Problem A. Speedy Justice for You

Input file:	`justice.in`
Output file:	`standard output`
Balloon Color:	`Yellow`

Los Pollos Hermanos is a very famous kingdom in which chickens lived together peacefully under the rule of their wise chicken king, *Mr. Fring*. One day, *Mr. Fring* noticed that the chickens started some quarrels that he was afraid they may evolve into civil war. He wanted to maintain the brotherhood between his chickens. So, he sent one of his most talented investigators, *Mike* to reveal the reason of these quarrels. After careful investigations, *Mike* knew that the chickens were fighting because some chickens had more seeds than the others. *Mr. Fring* thought that the only way to stop these quarrels to give these chickens *speedy justice*.

Mr. Fring is a busy man. So, he had to choose one of his loyal chickens to serve this speedy justice. He did not have to think a lot as he know a clever lawyer called *Jimmy* who always though that *Justice Matters Most*. Once *Jimmy* knew that he was chosen for this task, he told *Mr. Fring*: "Do not worry! It's all good, man".

Jimmy knew that in order to achieve justice, all the chickens must have the same number of seeds. To achieve this, he have to choose a certain number of seeds s which all chickens will have. Chickens which have more seeds than s should return the excess seeds to the authorities, while chickens which have less seeds than s should be given seeds by the authorities so that they have exactly s amount of seeds.

Jimmy might be a just chicken, but unfortunately, he is not very good at calculations. So he went for you to ask for your help. He will assume several values of s and for every value you should give him two numbers, the total number of seeds that should be taken from the rich chickens and the total number of seeds that should be given to the poor chickens.

Can you use your ultimate programming skills to maintain the brotherhood of the chickens?

Input

The first line contains a single integer n ($1 \le n \le 10^5$)– the number of chickens in *Los Pollos Hermanos* kingdom.

The second line contains n space-separated integers $a_1, a_2, ..., a_n$ ($1 \le a_i \le 10^9$), where a_i is the amount of seeds the i_{th} chicken has.

The third line contains a single integer q ($1 \le q \le 10^5$)– the number of questions that *Jimmy* will ask you.

Each of the next q lines contains a single integer s ($1 \le s \le 10^9$)– the number of seeds that all the chickens should equally have.

Output

For every question *Jimmy* asks you, print two integers separated with a single space– the total number of seeds that should be taken from the rich chickens and the total number of seeds that should be given to the poor chickens. The answer to every question must be printed in a separate line.

Example

justice.in	standard output
3 2 9 6 3 2 8 10	11 0 1 8 0 13

Note

For $s = 2$:

- First chicken has 2 seeds, so it should neither take nor give any seeds.
- Second chicken has 9 seeds, so it should return 7 seeds to the authorities.
- Third chicken has 6 seeds, so it should return 4 seeds to the authorities.

So the total number of seeds that the rich chickens will return is $7 + 4 = 11$ seeds. Since there in not any poor chickens, the total amount of seeds given by the authorities will be 0. So the first line of the output is "11 0".

For $s = 8$:

- First chicken has 2 seeds, so it should be given 6 seeds by the authorities.
- second chicken has 9 seeds, so it should return 1 seed to the authorities.
- Third chicken has 6 seeds, so it should be given 2 seeds to the authorities.

So the total number of seeds that the rich chickens will return is 1 seed, while the total number of seeds given by the authorities is $6 + 2 = 8$ seeds. So the second line of the output is "1 8".

For $s = 10$:

- First chicken has 2 seeds, so it should be given 8 seeds by the authorities.
- Second chicken has 9 seeds, so it should be given 1 seeds by the authorities.
- Third chicken has 6 seeds, so it should be given 4 seeds by the authorities.

Since there is not any rich chickens, the total number of seeds returned to the authorities is 0, while the total number of seeds given by the authorities is $8 + 1 + 4 = 13$ seeds. So the third line of the output is "0 13".

Problem B. CircleCool 2.0

Input file:	`circle.in`
Output file:	`standard output`
Balloon Color:	`Light green`

ZerooCool is a Problem Setter, and he loves to have circles in his problems, a few days ago he came up with yet another circle problem but he couldn't find a solution to it, ZerooCool needs to find a solution for this problem to add it to the upcoming SCPC (Which is running now I think) Can you help him find it?

You are given a ratio R multiplied by 10^7 which represents an arc of a circle (E.g $R = 5 * 10^6$ means half a circle), what is the expected number of points added randomly on the circumference of the circle before they can't fit in an arc of size R.

Output the answer modulo $10^9 + 7$.

