The International Collegiate Programming Contest
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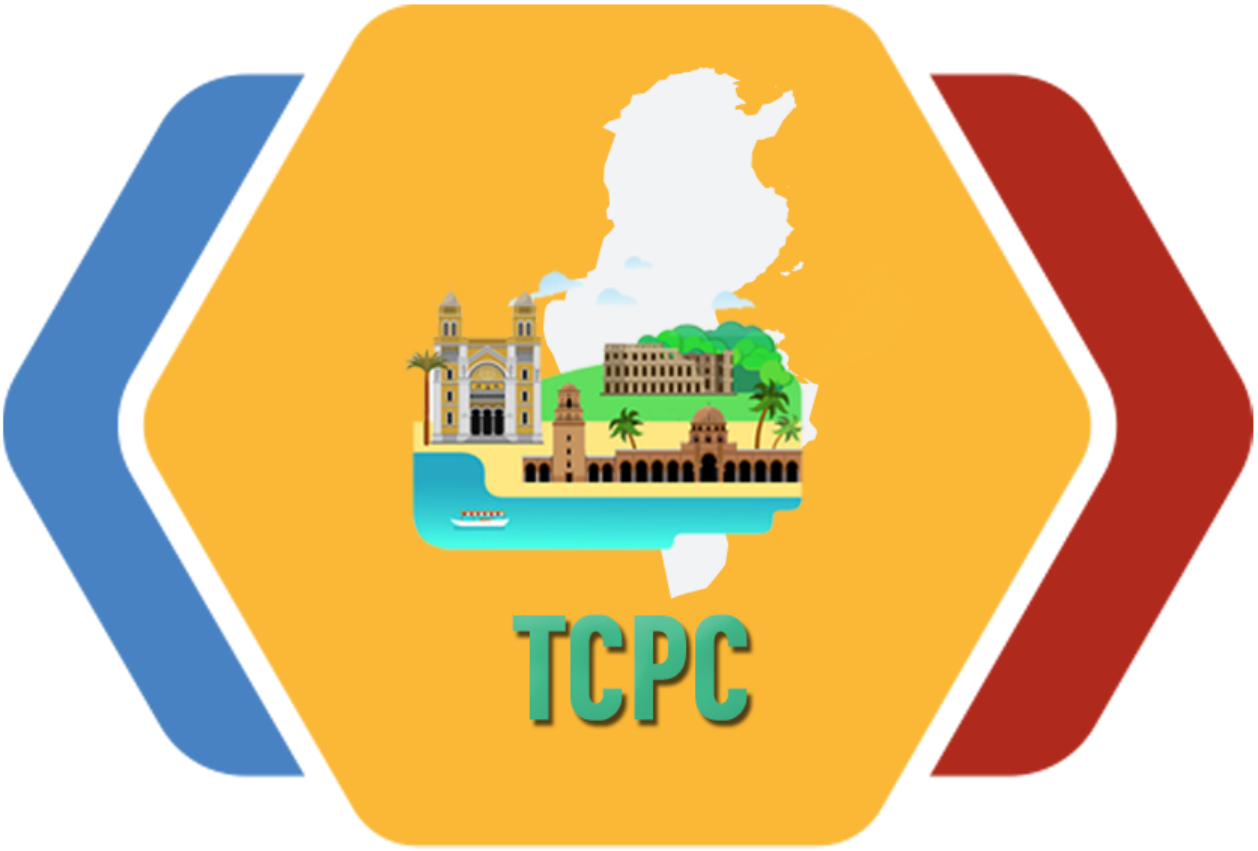


The 2021 Tunisian Collegiate Programming Contest

(Contest Problems)

Tunisia
October 2021

Problem A. Rabbits

Input file:	`rabbits.in`
Output file:	`standard output`
Balloon Color:	`Pink`

We have N female rabbits each of them will give birth to **exactly** K baby rabbits. Print the number of total rabbits.

