $a_1, a_2, \ldots, a_n$ ($0 \leq a_i < 2^{30}$) — the elements of the array.

Each of the next q lines contains two integers l and r ($1 \leq l < r \leq n$) — representing a query.

It is guaranteed that the sum of n over all test cases does not exceed $2 \cdot 10^4$,

and the sum of q over all test cases does not exceed $2 \cdot 10^4$.

Output

For each query, output a single integer — the count of pairs (i, j) such that $l \leq i < j \leq r$ and $a[i] \oplus a[j] \leq k$.

Output a new line between test cases.

Example

standard input	standard output
2 5 3 2 1 3 5 2 4 1 3 2 5 5 8 7 26 12 11 19 14 2 5 2 4 2 5 3 4 1 5 1 4 4 5	1 2 3 1 3 0 3 1 0

Problem C. Canals of Beersheba

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Black`

Aamer explores Beersheba's intricate network of canals and ancient water management systems, critical lifelines in the Negev Desert for millennia. Beyond their practicality, these systems highlight Beersheba's ingenuity and pivotal role as a crossroads of trade and civilization in arid landscapes.

My teacher asked me to obtain a string of N characters, each of which is either a or b with no **palindromes** of length 4 appearing in the string as a substring. Also, he wants the number of letters b in this string to be as **little** as possible.

So can you help me find the minimum number of letters b in the string?

Input

The first line contains a single integer N ($1 \leq N \leq 10^9$) — the length of the string.

Output

Print the minimum number of letters $'b'$ in the string that satisfies all the constraints.

Examples

standard input	standard output
5	1
2	0

Note

A palindrome is a sequence of characters that reads the same backward and forward.

Problem D. Diverse Culture of Al-Khalil

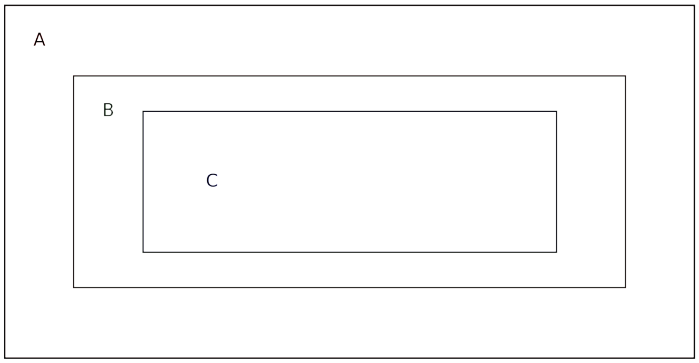
Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Purple`

Al-Khalil beckons Aamer with its bustling markets and ancient streets, reflecting a city that has thrived as a cultural crossroads for over 4,000 years. Revered by Christianity and Islam alike, Al-Khalil's vibrant mosaic of cultures and traditions enriches its identity as a hub of commerce, faith, and cultural exchange.

You are given n rectangles and you want to create a *nestangle* consisting of m rectangles positioned within each other, one inside the other. However, there is a specific rule:

- You will choose an integer s.
- Each rectangle area should be at least s larger than the rectangle inside it, in other words $bigger - smaller \geq s$.

As you see in the image below:



$A - B \geq s$, and $B - C \geq s$, and so on...

Given the areas of the rectangles, determine the maximum integer s that can make a nestangle of m rectangles.

Input

The first line contains an integer n ($2 \leq n \leq 10^5$) — the number of rectangles.

The second line contains n integers — each integer a_i ($1 \leq a_i \leq 10^5$) represents the area of the i-th rectangle.

The third line contains an integer m ($2 \leq m \leq n$) — the number of rectangles in the nestangle.

Output

Print the maximum integer s that can make a nestangle from m rectangles.

Examples

standard input	standard output
3 1 2 3 2	2
5 2 5 3 7 9 5	1

Note

First test case — We can put the $1st$ rectangle inside the $3rd$ rectangle and in this case we have a nestangle from 2 rectangles and s can reach 2 as the maximum value without violating the rule; $3rd$ area $- 1st$ area $\geq s$ $(3 - 1 \geq 2)$

Problem E. Exploration of Jericho's Oases

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Light Green`

Jericho captivates Aamer with its ancient oases and desert landscapes, emblematic of a city steeped in over 10,000 years of human settlement. Beyond its natural beauty, Jericho's resilience and archaeological treasures reflect its enduring role as a cultural and historical gem of the Levant region.