Input

The first line will have T $(1 \leq T \leq 10^5)$ the number of test cases The next T lines will contain one number R $(0 \leq R \leq 5 * 10^6)$ the ratio of the circle multiplied by 10^7

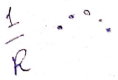
Output

Output one integer representing the expected number of points modulo $10^9 + 7$.

It can be shown that the answer can be expressed as an irreducible fraction $\frac{p}{q}$, output $p * q^{-1}$ *mod* $10^9 + 7$.

Example

circle.in	standard output
3 0 1231 687461	1 780917263 909593303



Problem C. GCD — Get Coke and Donuts

Input file:	gcd.in
Output file:	standard output
Balloon Color:	Dark green

Hemose gave *Khater* another cool problem.

He gave him an array of length n. He asked him to count the number of tuples $t(i, j, k)$ where $(1 \leq i < j < k \leq n)$ and (GCD(a_i xor a_j,a_i xor a_k) > 1).

Khater knew the solution, but he was hungry. So he went to get some coke and donuts and asked you to solve that problem for him.

Input

The first line contains a single integer T denoting the number of test cases.

The first input line of each test case contains a single integer n $(1 \leq n \leq 2000)$ — the length of the array. The second line contains n integers a_i $(0 \leq a_i \leq 10^6)$— the i-th element in the array.

Output

For each test case, print a single integer k — the number of tuples $t(i, j, k)$ where $(1 \leq i < j < k \leq n)$ and (GCD(a_i xor a_j,a_i xor a_k) > 1).

Examples

gcd.in	standard output
1 5 1 2 3 4 5	1
2 7 1 4 2 5 6 8 0 6 3 5 7 8 1 2	11 6

Note

The GCD of 0 and X is X where X is any non-negative integer.

Problem D. Just Keep Counting

Input file:	`count.in`
Output file:	`standard output`
Balloon Color:	`Silver`

Khater was practicing because he will compete in the next ICPC. He was trying to solve a counting problem.

Khater is given an array of bracket strings. Each string contains one of the two possible brackets — "(" or ")".

For Each string in the array, he is able to do the following:

- delete some characters in the string
- reorder the remaining string in any order he wants

After doing some operations *Khater* will have to concatenate all the strings in the array in the same order as the input. He wants to know the number of different correct bracket sequences he can get.

Some bracket sequences are called correct bracket sequences if:

- Empty string is a correct bracket sequence.
- if s is a correct bracket sequence, then (s) is also a correct bracket sequence.
- if s and t are correct bracket sequences, then st (concatenation of s and t) is also a correct bracket sequence

Khater didn't know what makes bracket sequences different. *YahiaS* told him that each character in all strings has a unique id. The two bracket sequences are different if the lists of the unique id of their characters are not exactly the same, please read the note sections for more explanation.

As the result can be very large, you should print the value modulo $10^9 + 7$ (the remainder when divided by $10^9 + 7$).

Input

The first input line of the input contains a single integer n ($1 \le n \le 30$) — the length of the array.

The second line contains n strings a_i ($1 \le len(a_i) \le 30$)— the i-th element in the array.

Output

For each test case, print a single integer k — the number of different bracket sequences *Khater* can get.

Example

count.in	standard output
2 () ()	5

Note

For the first test case, Let's assume that the id of the characters is as following :

- The first string () has id list of [1,2].
- The second string () has id list of [3,4].

Then *Khater* can get the following correct bracket sequences:

- with id list = []
- "()"with id list = [1,2]
- "()"with id list = [1,4]
- "()"with id list = [3,4]
- "()()"with id list = [1,2,3,4]

Problem E. EV triangle

Input file:	triangle.in
Output file:	standard output
Balloon Color:	Gold

MaghrabyJr and Eddard are arguing all the time on who is the better competitive programmer, unlike what you thought each of them is trying to prove that the other one is better!

MaghrabyJr presented Eddard with the following problem:

You are given 3 disjoint circles on the $2d$ plane.

Let's define a triangle to be *good* if:

- All three points of the triangle have integer coordinates.
- Each point belongs to exactly one circle.
- No two points belong to the same circle.
- The triangle has one side parallel to the x-axis and another side parallel to the y-axis

A point belongs to the circle if the distance from that point to the center of the circle doesn't exceed the radius of the circle.

Among all possible *good* triangles, a machine is going to pick a random one, with each *good* triangle having the same probability of being picked.

Find the expected value of the area of that triangle.

Eddard thought for a second and then solved the problem, can you do the same?

Input

The input consists of 3 lines each line describing one circle.

