Problem A. Anime Creator

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

This is an interactive problem.

The anime creator Polycarp is planning to create his own version of the famous anime Naruto. In Polycarp's version there are N characters, denoted as α_1, α_2, ..., α_n.

Due to complicated plot the powers of the characters are not transitive (i.e. if A is more powerful, than B, and B is more powerful, than C, it not means that A is more powerful, than C). After the first season is known that α_1 is more powerful than α_2, α_2 is more powerful than α_3, ..., α_n is more powerful than α_1.

Now he is planning the new episodes. Each episode may be either part of main timeline or the flashback. In each episode, two characters are fighting; in the episode from main timeline more powerful player destroys the less powerful one, in the flashback the more powerful player still wins, but no-one is really destroyed.

So, each episode is described by three integers (i, j, t), where i and j are the number of the characters that are fighting, and t defines if the episode is a flashback. The destroyed characters are destroyed forever and do not appear in the future episodes.

The relation in the power between any pair of characters is defined by Polycarp before he started the project, is kept in the secret, is consistent in both flashbacks and parts of main timeline and never changes (i.e. Polycarp for each two characters α_i and α_j can say for sure who is more powerful, and there are no ties).

The anime is considered interesting, if it is impossible after each episode to split all the alive characters by two groups A and B such as in the past episodes are no character from B, that wins the fight some character from A (either in flashback or in the episode from the real timeline).

Your task is to help Polycarp to finish his plot and reduce the number of alive characters to 3, using no more than $2N$ flashbacks, keeping the anime interesting. If after some episode an anime is not interesting, you immediately fail.

Interaction Protocol

The jury program starts the interaction with one integer t — the number of the test cases to process.

At the beginning of each test case the jury program will send to your solution one integer n ($4 \le n \le 500$) – the number of the characters. Then you can submit the episodes. Each submission have the form i j t ($1 \le i, j \le n$, $0 \le t \le 1$, $i \ne j$), where $t = 1$, if the episode is flashback and $t = 0$ otherwise. After that the jury program sends one integer x — the number of the winner (x is either i or j). When there are 3 characters left, the processing of the current test case will be ended.

You may assume that the sum of n for all test cases does not exceed 10^4.

If at some time the jury program prints -1, you shall immediately exit your program, otherwise the verdict can be defined randomly.

Do not forget to print end-of-line character and flush the output after each query.

Example

standard input	standard output
1 4 3 3	 1 3 1 3 4 0

Problem B. Binary String Transformation

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

You are given two binary strings A and B of length N each. Your task is to check if it is possible to transform A to B using zero or more operations of the following type:

- Choose a substring in A, starting at position L and ending at position R, such as $R - L \geq 3$, $A_l = A_r = 0$, $A_{l+1} = \ldots = A_{r-1} = 1$.
- Swap digit at position L with digit at position $L + 1$ and digit at position R with digit at position $R - 1$.

Input

The first line of the input contains one integer N ($1 \leq N \leq 10^5$) — the length of the input strings.

The second line contains the source string: a binary string A of length N.

The third line contains the target string: a binary string B of length N.

Output

Print "`Yes`", if A can be transformed into B using zero or more operations, described in the statement, and "`No`" otherwise.

Examples

standard input	standard output
8 01101110 10101101	Yes
7 0111110 1101011	Yes
6 101010 111000	No
9 011011110 011011110	Yes

Note

In Sample 1, first apply operation with $L = 1$ and $R = 4$, obtaining the binary string 10011110, then apply operation with $L = 3$ and $R = 8$, obtaining the binary string 10101101, that is the answer.

Problem C. Cotangent

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

Consider the function $S(k, l)$ of two integer arguments k and l such as $k \bmod 3 \neq 0$ and $(k, l) = 1$ as the following sum:

$$\sum_{j=1}^{k-1} \operatorname{ctg}(\pi \cdot j/k) \cdot \operatorname{ctg}(l \cdot \pi \cdot j/k)$$

Given k and l, calcuate $S(k, l)$.

Input

The first line of the input contains two integers k and l ($2 \leq k, l \leq 10^9$, k is not divisible by 3, k and l are coprimes).

Output

Print the answer with absolute or relative error 10^{-9} or better.

Examples

standard input	standard output
10 3	0
11 7	-6
11345435 7	6129463102750

Problem D. Distinct Numbers

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

Given the sequence of n integers v_i, each integer is the random number, choosen equiprobably from $1...n$.

Your task is to process the queries. Each query is defined as two random segments $[a_l, a_r]$ and $[b_l, b_r]$. Endpoints of each segment is 2 integers chosen equiprobably from $1 \dots n$ and sorted by non-decreasing order.