Input

The input is a single line containing two space separated integers N, K.

$1 \leq N \leq 10^4$

$1 \leq K \leq 10^4$

Output

For each test case print a line with a single integer, the number of rabbits.

Examples

rabbits.in	standard output
1 1	2
2 3	8

Note

In the first case, there are one female rabbit and one baby rabbit.

In the second case, there are two female rabbits and six baby rabbits so the total number is 8.

Problem B. Keep Safe

Input file:	`safe.in`
Output file:	`standard output`
Balloon Color:	`Orange`

Khater was visiting the Greatest Unique Country (*GUC*) to enjoy his vacation. He met the president *Slim* who told *Khater* that there were many thieves in the country. He asked *Khater* to help him to keep the country safe.

The country consists of n cities and m one-way roads connecting between them. He can build as many police stations in the country, But he can build at most one police station in each city.

The country is considered safe if for any city c_i in the country there is at least one police station p_j which the police men can go from p_j to c_i and return back from c_i to p_j.

For building a police station in a city i, *Khater* will gain v_i points if $(0 \leq v_i)$. Otherwise he will lose $|v_i|$ points.

The total score is calculated as the total points he can achieve.

Khater wants you to help him to know the maximum score he can get and the number of ways he can get this score.

The number of ways may be very large so you are asked to output it modulo $10^9 + 7$.

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, m $(2 \leq n \leq 10^5)$ and $(1 \leq m \leq min(n * (n-1), 10^5))$ — denoting the number of cities in the country and the number of one-way roads in the country.

The second input line of each test case contains n integers $(-10^9 \leq v_i \leq 10^9)$ — denoting the points of building a police station in city c_i.

The next m lines contains two integers x, y $(1 \leq x, y \leq n)$ — denoting that there is a one-way road from city c_x to city c_y.

Output

For each test case, print two integers s, k — the maximum score he can achieve and the number of ways he can get this score modulo $10^9 + 7$.

Example

safe.in	standard output
2 5 5 1 2 3 -4 -5 1 2 2 3 3 4 4 1 4 5 5 5 1 2 0 -4 0 1 2 2 3 3 4 4 1 4 5	1 1 3 2

Problem C. Adhm not Adham

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

~~***Adham***~~ ***Adhm*** writes his name like this ***"Adhm"*** while others write it like this ***"Adham"***, which way is correct is a statement for another problem, But the statement for this problem is talking about one of Adhm's friends called ~~***Medhat***~~ ***Methat***, Methat writes his name like this ***"Medhat"*** but Adhm always annoys him and write it like this ***"Methat"***, So he annoys Adhm back and writes his name like this ***"Adham"***, So to put an end for this annoyment they decide to play a game and whoever wins will decide what each one of them should be called.

The game starts by Adhm creating an array of non-negative Integers of size **N** and its sum is **S**, then Methat tries to find a continuous subarray with sum divisible by **X** ***(The subarray can't be the whole array and can't be empty)***, If Adhm can create an array such that Methat can't find any such subarray then Adhm wins else Methat will win. Determine if Adhm can win.

Input

The first line contains t ($1 \leq t \leq 5 * 10^5$) the number of test cases The following t lines contain 3 Integers N, S, X ($2 \leq N, S, X \leq 10^6$), The size of the array, the sum of the array, and the divisor of the subarray that Methat must find.

Output

Output ***"Adhm"*** if Adhm can win or ***"Methat"*** otherwise.

Example

adhm.in	standard output
2 4 6 6 4 3 3	Adhm Methat

Note

Notice that *0* is divisible by all positive integers

Problem D. Min Min

Input file:	`min.in`
Output file:	`standard output`
Balloon Color:	`Light Green`

Adhm wanted to study Artificial Intelligence but it was so hard for him because he is so lazy and he prefers Competitive programming more, And one day he knew about an algorithm in AI called the Min-Max algorithm, So he was inspired and made his own algorithm in Competitive programming and called it the Min-Min algorithm.