The i_{th} of them will contain 3 integers x_i, y_i and r_i the x and y coordinates of the center and the length of the radius for the i_{th} circle

$0 \leq x_i, y_i \leq 10^6$

$1 \leq r_i \leq 10^3$

Output

It is guaranteed that the required expected value can be represented as an irreducible fraction P/Q. You need to print the value $(P * Q^{-1})$ modulo 1000000007.

Examples

triangle.in	standard output
0 0 1 3 2 1 1 3 1	687500008
0 0 1 3 1 1 1 3 1	944444454

Note

In the first test case there are 8 possible good triangles as follows

$(0,-1)(3,3)(0,3)\ area = \frac{12}{2}$
$(0,0)(3,3)(0,3)\ area = \frac{9}{2}$
$(0,1)(3,1)(0,3)\ area = \frac{6}{2}$
$(0,1)(3,3)(0,3)\ area = \frac{6}{2}$
$(1,0)(2,2)(1,2)\ area = \frac{2}{2}$
$(1,0)(3,2)(1,2)\ area = \frac{4}{2}$
$(1,0)(3,3)(1,3)\ area = \frac{6}{2}$
$(1,0)(4,2)(1,2)\ area = \frac{6}{2}$
$EV = (\frac{12}{2} + \frac{9}{2} + \frac{6}{2} + \frac{6}{2} + \frac{2}{2} + \frac{4}{2} + \frac{6}{2} + \frac{6}{2}) * \frac{1}{8} = \frac{51}{16}$

Problem F. Ziko on the grid

Input file:	grid.in
Output file:	standard output
Balloon Color:	Pink

Ziko is known for his love for mango. One day, *Ziko* slept hugging his favorite mango, but when he woke up, he found himself in the top left corner of a grid but without his mango. He could see that his mango was at the bottom right corner of the grid.

Ziko has a rare disorder called *OCD* — Only Cross Diagonally. This means that if *Ziko* is in row i and column j on the grid, in one move he can go to:

- row $i+1$ column $j+1$
- row $i-1$ column $j-1$
- row $i+1$ column $j-1$
- row $i-1$ column $j+1$

otherwise he will go crazy.

Can you tell *Ziko* if he can reach his mango without going crazy?

Input

The input consists of several test cases. The first line of the input consists of a single integer t ($1 \le t \le 100000$), The number of test cases.

Every test case consists of a single line having two integers n, m ($1 \le n \le 10^9$, $1 \le m \le 10^9$) where n is the number of rows in the grid, while m is the number of columns in the grid.

Output

For every test case, if *Ziko* can reach his mango without going crazy, print "YES" otherwise print "NO" (without quotes). The answer of every test case must be printed in a separate line.

Example

grid.in	standard output
3 8 8 3 2 6 4	YES NO YES

Problem G. I^{th} String

Input file:	ith.in
Output file:	standard output
Balloon Color:	Purple

Abdelrahman and Ziko are two friends. Abdelrahman loves binary strings (strings consist only of 0's and 1's), he also like them to be of the same length and Ziko loves sorted arrays. They were asked to prepare some problems by Khater, So they came up with this problem.

For some integer n there exists a sorted array a that contains all binary strings of length n that satisfy the following properties:

1. The string has exactly two 1's.
2. All rest positions are 0's.

For Example, if $n = 4$, a would be $[0011, 0101, 0110, 1001, 1010, 1100]$.

Given n and some string S that is an element of a, can you determine the index of S in a.

In other words, print i $(1 \leq i \leq |a|)$ which indicates the position of S in a.

$|a|$ indicates the size of a.

Input

First line of the input file contains one integer T $(1 \leq T \leq 1000)$- the number of test cases in the file. Then T test cases follow.

Each test case is written on two lines. The first line contains integer n $(3 \leq n \leq 10^6)$- the length of the strings in a.

The second line of each test case contains String S $(|S| = n)$. It's guaranteed that S is in a.

The sum of values n over all test cases in the test doesn't exceed 10^6.

Output

For Each test case print single integer i the index of S in a.

Example

ith.in	standard output
7 5 00011 5 00101 5 10010 5 11000 3 011 3 101 20 00000100000100000000	1 2 8 10 1 2 100

Problem H. HxH

Input file:	killua.in
Output file:	standard output
Balloon Color:	Red

On his way to save his sister *Alluka*, *Killua found a huge gate.*

Killua tried to open the gate but it was beyond his powers.

His brother Illumi told him that there is a challenge written on the gate that must be solved for it to open, the challenge is as follows.

