

## Problem A. Almost A+B?

Input file:            standard input  
Output file:           standard output  
Time limit:           1 second  
Memory limit:         1024 megabytes

We will call a prime number *anisotropic* if the sum of all its divisors is not divisible by the number of these divisors.

Given an integer  $n$ , find the anisotropic prime number closest to it.

### Input

The input contains one integer  $n$  ( $1 \leq n \leq 10^9$ ).

### Output

Print one integer — the anisotropic prime number closest to the given one. If there are several such numbers, print the largest one.

### Example

standard input	standard output
2	2

## Problem B. Banners Before QC

Input file: *standard input*  
Output file: *standard output*  
Time limit: 1 second  
Memory limit: 1024 mebibytes

Two stage coordinators, Mira and Leo, are preparing the opening ceremony of a city festival. They still have some jobs to finish, and the guests will arrive very soon! Fortunately, the plan is already fixed, the jobs are split between Mira and Leo, and the time needed for each job is known. The only thing left is to decide in which order they will do their own jobs. Neither coordinator likes handling several jobs at the same time, so each of them will choose an order for their jobs and then complete them one by one in that order.

There is one important rule. Some jobs are “decoration jobs”, and some jobs are “technical-check jobs”. A decoration job prepares some part of the venue, while a technical-check job verifies that the already prepared parts work as intended. For safety reasons, every decoration job, even one assigned to the other coordinator, has to be completed strictly before any technical-check job is completed. Note that a coordinator may start a technical-check job before all decoration jobs are completed: they can check the parts that are already ready, but the check cannot be fully completed before the whole venue is decorated.

You are the chief coordinator of the ceremony, and your goal is to make sure that Mira and Leo do not waste any time. This means that immediately after one of them completes some job, they have to start doing some other job assigned to them (unless they have already completed all their jobs, of course). Moreover, both coordinators have to start working immediately and simultaneously. Each coordinator is free to choose any order of the jobs assigned to them, but the rule about decoration and technical-check jobs must be satisfied.

You wonder how many correct ways for the coordinators to order their own jobs there are in total. As this number might be very large, calculate it modulo 998 244 353. Two ways are considered different if and only if there are two jobs assigned to one coordinator such that in the first order the first job is completed before the second job and in the second order the second job is completed before the first one.

### Input

The first line contains two integers  $n$  and  $m$  ( $1 \leq n, m \leq 10^5$ ) — the number of jobs assigned to Mira and Leo, respectively.

The next  $n$  lines contain the description of Mira’s jobs. Each line contains an integer  $t_i$  ( $1 \leq t_i \leq 10^9$ ), and a letter  $c_i$  ( $c_i \in \{\text{D}, \text{T}\}$ ). The integer is the time to complete this job, and the letter is “D” if this job is a decoration job and “T” if this job is a technical-check job.

The final  $m$  lines contain the description of Leo’s jobs in the same format.

### Output

Print one integer — the number of correct ways taken modulo 998 244 353.

## Examples

<i>standard input</i>	<i>standard output</i>
2 2 8 T 100 T 3 D 5 D	2
2 1 10 D 3 T 1 D	1

## Problem C. Choosing Best Friend

Input file: *standard input*  
Output file: *standard output*  
Time limit: 1 second  
Memory limit: 1024 mebibytes

There are  $n$  people. Each two people among them are either friends or not. Friendship is bidirectional. Each person wants to select best friends — some non-empty subset of their friends. The only condition they want to satisfy is that all sets of best friends among  $n$  people must be unique. Note that the “being the best friends” property may not be bidirectional (i.e., it is possible that X is best friend for Y, but Y is not the best friend for X).

You are given all friendships. Find any possible selection of sets of best friends such that the total size of sets of best friends is minimum possible. Or you should state that it is impossible to find such a selection.

### Input

The first line contains a single integer  $t$  ( $1 \leq t \leq 10^4$ ) — the number of testcases. Next lines contain descriptions of testcases.

The first line of each testcase contains a single integer  $n$  ( $2 \leq n \leq 500$ ) — the number of people.