For each such pair your task is to find the number of the distinct integers in those segments.

Input

The first line of the input contains one integer n ($1 \le n \le 200\,000$).

The second line contains n integers v_i, generated randomly and equiprobably ($1 \le v_i \le n$).

The third line contains one integer m ($1 \le m \le 200\,000$).

Each of the following m lines contains queries a_l, a_r, b_l, b_r ($1 \le a_l \le a_r \le n$; $1 \le b_l \le b_r \le n$).

Output

For each query, print the answer in the separate line.

Example

standard input	standard output
15 14 2 4 14 4 7 2 5 11 6 4 14 8 2 10 10 10 15 4 15 7 14 7 15 1 3 11 13 7 14 2 2 5 11 3 5 5 13 1 2 4 15 3 9 4 8 3 12 3 10 8 13 6 6 12 13	9 8 4 7 7 8 9 7 8 3

Problem E. Encoded Palindrome

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

The *hexadecimal string*, i.e. string consisted of digits '`0`' - '`9`' and letters '`A`'-'`F`' is considered an *encoded palindrome*, if the binary string, obtained after replacement of hexadecimal digits with their **4-bit** representations (with leading 0's), is the palindrome.

You have the hexadecimal string. Your task is to rearrange the string and delete the least number of characters (or delete no characters, if that is possible) to obtain the encoded palindrome. If there are more than one encoded palindromes, print lexicographically maximal one. If it is impossible to build any encoded palindrome, print the empty string (as it is the encoded palindrome of length 0).

Input

The input contains the string S, consisting of digits '`0`' - '`9`' and letters '`A`'-'`F`' ($1 \le |S| \le 10^5$).

Output

Print the encoded palindrome of maximum possible length (as the **hexadecimal** string), that can be obtained by rearrangement and possibly deletion of some characters in the string S. If there are more than one encoded palindrome of the maximal length, print lexicographically maximal one.

Examples

standard input	standard output
10836006F	860F061
33	

Problem F. Fruitland

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

You are going to travel to the Fruitland, to buy big amount of the fruits and then sell at your home country. You have X coins, and the laws of the Fruitland allow spending no more than Y coins for the fruits.

There are N cities with big fruit markets in the Fruitland, one market per city. Each city is assigned an unique integer from 1 to N. At each market you can buy the fruits. The fruits are sold in units; you may buy only integer amount of units, not greater than number c_i of units on the stock of this market. Each type of fruit have a cost p_i per unit and the value v_i per unit.

The direct movement from city i to city j costs $m_{i,j}$ coins. Note that it is possible that $m_{i,j} \neq m_{j,i}$.

Your task is to start at the city 1, buy the fruits in the way that summary value is maximized, and return to the city 1. You may spend no more than X coins total and no more than Y coins on the fruits themself.

Input

The first line of the input contains the number of cities N, amount of the coins X you have, and the maximum amount of coins Y you can spend to buying fruits, respectively ($1 \leq N \leq 14$, $1 \leq X \leq 10^4$, $1 \leq Y \leq min(1000, X)$).

Then N blocks with the information on the fruit markets in each city follow. The first line of the i-th block contains one integer K_i ($1 \leq K_i \leq 300$) — the number of the fruit types sold at market of i-th city.

j-th of the following K_i lines contains three integers $p_{i,j}$, $v_{i,j}$ and $c_{i,j}$, that is the price for one unit of the i-th fruit on the market, the value of the unit of that fruit and the number of units on stock, respectively ($1 \leq p_{i,j}, v_{i,j}, c_{i,j} \leq 1000$).

Then the matrix $N \times N$ follow, the j-th integer in i-th line is the cost $m_{i,j}$ of the direct movement from the city i to the city j (note that the prices may not be symmetric) ($0 \leq m_{i,j} \leq 10^4$, $m_{i,i} = 0$ for any i).

Output

Print one integer — the maximal possible value of the bought fruits.

Examples

standard input	standard output
1 12 12 3 1 12 1 2 22 3 3 32 4 0	130
2 20 20 3 1 16 1 2 27 3 3 38 2 1 5 179 1 0 2 3 0	314
3 20 10 1 2 2 2 1 5 5 5 1 7 7 7 0 1 0 1 0 0 0 1 0	10

Problem G. Game Of Risk of Rain

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

In the shooting game `Risk of Rain` the attack with some probability a (that is an integer percent) can be critical.

There is magical item — `Clover` which works in the following way: if the attack is not critical, then additional random check is performed and with same probability the attack become critical.

If the player have k `Clovers` in the inventory, then test if the attack was critical, is performed k additional times.