You are given an array a of n numbers and a permutation p of the same size.

There are two types of queries:

- 1 k ($1 \le k \le 10^9$): apply the permutation p to the array k times.
- 2 m ($l_1, r_1, l_2, r_2, ..., l_m, r_m$) ($1 \le m \le 1000$) ($1 \le l_i \le r_i \le n$): for every l_i and r_i output the minimum number in array a from l to r.

Input

The first line of the input contains one integer n ($1 \le n \le 1000$).

The second line contains n integers a_1, a_2, ..., a_n ($1 \le a_i \le 10^9$).

The third line contains n integers p_1, p_2, ..., p_n ($1 \le p_i \le n$).

The fourth line of the input contains one integer q ($1 \le q \le 1000$).

Then you will have q queries. Each query is given in the format described in the problem statement.

For each query of type 2, you will be given an integer m, and for the next m lines, you will be given 2 integers l and r in every line.

It is guaranteed that there is at least one query of the second type.

Output

For each query of the second type print m integers — one per line — each integer is the minimum element in the array from l_i to r_i.

Example

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

Note

A permutation p of size n is an array of size n in which each integer from 1 to n occurs exactly once. For

example, $[1, 4, 3, 2]$ and $[4, 2, 1, 3]$ are correct permutations of size 4 while $[1, 2, 4, 1]$ and $[1, 2, 2, 6]$ are not permutations.

Applying permutation p to array a means rearranging the elements of a according to p. For example if a is [1,6,3] and p is [2,3,1] then array a after applying p to it 1 time will be $[6, 3, 1]$.

Problem F. Fishing Traditions of Tiberias

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Blue`

Aamer explores Tiberias, where ancient fishing traditions intertwine with spiritual significance and healing practices dating back over 2,000 years. Set on the shores of the Sea of Galilee, Tiberias continues to embody a harmonious blend of nature, tradition, and spiritual renewal.

Mohamed loves good arrays. So he has an array of positive integers which satisfy some divisibility conditions. More precisely, he calls an array good if for every i from 1 to $n-1$, A_i is divisible by A_{i+1}. Please help him count the number of good arrays of length n consisting of integer numbers not greater than K.

Input

The only input line contains two integers n and K ($1 \le n, K \le 5 * 10^7$) — the length of the array and the maximum allowed value.

Output

Output a single integer — the total number of good arrays of length n consisting of positive integers not greater than K. As this number might be quite large, please output its remainder modulo 998244353.

Example

standard input	standard output
3 2	4

Problem G. Gateways of Beisan

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Gold`

Beisan, known historically as Beit She'an, invites Aamer to uncover its archaeological wonders and strategic significance in the Jordan Valley. For over 5,000 years, Beisan's ancient gateways have served as conduits of cultural exchange and a testament to its enduring legacy as a pivotal junction of civilizations.

Given a string S, we will call S unbalanced if and only if the length of S is at least 2, and more than half of the letters in S are the same. For example, both "aaa"and "eeeed"are unbalanced, while neither panda nor "z"is.

You are given a string S consisting of lowercase letters. Determine if there exists a (contiguous) substring of S that is unbalanced.

Input

The first line contains an integer N ($2 \leq N \leq 10^5$) denoting the length of the given string.

String S consisting of lowercase letters.

Output

If the answer exists, output "YES"; otherwise, output "NO".

Examples

standard input	standard output
7 mohamed	NO
3 aaa	YES

Problem H. Harbor Life in Jaffa

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Pink`

Aamer immerses himself in the vibrant harbor life of Jaffa, where maritime activity has shaped its identity as a gateway for trade and cultural interaction. Navigating through its bustling waters, Jaffa's strategic importance and historical role as a hub of connectivity come alive amidst the ebb and flow of commerce.

This is an interactive problem.

While participating in the ECPC qualifications, Gohary and Abouraya decided to take a tour of Alexandria. They made a map of the city where they represented it by a tree, where each tourist attraction is a node and the streets are edges connecting those nodes.

Abouraya and Gohary want to make some trips before the contest. A trip is uniquely defined by the tourist attractions it visits. A trip cannot visit the same attraction twice. Moving on any street always takes one unit of time. However, their car needs to refuel exactly one time during each trip. To sum up, the time needed for the trip is the time taken moving along the streets and the time taken for refueling (see notes for examples).