The Min-Min algorithm takes an array of integers of size N from A_1 to A_N and rearranges the array in a way that **minimizes the minimum** between

1- The sum of the absolute difference between the odd positions.($|A_1\text{-}A_3|+|A_3\text{-}A_5|$....)

2- The sum of the absolute difference between the even positions.($|A_2\text{-}A_4|+|A_4\text{-}A_6|$....)

Adhm Wanted to test his algorithm, So you were given this task, Given an array of integers find the minimum value that *Adhm*'s algorithm will get.

Input

The first line will have N ($4 \leq N \leq 10^5$) the size of the array The next line will contain N integers the elements of the array ($0 \leq A_i \leq 10^9$)

Output

The output is one integer representing the minimum value you can get

Examples

min.in	standard output
4 1 5 3 2	1
9 19 4 14 1 11 13 17 3 12	3

Problem E. XOR = SUM

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

Given 2 binary strings (strings that consist only of 0s and 1s) of length N that represent the numerical representation of numbers A and B in base 2, find out if it is possible to make the following equation true by performing **at most 1 swap** of two bits of A: A_i and A_j $(1 \leq i, j \leq N)$:

$$A + B = A \oplus B$$

Input

The first line contains one integer T that represents the number of test cases and is followed by $3T$ lines

- 1^{st} line of each test case contains 1 integer N $(1 \leq N \leq 10^6)$
- 2^{nd} line of each test case contains a binary string representing the number A
- 3^{rd} line of each test case contains a binary string representing the number B

It is guaranteed that the sum of N over all test cases does not exceed 10^6

Output

For each test case print on a seperate line: "YES"if it is possible to make $A + B = A \oplus B$, otherwise print "NO"

Example

xorsum.in	standard output
3 6 101010 010101 3 100 100 8 10011011 10010100	YES YES NO

Note

($\oplus$ is the bitwise-XOR operator)

In the first test case the equation is already true.

In the second test case we can swap the first bit of A with the last bit of A in order to make the equation true.

In the last test case there isn't any possible way to make the equation true using at most 1 swap.

Problem F. Xor Count

Input file:	`hypo.in`
Output file:	`standard output`
Balloon Color:	`Blue`

One day Hosssam received a small machine for his 21st birthday. The machine asks the user to enter an input which consists of any amount of integers and then the machine asks the user to select a range of integers. Once the machine runs , it shows on its screen an output which is a single integer.

Hosssam tried to figure out what is the relation between the input and the output of the machine and he came up with the following hypothesis:

Once the machine is given an input of K integers, and the selected range is L, R ,for each integer X that is inside the selected range (L, R) **(Inclusive)** , the machine will count it's occurrence in the input (The K integers), then it will store those occurrences somewhere in it's memory, and finally it will output the XOR of those occurrences.

For example if the machine was given **(1,1,3,3,3,1,1,2,7,7)** as an input, and the selected range was $[1, 4]$ it will first calculate the occurrences of 1 which is 4, then the occurrences of 2 which is 1, then the occurrences of 3 which is 3 and lastly the occurrences of 4 which is 0.

so the output should be $4 \oplus 1 \oplus 3 \oplus 0$ which is equal to 6.

Hosssam wanted to make sure that his hypothesis is correct, so he will be testing it on Q subarrays of an array of size N.

For each test he wrote down 4 integers i , j , X and Y which means that the subarray $a_i, a_{i+1}, a_{i+2}, \ldots, a_j$ will be given to the machine as an input and the selected range will be (X, Y)

Since Hosssam is lazy he asked you to help him compute the answer for the Q queries so that he can test his hypothesis later.

Input

The first line contains two integers N and Q $(1 \leq N \leq 10^5)$ $(1 \leq Q \leq 10^5)$

The second line contains N integers $a_1, a_2, \ldots, a_n$ $(1 \leq a_i \leq 10^6)$.

the next Q lines contain four integers i , j , X and Y $(1 \leq i \leq j \leq N)$ $(1 \leq X \leq Y \leq 10^6)$ the start and the end of the subarray that will be given to the machine and the selected range which will also be given to the machine.