You are given the percentage of the critical attack b with k `Clovers` in the inventory. Your task is to reconstruct the minimal value of **integer percentage** a.

Input

The first line of the input contains one integer t — the number of the test cases ($1 \le t \le 2020$).

Then t lines follow. Each line represents one test case and contains two integers b and k ($0 \le b \le 100$, $1 \le k \le 20$) — the resulting probability, in percents, and number of `Clovers` in the inventory.

Output

Print t lines, each containing one integer — the answer to the respective test case.

Example

standard input	standard output
2 50 1 99 1	30 90

Problem H. How Many Coins Are Taken?

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

Given a rectangular grid $n \times m$. Let's denote the intersection of i-th row and j-th column as (i, j).

Initially Alice puts on the each cell contains exactly one coin.

But then arrives Bob and did k actions of two types:

- "`+ s`" — take all coins placed on the cells (i, j) such as $i + j = s$ $(2 \le s \le n + m)$;
- "`- d`" — take all coins placed on the cells (i, j) such as $i - j = d$ $(1 - m \le d \le n - 1)$;

Your task is to count number of the coins taken by Bob.

Input

The first line of the input contains two integers n and m — the dimensions of the board $(1 \le n, m \le 10^9)$.

The second line contains one integer k $(0 \le k \le 300\,000)$ — the number of Bob's actions.

Each of the following k lines contains one action in the format described in the statement. The actions are listed in the same order as they are performed.

Output

Print one integer — the number of the coins taken by Bob.

Example

standard input	standard output
4 4 3 + 3 + 6 - 0	8

Problem I. Integers And Bitcount

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

Find two non-negative integers x and y such as $\texttt{bitcount}(x) = a$, $\texttt{bitcount}(y) = b$ and $\texttt{bitcount}(x + y) = c$.

Here $\texttt{bitcount}(x)$ is number of ones in the binary representation of the integer x.

Input

The first line of the input contains three integers a, b and c ($0 \le a, b, c \le 10^5$).

Output

If it is impossible to find those integers, print "`No`".

Otherwise print "`Yes`" at the first line, in the second line print the binary representation of the integer x, in the third line — the binary representation of the integer y. The length of each integer should not be greater than 10^6.

Examples

standard input	standard output
1 1 1	Yes 1 1
1 2 3	Yes 10 101
1 1 10	No

Problem J. Jumping Subsequences

Input file:	`standard input`
Output file:	`standard output`
Time limit:	3 seconds
Memory limit:	512 megabytes

Task about the queries on the segment, task about the subsequence, task about the queries on the segment, task about the subsequence, another task about the queries on...

How interesting... And what will be those two ideas are merged in the one task...

Given string S consisting of lowercase English letters. Additionally you are given the queries; each query is the segment l_i, r_i. To answer the query, you shall determine the length of the maximal *jumping* subsequence of the substring $S[l..r]$.

We will call the sequence *jumping*, if it have the form "`xyxyx...`" for some two **distinct** letters x and y.

Additionally, you shall print those two letters that are forming the maximal jumping subsequence. If there are more than one solutions, print one where the first character is lexicographically minimal, if there is still a tie, print one where the second character is minimal.

Input

The first line of the input contains one string S ($1 \le |S| \le 1\,500\,000$) consisting of lowercase English letters.

The second line contains one integer m — the number of queries ($1 \le m \le 100\,000$).

Each of the following m lines contains two integers l_i and r_i — the start and the finish of the substring from the i-th query ($1 \le l_i \le r_i \le |S|$).

Output

For each query, print the answer in the separate line: first the length of the maximal jumping subsequence, then the letters that are forming it.

Example

standard input	standard output
abacaba 6 1 7 2 6 1 3 2 3 2 4 4 4	5 ab 3 ac 3 ab 2 ba 2 ac 1 ca

Problem K. Keep Them Equal

Input file:	standard input
Output file:	standard output
Time limit:	3 seconds
Memory limit:	512 megabytes

Given a tree — the connected graph of n vertices and $n-1$ edges.

When the vertex is deleted from the tree, it turns into the several trees.

For each vertex you shall find the second vertex such as if those two vertex will be deleted from the tree, then the size (i.e. the number of vertices) of the maximal of the resulting trees will be minimal as possible.

Input

The first line of the input contains one integer n — the number of the vertices ($2 \le n \le 300\,000$).

Each of the following $n-1$ lines contains two integers a_i and b_i, denoting that those vertices are connected by the edge ($1 \le a_i, b_i \le n$).

Output

For each $1 \le i \le n$ print in the new line the number of the second vertex to be deleted with the vertex i.

If there are more than one solutions, print any of them.