Each street in Alexandria has a gas station that takes a certain amount of time to refuel the car. Everything was looking in order for the boys to have some good time until Abouraya lost the map they had created. Fortunately for them, Omar had made the same map last year, so he could help them.

Instead of giving them the map directly, he would give them only the number of attractions and the streets that connect them, but he won't give them the times the gas stations took. Instead, he would play a game with them. Each turn they can choose two different simple paths and ask Omar for the sum of the times of the gas stations on those two paths.

The paths are considered different if and only if there is at least a single node that is on one of them but not the other. Omar will then reply with the required sum. Abouraya and Gohary can make at most $n-1$ such questions.

Since they have a very limited time before the contest, Abouraya and Gohary want to know how many different trips can be made in no more than k units of time.

Interaction Protocol

The first line contains a single integer t ($1 \le t \le 10^4$) — the number of test cases. Your program should always read this number.

For each test case, the first line contains two integers n ($4 \le n \le 10^5$) and k ($1 \le k \le 10^{10}$) — the number of nodes of the tree and the maximum time they can spend. Your program should always read those two numbers.

Each line of the next $n-1$ lines contains two integers u and v ($1 \le u, v \le n$), indicating that there is an edge between nodes u and v in the tree. It is guaranteed that the given graph is a tree. Your program should always read those $n-1$ numbers.

It is guaranteed that the sum of values of n over all test cases does not exceed 10^5 and that the times of the gas stations do not exceed 10^{10}.

After that, your program should print to the standard output the path queries to the interactor.

The query should be in the format "? u v x y " indicating that the first path you choose is the path from node u to node v ($u \neq v$) and that the second path is from node x to node y ($x \neq y$). The two paths have to be different. The interactor will then print the sum of the weights on the requested path.

After making the needed queries, your program should output "! m ". where m is the number of trips that can be made in no more than k units of time.

Your program can do at most $n - 1$ queries. The answer is not considered a query.

Do not forget about the flush operation after each printed line.

Making invalid queries or making more than $n - 1$ queries will lead to a wrong answer verdict.

After outputting a query, ensure you end the line and flush the output to avoid a Time Limit Exceeded **TLE** verdict. To flush the output, use:

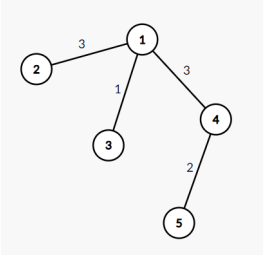
- fflush(stdout) or cout.flush() in C++,
- System.out.flush() in Java,
- stdout.flush() in Python.

Example

standard input	standard output
1 5 3 1 2 1 3 1 4 4 5 8 3 4 5	? 2 4 4 5 ? 3 1 4 5 ? 3 1 1 2 ? 5 4 2 1 ! 4

Note

The sample test case



The trips that can be made in less than 3 units are:

- $1 \to 3$ in 2 units
- $4 \to 1 \to 3$ in 3 units
- $4 \to 5$ in 3 units
- $5 \to 4 \to 1 \to 3$ in 4 units

notice that $4 \to 1 \to 3$ and $3 \to 1 \to 4$ are the same so they are counted only once.

Problem I. Interwoven Cultures of Nablus

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Yellow`

Nablus's winding streets and lively markets reflect a city that has flourished as a commercial and cultural center for over 2,000 years. Offering Aamer a glimpse into its history, he discovered how Nablus has been considered the main commercial and industrial center in Palestine, and even well-known for its sweets like Nabulsi Kunafa.

There's an onsite contest today.

Luckily, I'll be present, and I'm committed to minimizing cheating processes.

In the contest, there are N chairs and N participants. Each participant denoted as I ($1 \leq I \leq N$) occupies the ith chair.

Each person I has a list of size X (containing all the times he attempted to cheat). Note : every person has his own X.

The contest lasts for $4 * 10^4$ minutes. At the start of the contest, I stand at the $first$ chair in minute 1. If I'm at chair X at minute M and the person sitting in chair X tries to cheat, I will catch this person (Note : catching a person does not take any time and I can catch the same person more than one time).

Every minute, I can move to the next chair, the previous chair, or remain at the same chair. Each option takes one minute(if I'm at chair X at time M, I can choose to go to $X + 1$ or $X - 1$ or remain at the same X, but take care that the new X chair exists).

I aim to catch the maximum number of attempts in the shortest possible time, can you help?

Input

The first line contains one integer N ($1 \leq N \leq 4 * 10^3$) — corresponding number of chairs and people.