Output

For each query print the answer in a new line.

Example

hypo.in	standard output
10 3 10 9 4 6 2 6 4 10 7 10 6 10 10 10 3 10 6 7 1 10 1 10	2 3 2

Note

($\oplus$ is the bitwise-XOR operator)

In the first query the selected subarray is **6,4,10,7,10** and the selected range is $[10, 10]$, the occurrences of 10 are 2 , so the answer is 2.

In the second query the selected subarray is **4,6,2,6,4,10,7,10** and the selected range is $[6, 7]$,the occurrences of 6 are 2 and the occurrences of 7 are 1 so the answer is $2 \oplus 1$ which is 3.

In the third query the selected subarray is the whole array and the selected range is $[1, 10]$, the occurrences of 2 are 1 ,the occurrences of 4 are 2, the occurrences of 6 are 2, the occurrences of 7 are 1, the occurrences of 9 are 1 , the occurrences of 10 are 3 and the rest of the occurrences are all 0. so the answer is $1 \oplus 2 \oplus 2 \oplus 1 \oplus 1 \oplus 3 \oplus 0 \oplus 0 \oplus 0 \oplus 0$ which is 2.

Problem G. Hamza, Musa and You

Input file:	`circles.in`
Output file:	`standard output`
Balloon Color:	`Violet`

Musa was solving a coding problem yesterday.

While he was reading the problem's statement, he found this sentence "*Hamza* couldn't solve this problem, so he is asking you to solve it.". But *Musa* doesn't like it when a problem asks him to solve for another person! So, he is asking you to solve it.

Given three points on an infinitely large playground, is it possible to construct a circular running track of any area that would be passing through all three of them?

Input

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

The first input line of each test case contains 6 integers $x1$, $y1$, $x2$, $y2$, $x3$ and $y3$ ($-10^4 \leq x1, y1, x2, y2, x3, y3 \leq 10^4$) — the coordinates of the three points

Output

For each test case, print "Possible"(without the quotes) if it is possible to construct a circular running track of any area that would be passing through the three points. Otherwise, print "Impossible".

Example

circles.in	standard output
2 1 2 3 4 5 6 1 2 3 3 5 7	Impossible Possible

Problem H. Time Tree

Input file:	`time.in`
Output file:	`standard output`
Balloon Color:	`Navy`

You are given a rooted tree at 1 with N nodes where each node, i has 3 integers, a_i b_i c_i. Each node starts unmarked. The $i-th$ node will be marked as follow:

- if i is leaf then it will be marked at a_i
- otherwise $min(a_i, v_i + c_i)$ where v_i is the time when at least b_i percent of The subtree of the ith node are marked (excluding i).

Answer Q queries how many nodes are marked before or at time x

There are T 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 second line has the N space separated integers of a. The third line has the N space separated integers of b. The fourth line has the N space separated integers of c. 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 one integer x.

$0 < N, Q \leq 10^5$

$0 < b_i \leq 100$

$0 \leq a_i, c_i, x \leq 10^9$

$0 < u, v \leq N$

$0 < T \leq 10^4$

It is guaranteed over all the cases that the sum of $N \leq 10^5$ and the sum of $Q \leq 10^5$.

Output

For each query output an integer, the amount of nodes marked before or at time x.