Example

standard input	standard output
10 9 8 7 6 6 5 2 1 3 10 3 7 2 9 4 2 9 3	3 3 2 3 9 9 9 3 7 9

Problem L. Little Sasha and Circles

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

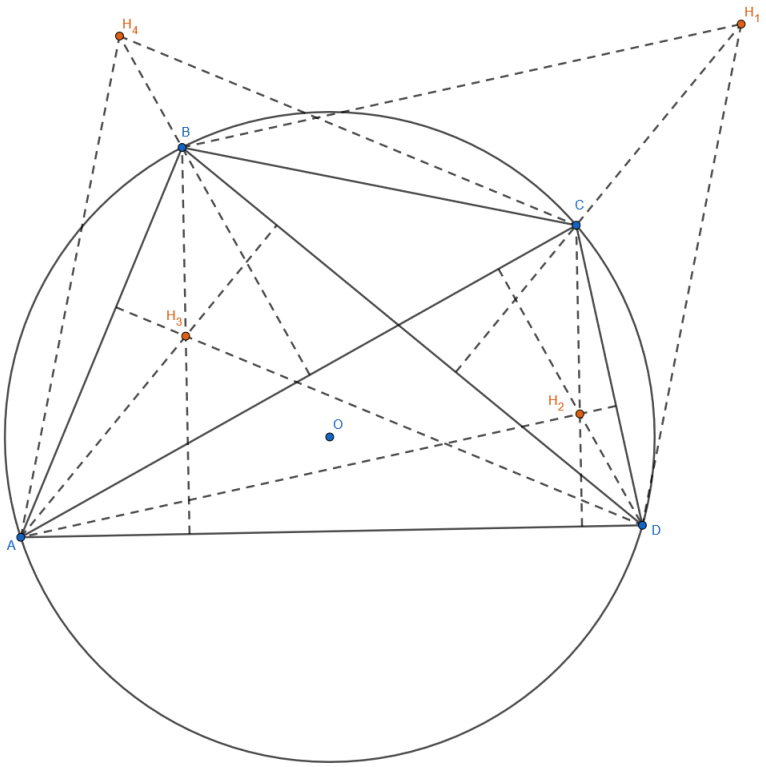
Little Sasha likes geometry, even if he is not so strong in math. He likes to create the interesting geometry drawings.

Yesterday Sasha returned from the school and created the following picture. First, he marked the point O as the center of the coordinate system with axis Ox and Oy, then he drew the circle with the center in O and choose selected points A, B, C and D on that circle.

Then he considered the triangles BCD, ACD, ABD and ABC and marked the intersection point of the heights in those triangles H_1, H_2, H_3 and H_4.

After some time Sasha looked at the drawing and found that all drawing disappeared except for the points H_1, H_2, H_3, H_4 and O.

Help little Sasha to restore the points A, B, C and D or tell that it is impossible.



Its how the drawing may look like

Input

The input consists of the 4 lines. i-th of those lines contains two integers x_i and y_i – the coordinates of the point H_i. Coordinates are not exceeding 10^8 by the absolute value.

Output

If it is possible to uniquely restore the coordinates of the points, print "`YES`", then in each of following four lines print the coordinates of the points A, B, C, D, in that order, otherwise print "`NO`".

The coordinates shall be printed with absolute or relative error 10^{-9} or better.

Examples

standard input	standard output
0 1 1 0 0 -1 -1 0	YES 0.000000000000 -1.000000000000 -1.000000000000 0.000000000000 0.000000000000 1.000000000000 1.000000000000 0.000000000000
0 1 0 2 0 -1 0 -2	NO

Problem M. Modular Recurrent Sequence

Input file:	`standard input`
Output file:	`standard output`
Time limit:	3 seconds
Memory limit:	512 megabytes

Consider the sequence $\{f_i\}$ such as $f_0 = 0$, $f_1 = 1$, and $f_n = (af_{n-1} + bf_{n-2}) \mod p$, where p is prime and $1 \le a, b < p$.

Your task is to answer the queries in the form "check if exists the index i such as $f_i = x$ and $f_{i+1} = y$".

Input

The first line of the input contains three integers p, a, b ($0 < a, b < p \le 10^6$). The second line contains one integer $1 \le q \le 10^6$ – the number of the queries. Each of the following q lines contains one query — two integers x and y ($0 \le x, y < p$).

Output

For each query, if the sequence does not contain the pair (x, y) as the continuous subsequence, print -1. Otherwise print $t_i \ge 1$ — the minimal index of the first number in such pair.

Examples

standard input	standard output
5 1 1 3 0 1 1 1 3 3	20 1 6
5 3 2 3 0 1 1 3 3 1	24 1 2