Then  $n - 1$  lines follow, the  $i$ -th line contains a string of length  $n - i$  consisting of characters 0 and 1. For each  $j$  ( $i < j \leq n$ ), the  $(j - i)$ -th character of this string is 1 if  $i$  and  $j$  are friends, and 0 otherwise.

It is guaranteed that the sum of  $n^2$  does not exceed  $2.5 \cdot 10^5$ .

### Output

Print answers to testcases in the given order.

If it is impossible to select sets of best friends to satisfy the conditions, print a single integer  $-1$ .

Otherwise, print  $n$  lines. The  $i$ -th line should start with  $s_i$  ( $s_i \geq 1$ ) — the number of selected best friends for the  $i$ -th person. Then  $s_i$  different integers  $a_{i,1}, \dots, a_{i,s_i}$  ( $1 \leq a_{i,j} \leq n$ ,  $a_{i,j} \neq i$ ) in the line should follow — best friends of the  $i$ -th person. For each  $j$  ( $1 \leq j \leq s_i$ ) people  $i$  and  $a_{i,j}$  should be friends.

All sets  $\{a_{i,1}, \dots, a_{i,s_i}\}$  should be different. The sum  $\sum_{i=1}^n s_i$  should be minimum possible.

If there are multiple possible answers, you should print any.

### Example

<i>standard input</i>	<i>standard output</i>
2	1 2
5	1 1
1000	1 4
011	1 3
10	2 2 4
1	-1
3	
11	
0	

## Problem D. Deletion-Proof Badge

Input file: *standard input*  
Output file: *standard output*  
Time limit: 1 second  
Memory limit: 1024 mebibytes

The security office of the city festival prints a positive integer on every access badge. Before a badge is approved, an inspector may erase zero or more digits from its decimal representation, keep the remaining digits in their original order, and read the result as a decimal integer. At least one digit must remain. If the inspector can obtain a prime number this way, the badge code is considered suspicious.

Call a positive integer *prime-proof* if it is not prime itself and no prime number can be obtained from its decimal representation by erasing digits. For example, 104 is prime-proof because neither 0, 1, 4, 10, 14, nor 104 are primes, but 2024 is not prime-proof because we can erase the first, second, and fourth digits and obtain the prime number 2.

Note that the prime numbers are the integers that have exactly two distinct divisors: themselves and one.

Given an integer  $n$ , count the number of prime-proof codes with exactly  $n$  decimal digits (without leading zeroes) modulo 998 244 353.

### Input

Input contains one integer  $n$  ( $1 \leq n \leq 10^6$ ).

### Output

Print one integer — the number of  $n$ -digit prime-proof codes modulo 998 244 353.

### Example

<i>standard input</i>	<i>standard output</i>
1	5

### Note

The one-digit prime-proof codes, mentioned in the sample, are 1,4,6,8, and 9.

## Problem E. Exactly One Of...

Input file:            **standard input**  
Output file:           **standard output**  
Time limit:            1 second  
Memory limit:         1024 megabytes

You are given the decimal representation of a positive integer  $n$  without leading zeros.

You need to increase or decrease exactly one digit by 1 so that the number becomes divisible by 7 (and still has no leading zeros). In how many ways can this be done?

### Input

The input contains a single integer  $n$  ( $1 \leq n < 10^{10^5}$ ), written without leading zeros.

### Output

Output a single integer — the number of ways to increase or decrease exactly one digit by 1 so that the number is divisible by 7.

### Examples

standard input	standard output
17	0
1002	2

## Problem F. Fix The Bad Ping

Input file: *standard input*  
Output file: *standard output*  
Time limit: 1 second  
Memory limit: 1024 mebibytes

*This is an interactive problem.*

Alber Blanc is a proprietary trading firm that provides liquidity for many exchanges with a particular focus on emerging markets. They also provide professional services as a derivatives market maker on different exchanges.

As a developer at Alber Blanc, you have been tasked with optimizing the connections between exchange servers and fund servers. There are a total of  $10^9$  exchange servers and  $10^9$  fund servers, and each exchange server is directly connected to every fund server, resulting in  $10^{18}$  connections. Testers have noted that two connections are performing slower than expected. Typically, the latency between servers is 1ms; however, in two cases, the latency is 2ms. To resolve the issue, testers need your help to identify which connections are slow.