For each I , it contains X ($1 \leq X \leq 3*10^3$), then a list of size X . For each J, get arr_j ($1 \leq arr_j \leq 4*10^4$) -> array sorted in non decreasing order.

Output

Print the maximum number of cheating attempts you can catch and the minimum time to do this.

Example

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

Problem J. Journey in Safed's Mysteries

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Red`

Safed beckons Aamer with its mystical allure and spiritual significance, steeped in over 2,000 years of cultural and historical richness. As he navigates its winding alleys and sacred sites, Safed's reputation as a spiritual beacon offers moments of contemplation and discovery.

There are n sharks, which can be classified into two types: armored and unarmored.

- An armored shark requires one bullet to destroy the armor and then becomes unarmored.
- An unarmored shark can be defeated by either bullets or by sacrificing health points.

You have limited health points HP and bullets b, and you want to catch the sharks, but you can catch a shark only when the shark's health becomes zero. Each bullet or health point that you use reduces the shark's health H_i by one.

Please note that the sharks will arrive one at a time, not all at once, and you can't skip any shark when it arrives.

Your task is to determine the maximum number of sharks that you can catch without dying ($HP > 0$).

Input

The first line consists of 3 integers — n ($1 \le n \le 10^5$) The total number of sharks, HP ($1 \le HP \le 10^6$) The total amount of health points, b The number of bullets ($1 \le b \le 10^6$).

Followed by n lines, Each line consists of 2 integers describing a shark — H_i ($1 \le H_i \le 10^6$) The health of the i-th shark, A_i ($0 \le A_i \le 1$) The type of the i-th shark, if the shark is armored then ($A_i = 1$) else ($A_i = 0$) .

Output

Output a single integer — representing the maximum number of sharks that Ibrahem can successfully catch without dying.

Examples

standard input	standard output
5 5 5 1 1 2 0 3 1 4 0 5 1	3
4 7 5 5 1 3 0 4 1 2 0	2

Problem K. Kaleidoscope of Ramla's Diversity

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Light Blue`

Ramla's urban landscape reveals layers of cultural diversity and historical heritage spanning over 1,300 years. Founded during the early Islamic period, Ramla's streets and markets showcase its role as a vibrant hub of trade, agriculture, and religious tolerance, shaped by centuries of multicultural influence.

You are given an array A of n non-negative integers $A(a_1, a_2, a_3, .., a_n)$, and you are required to answer q queries.

You are given the q queries as follows:

- l r x — Find the largest non-negative integer y that is not present in this range in the array $[a_l, a_{l+1}, .., a_r]$, where y must be $\leq x$.
- If there is no integer y that satisfies the conditions, print -1.

Input

The first line contains two integers n, q ($1 \leq n \leq 10^6, 1 \leq q \leq 10^6$) — the length of the array A, and the number of queries.

The second line contains n non-negative integers ($0 \leq a_i \leq 10^6$).

The next q lines contain three integers l, r, x ($1 \leq l \leq r \leq n, 0 \leq x \leq 10^6$).

Output

Print q lines, each line contains the answer for the i_{th} query.

If there is no integer y that satisfies the conditions, print -1.

Example

standard input	standard output
5 3 1 2 0 4 5 1 4 4 1 3 2 1 2 2	3 -1 0

Problem L. Logistics of Lod's Connectivity

Input file:	standard input
Output file:	standard output
Balloon Color:	Green

The city of Lod is located to the southeast of the city of Jaffa, about 15 km away from it, and to the northeast of the city of Ramla, about 5 km away from it. Lod is 50 meters above sea level. It occupies an important position as it is a transportation node where railway lines meet and it is the meeting point of Jaffa, Haifa, Al-Quds and Egypt, and through it the traveler can move from Egypt to Palestine and then to Lebanon and Turkey.

In the vast "Stellaris" universe, a courageous explorer named Layla set off on a mission to uncover the universe's origins.

Layla began an incredible journey. Sometimes she struggled to travel in a straight line, and other times she forgot the direct route to her desired destination, so she had to change direction N times. For each change, Layla wrote down the angle of the distance traveled in degrees, and the distance covered.

The main goal was to discover the shortest path from the starting point to the desired ending point.

Your output will be considered correct when its absolute or relative error from our answer is at most 10^{-4}.

Input

The first line contains a positive integer N, $(1 \le N \le 10^5)$.