Example

time.in	standard output
2 5 50 40 30 20 10 99 60 99 99 99 50 5 50 50 50 1 2 2 3 2 4 4 5 4 35 30 25 20 4 43 13 21 8 24 15 19 16 10 1 6 26 2 1 3 1 4 3 5 12 13 14 20 42	4 4 3 2 1 2 3 4 4

Note

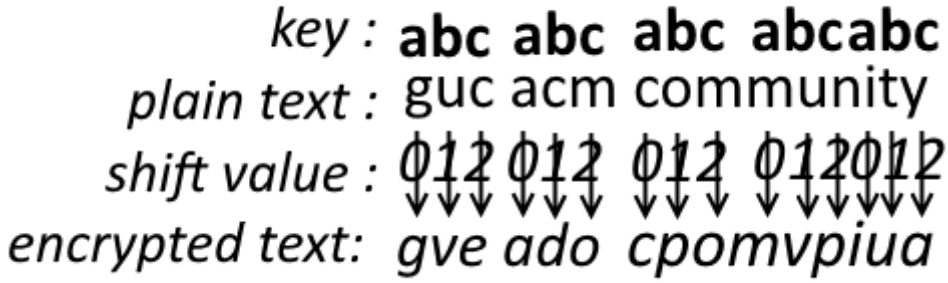
The tree is rooted at node 1.

Problem I. V. Cipher

Input file:	`cipher.in`
Output file:	`standard output`
Balloon Color:	`White`

Since childhood, Omar and Raafat were fascinated with cryptography and its ability to protect data from unauthorized access. While surfing the web, they stumbled upon a recent internet mystery that has gone viral. They got thrilled since it's now there time to indulge themselves into one of their favorite hobbies; solving puzzles! The puzzle is to decrypt a text by supplying the website with the correct key. Luckily, the website contains an example of plain text, its encrypted form and the key used in encryption.

Your task is to help Omar and Raafat extract the key used to encrypt the example so that they can decrypt the other text. The idea that came to their mind is that the algorithm applied may have been the "Vigenère Cipher". Vigenères' cipher uses a string of letters as a key for encryption and decryption. each letter of the key is used to shift the letters of the plain text by a certain value. For each letter in the alphabet, the corresponding shift value is equal to the index of the letter of the alphabet starting from 0. For example, the character 'a' shifts by value 0, character 'b' shifts by value '1', character 'z' shifts by value 25 and so on... the key is applied consecutively on the plain text to encrypt it. For example, for the key "abc" and the plain text "guc acm community" here is how it is applied:



If the shift value exceeds the alphabet we wrap around and continue from the beginning of the alphabet. Spaces are ignored and are not encrypted.

Omar and Raafat noticed that the input box has a character limit which means that they have to find a correct key for decryption with the smallest possible length.

It is guaranteed that both the encrypted and (decrypted/plain text) only contain spaces and latin lowercase letters (a - z), and that it is a valid encryption.

Input

The first line contains the encrypted text with length L ($1 \leq L \leq 10^3$).

The second line contains the decrypted text (the original text before encryption).

Output

Output the encryption key that has the minimum length.

Examples

cipher.in	standard output
plain text plain text	a
aero ninut one zero minus one	baaa
sdst ld test me	zzaa

Problem J. Artwork

Input file:	artwork.in
Output file:	standard output
Balloon Color:	Silver

Khair is a promising artist. One day, he received an order where he was tasked to create a drawing B. Since he was not a hard-working student, he only learned at college how to draw a certain drawing A.

A drawing is represented as 2D array of size $N * N$. Each cell is either painted (1), or not (0).

Khair starts with a plain paper of the same size and tries to paint B using the following operations:

1. Paint A on the paper. More formally, for each cell(i, j) that is painted in A, paint cell(i, j) in the paper.
2. Rotate the paper 90 degrees (clockwise or anti-clockwise).

Khair can use any operation any number of times (*possibly* 0) and in any order.

Can *Khair* fulfill the order and draw B using these operations?

Input

The first line contains T ($1 \leq T \leq 10^3$), the number of test cases.

The first line of each test case contains the integer N ($1 \leq N \leq 10^3$)

The next N lines represent drawing A. Each line contains N integers.

The next N lines represent drawing B. Each line contains N integers.

Each integer is either 1 (painted) or 0 (not painted).