You are given a string s of length n, m strings of the same length and an integer k, you need to find out if there is way to construct the string s from an empty string a using the following process **any number of times (you start with an empty string a and an integer $i = 1$.)**

1. **select any string y from the m given strings.**
2. **select any integer x such that $(k \leq x \leq n - i + 1)$**
3. **append the substring $y_i, y_{i+1}, y_{i+2}, \ldots, y_{i+x-1}$ to the end of string a.**
4. **set i to be $i + k$.**

Killua couldn't solve the challenge and asked for your help to solve it.

Input

The first line contains three integer n, m and k such that $(1 \leq n \leq 4000)$, $(1 \leq m \leq 4000)$ and $(1 \leq k \leq n)$

The next line contains a string s consisting of n lowercase English letters.

m lines follow where each line contain a string m_i.

Output

Print YES if there is a way to construct the string s using the process described above, otherwise print NO

Examples

killua.in	standard output
13 4 3 hunterxhunter iloovexhunter killuaxkillua hunchhcnuhhun gonterrstegan	YES
1 4 1 a b c d e	NO

Note

In the first sample, we can construct string s using the following processes:

1. *select hunchhcnuhhun as y and 3 as x*
2. *select gonterrstegan as y and 3 as x*
3. *select iloovexhunter as y and 7 as x*

This way the following changes happen to a:
$\rightarrow$ "*hun*" $\rightarrow$ "*hunter*" $\rightarrow$ "*hunterxhunter*"
In the second sample, there doesn't exist any way to construct the string s

Problem I. Long Lines

Input file:	`lines.in`
Output file:	`standard output`
Balloon Color:	`Light blue`

You are given two integers n and k.

Print "Pass" if $n * k$ is strictly less than 1000, otherwise print "Fail"

There are T test cases you have to answer.

Input

The first line contains an integer $1 \leq T \leq 10^5$ representing the number of test-cases

Each test-case contains two integers n and k $(1 \leq n, k \leq 100)$

Output

For each test case print on a single line "Pass" if $n * k$ is strictly less than 1000 and "Fail" otherwise.

Example

lines.in	standard output
2 5 20 10 100	Pass Fail

Problem J. MathTree Mastery

Input file:	tree.in
Output file:	standard output
Balloon Color:	Dark blue

MathTree is a mighty data structure that only an elite few have managed to master using it, it's a full binary tree in which every node has a digit from 0 to 9 and every edge has one of three operations add, multiply, and concatenate, so the path from any node to any other node is an arithmetic calculation and the value of that path is the answer to that calculation.

Adhm is an apprentice who wants to become a MathTree master, so he asked *Hemose* the most powerful MathTree master he knows to help him become a MathTree master, Hemose accepted to teach Adhm the MathTree Mastery, but like every other wise master, Hemose asked Adhm to do this hard task first before he can teach him.

Hemose asked Adhm to draw every possible MathTree of depth N and for each tree he computes the sum of all the paths from the root to all leaves and then he adds the values he obtained from all trees, can you Help Adhm find the correct final answer.

because the answer could be very large print the answer module $10^9 + 7$.

Input

The first line will have T ($1 \leq T \leq 100$) the number of test cases The next T line will contain one integer N ($1 \leq N \leq 10^{18}$) the depth of the MathTree.

Output

The output is one Integer representing the final value modulo $10^9 + 7$.

Example

tree.in	standard output
2 52424353227940400O 47975036182556868	954312078 968280475

Note

Concatenation is done before multiplication and both of them are done before addition.

Problem K. Parachuting

Input file:	parachute.in
Output file:	standard output
Balloon Color:	Brown

Parachuting is a very popular activity in Dragon Land. Each player jumps from the helicopter at the at a particular point(x_0, y_0) moves vertically downwards until the player reaches the land at height 0.

However, Parachuting in Dragon Land is a not that easy, it's a little dangerous! Not all of the P players can make it to the land safely, because there are D dragons flying in the sky. Each dragon is at a unique fixed position (x_1, y_1). Initially, the player is moving vertically downwards. If a player hits a dragon, the dragon will blow the player away to a new position (x_2, y_2) where $(y_2 < y_1)$, from which the player will continue moving downwards. If the player hits k dragons, he dies. Assume players do not collide with each other.

Find out whether each player will die or land safely. If a player lands safely print x coordinate where he landed, otherwise print "NO". All coordinates are integers.

Input

The first line contains an integer: P $(1 \leq P \leq 10^5)$– the number of players

The second line contains an integer: k $(1 \leq k \leq 10^5)$– the number of dragons that if hit by a player the player dies.

The next P lines contain 2 integers (x_0, y_0) denoting the initial position of each player – the i^{th} line denotes the initial position of the i^{th} player $(0 \leq x_0, y_0 \leq 10^9)$.

The next line contains a single number D $(1 \leq D \leq 10^5)$– the number of dragons in the sky.