Each of the next N lines contains two integers, a and b $(0 \le a \le 360, 1 \le b \le 10^9)$ – the angle of the distance traveled in degrees and the distance covered.

Output

Output the length of the express route from the starting point to the desired end.

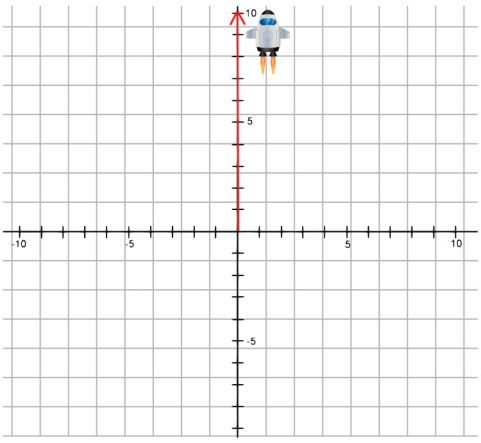
Examples

standard input	standard output
2 90 10 270 6	4.000000
10 148 835536810 250 655028053 266 267140383 308 474155415 11 740201328 127 156078947 86 940091475 261 683466162 74 421759523 172 639655008	621776139.436516

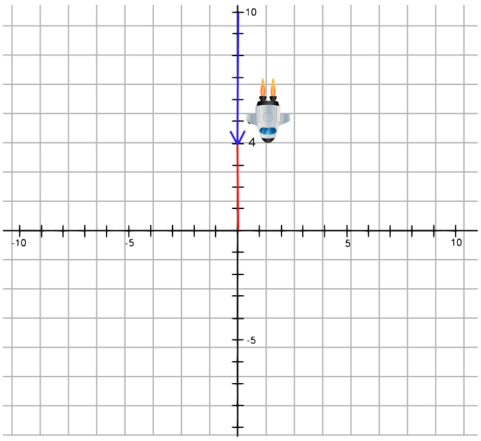
Note

The angle is measured counterclockwise from the positive X-axis.

For the first test case:



Layla moved 10 units with a 90-degree angle counterclockwise from the positive X-axis.



Then she moved 6 units with a 270-degree angle counterclockwise from the positive X-axis, resulting in the shortest path from the starting point to the desired end being 4 units.

Problem M. Majestic Crossroads Al-Nasserah

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Rose`

Al-Nasserah in the heart of Lower Galilee overlooks the Marj Ibn Amer plain and serves as a transition between this plain and the mountainous Upper Galilee. Historically significant, it connected main roads between Syria, Egypt, Jordan, and Palestine, attracting commercial caravans.

You are given three positive integers a, b, c. Your task is to count the number of divisors of $LD(a, b, c)$

Recall that the Ladallacian transform of any three integers a, b, c is defined as follows:

$LD(a, b, c) = \sum_{i=0}^{(a+c)^b} (\lceil \frac{i}{a+c} \rceil - i\%(a + c))$

Input

The input consists of three positive integers a, b, c ($1 \leq a, c \leq 10^9, 2 \leq b \leq 40$)

Additional constraint of the input: it is guaranteed that $LD(a, b, c) \leq 2^{100}$

Output

Output the number of divisors of $LD(a, b, c)$

Example

standard input	standard output
2 5 2	22

Note

Substituting with $a, b, c = 2, 5, 2$

$LD(2, 5, 2)$ will equal 130048 which has 22 divisors

Problem N. Navigation Challenges in Gaza

Input file:	`standard input`
Output file:	`standard output`
Balloon Color:	`Silver`

Gaza City's turbulent history and strategic significance shape Aamer's exploration of its intricate urban landscapes. Founded over 4,000 years ago, Gaza's resilience amidst challenges reflects its enduring spirit and the complexities of navigating humanitarian aid and development in a dynamic and diverse environment.

Kyali hates **Fibonacci**. So he decided to make his own sequence.

The **Kyali** sequence $K_1, K_2, K_3, K_i, K_{i+1}, \ldots$ is defined as follows:

- $K_1 = 1, K_2 = 2$
- K_i = Last Digit of $K_{i-1}*$ Last Digit of K_{i-2}

Given i (where i is the index of the sequence element).

You need to find the value of K_i.

Note: "Last Digit"means the least significant digit.

Input

One line contains one integer i ($1 \leq i \leq 10^6$).

Output

Print the value of K_i.

Examples

standard input	standard output
5	8
2	2