The sum of N over all test cases is $\leq 10^3$

Output

Print **"YES"** if *Khair* can draw B, or **"NO"** otherwise.

Example

artwork.in	standard output
2 2 1 1 0 0 1 1 0 1 3 0 1 0 0 1 0 0 0 0 0 0 0 1 0 1 0 1 0	YES NO

Note

Note that if the cell is currently painted, and we paint it again, it will stay the same (More formally if the current cell in the paper is 1 and the corresponding cell in A is 1 , the cell stays 1 after we paint it with A).

In the first test case, the plain paper at the start is empty. First we draw A at the paper, Then we rotate the paper 90 degrees clockwise, Then we draw A again at the paper. now the paper is identical to B.

In the second test case there is no possible way to start with a plain paper and get B using any sequence of painting and rotating operations.

Problem K. Beautiful Pair

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

You are given a **huge positive integer** A. It is guaranteed that this number has no leading ZEROS.

You can perform two types of operations using some given key value K (a positive integer):

1. You can add any multiple of K to A. $(A = (A + K * X), where X = 0, 1, 2, 3, 4, 5. . . . .)$
2. You can subtract any multiple of K from A. $(A = (A - K * X), where X = 0, 1, 2, 3, 4, 5. . . . .)$

Your friend Abdelrahman believes that the pair (A, K) is beautiful if you can make A become $ZERO$ through performing the previous operations only.

Find out if a given Pair (A, K) is beautiful pair or not.

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 huge Integer A $(1 \leq |A| \leq 10^5)$ where $|A|$ is the length of the integer A.

The second line contains an integer K $(1 \leq K \leq 10^9)$ denoting the key value.

Output

For each test case, print "YES"(without the quotes) if the pair (A, K) is beautiful. Otherwise, print "NO".

Example

pair.in	standard output
3 12 3 12 4 12 5	YES YES NO

Problem L. Packing

Input file:	pack.in
Output file:	standard output
Balloon Color:	Dark Green

Nour *is preparing for the invasion but he needs your help to pack the rocks onto the submarines. There are N rocks and you should check whether they can fit into the given configuration of boxes.*

Formally, given an array A of N integers. Answer Q queries where you are given x, x_cnt, y and y_cnt. You have x_cnt boxes of size x and y_cnt boxes of size y. Can you contain A in these boxes?

The items are contained if when you put x_cnt boxes of size x before y_cnt boxes of size y you can distribute the items of A so that the following conditions are met:

1. Each item of A is assigned to one box.

2. The sum of all items assigned to a box doesn't exceed that box's size.

3. The relative order of the items in A is maintained when placed in the boxes.

There are T 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 second line has the N space seperated integers of A. The third line has the integer Q. Then Q lines follow, where each line has x, x_cnt, y and y_cnt separated by spaces.

$0 < Q, A_i, x, y, \sum_{i=1}^{N} A_i \leq 10^6$

$0 < N \leq 10^5$

$0 \leq x\_cnt, y\_cnt \leq N$

It is guaranteed over all the cases that the sum of $N \leq 10^5$, the sum of $Q \leq 10^6$ and the sum of $\sum_{i=1}^{N} A_i \leq 10^6$

Output

For each query output 'Yes' or 'No' on a new line.

Example

pack.in	standard output
2 6 3 2 4 5 2 7 2 5 2 7 2 7 2 5 2 6 3 1 3 5 6 8 4 3 3 8 3 4 3 8 3 7 1 11 2 7 1 11 1	Yes No Yes Yes Yes No

Note

In the first query of the first testcase we have 2 boxes of size 5 and 2 boxes of size 7, in other words we have the following boxes sizes 5, 5, 7, and 7 , we can place the first two rocks in the first box, the third rock in the second box, the fourth and fifth rocks in the third box and the last rock in the last box. So the sum of the rocks in each box are 5, 4, 5 and 7 respectively.

In the second query of the first testcase, there isn't any valid way of assigning the rocks into the boxes which satisfy the conditions.