The next D lines each contains 4 integers x_1, y_1, x_2, y_2 describing a dragoon. In each line, the first two integers: x_1, y_1 are the fixed position of the dragon and the last two integers x_2, y_2 are the position the player will be blown to if the player hits this dragon $(0 \leq x_1, y_1, x_2, y_2 \leq 10^9)$. The j^{th} line describes the j^{th} dragon.

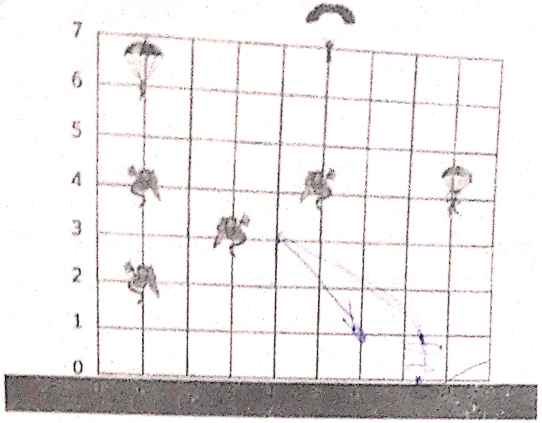
Output

For each player print a single line containing either The x coordinate where he landed if the player will survive or "NO" if the player will not.

Example

parachute.in	standard output
3 3 1 6 5 7 8 4 4 1 4 3 3 1 2 4 1 3 3 1 2 5 4 4 2	NO 4 8

Note



Testcase 1 visualization

The first player starts at height = 6 and hits 3 dragons so he dies since k=3, while the second player starts at height = 7 hits only one dragon and lands safely at x=4 and the third player starts at height = 4 does not hit any dragons and then lands safely at x=8.

Problem L. Path Subsequence

Input file:	path.in
Output file:	standard output
Balloon Color:	Black

Given a tree consisting of N vertices numbered from 1 to N and the tree is rooted at vertex 1.

You will be given Q queries, each query in the form of

- u v $(1 \leq u, v \leq N)$.

For each query you need to count the number of distinct arrays S that satisfy the following conditions:

1. The path between vertex 1 and u is a subsequence of S.
2. The path between vertex 1 and v is a subsequence of S.
3. S is the shortest possible array to satisfy the conditions above.

There are T testcases that you have to solve.

It is guaranteed that $\sum N, \sum Q \leq 2 * 10^5$ over all testcases

Input

The input consists of multiple test cases. The first line contains a single integer T $(0 < T \leq 10^4)$ — the number of test cases.

The first line of each test case contains a single integer N.

The next $N - 1$ lines contained 2 integers u, v, where there is an edge between node u and node v.

The next line has the integer Q. Then Q lines follow, where each line has two integers u and v $(u \neq v)$.

$1 < N, Q \leq 2 * 10^5$

$1 \leq u, v \leq N$

Output

Output a single integer per query, the number of distinct sequences S that satisfy the above conditions for the given u and v mod $10^9 + 7$.

Example

path.in	standard output
2 6 1 2 1 3 2 4 2 5 3 6 5 1 2 2 3 3 4 4 5 5 6 2 1 2 1 1 2	1 2 3 2 6 1

Note

Paths include the starting and ending vertex.

Problem M. Longest good subsequence

Input file:	long.in
Output file:	standard output
Balloon Color:	White

You are given an array A of n integers.

You are also given an integer k and your task is to find the length of the longest *good* subsequence of array A

A sequence of integers is called *good* if the length of the longest increasing subarray of the given sequence doesn't exceed k

for example if $k = 3$ the sequence $[3, 1, 2, 4, 4]$ is called *good*, while the sequence $[3, 1, 2, 4, 5]$ is not called *good*

Please refer to the notes for the definitions of subsequence, subarray and increasing subarray.

Input

The first line contains a single integer T denoting the number of test cases.

The first input line of each test case contains two integers n, k ($2 \le k \le n \le 10^6$)

The second line contains n integers A_i ($1 \le A_i \le 10^9$)— the i-th element in the array.

Output

For each test case, print a single integer — the length of the longest good subsequence of array A

Example

long.in	standard output
4 6 2 1 2 3 4 5 6 6 2 3 2 1 5 6 4 6 2 6 5 1 2 3 4 6 3 1 2 4 3 6 5	2 5 4 6

Note

A subsequence is a sequence that can be derived from the given sequence by deleting zero or more elements without changing the order of the remaining elements.

A subarray is the sequence of consecutive elements of the initial sequence. Subarray is called increasing if each element of this subarray (except for the first one) is strictly greater than previous.