To find the slow connections, you can measure the total latency of certain connections. Specifically, you can select  $e_\ell$ ,  $e_r$ ,  $f_\ell$ , and  $f_r$ , run tests with these parameters, and determine the total latency of all connections between exchange servers numbered  $e_\ell \leq i \leq e_r$  and fund servers numbered  $f_\ell \leq j \leq f_r$ .

The testers urgently request information about the slow connections, so you may measure the total latency no more than 125 times.

### Interaction Protocol

The interaction begins with your program making queries. Each query is the line in the format “?  $e_\ell f_\ell e_r f_r$ ” (without quotes), where  $1 \leq e_\ell \leq e_r \leq 10^9$ ,  $1 \leq f_\ell \leq f_r \leq 10^9$ , to represent the parameters of the test. In response, the jury program outputs a single integer — the total latency of selected connections. You may make no more than 125 queries in total.

To output your answer, print the line “!  $e_1 f_1 e_2 f_2$ ” (without quotes), where  $e_1$  and  $f_1$  are the server numbers that make up the first slow connection, and  $e_2$ ,  $f_2$  are the server numbers of the second slow connection. Connections can be output in any order. Note that outputting the answer does not count as a query.

It is guaranteed that slow connections do not change during the interaction (i.e., the interactor is not adaptive). Remember to print the newline and flush the output buffer after each query and after the answer, or your solution will get IL (Idleness Limit Exceeded).

### Example

<i>standard input</i>	<i>standard output</i>
1	? 1 1 1 1
2	? 2 2 2 2
9	? 3 4 5 6
10	? 4 4 6 6
4	? 6 4 6 6
2	? 6 5 6 6
	! 2 2 6 4

## Problem G. Good Coach

Input file: *standard input*  
Output file: *standard output*  
Time limit: 1 second  
Memory limit: 1024 mebibytes

On one of the planets in a far, far away galaxy, a numeral system with base  $b$  is used. In one of the major cities on this planet, there is a developed network of buses. The routes of the buses are numbered with positive integers.

One day, the Intergalaxy Collegiate Programming Contest (ICPC) Finals was held in this city. The coach of the team from Earth noticed an interesting fact: at the stop near the contest venue, there are  $x$  bus route numbers written on the banner, and each of the  $b$  digits appears on this banner exactly once.

The coach found that this fact is funny and asked his team to check for given  $x$  and  $b$  whether such a situation is possible, and if it is, output the  $b$ -ary representation of the minimum possible value of the largest number to be written on the banner in this case.

### Input

The first line contains one integer  $x$  — the number of bus routes whose numbers are displayed on the banner ( $1 \leq x \leq 100$ ). The second line contains one integer  $b$  ( $2 \leq b \leq 100$ ) — the base of the numeral system.

### Output

If the situation is impossible, output  $-1$ . Otherwise, output the  $b$ -ary representation of the minimum possible value of the largest bus route number displayed on the banner, as a sequence of integers representing the corresponding digits in decimal notation, ordered from the most significant  $b$ -ary digit to the least significant. For example, the number  $CD3_{16}$  should be output as “12 13 3”.

### Examples

<i>standard input</i>	<i>standard output</i>
10 10	-1
9 10	1 0

### Note

In the first example, it is impossible to form 10 positive numbers from the 10 digits of the decimal system in the required way, as 0 is not a positive number. In the second example, the list of routes will be 10, 2, 3, 4, 5, 6, 7, 8, 9.

## Problem H. Hi!

Input file:            **standard input**  
Output file:           **standard output**  
Time limit:            1 second  
Memory limit:         1024 megabytes

In the messenger “Hi!”, when sending a file, the upload progress is displayed with the following animation: the percentage of the upload is represented by a shaded arc of a circle with a radius of 1, centered at the point  $O(0, 0)$ . Specifically, a file uploaded by  $k$  percent corresponds to  $k$  percent of the full circle (that is, when the file is fully uploaded, the entire circle is shaded; for an 80 percent upload, an arc of 288 degrees is shaded; for a 25 percent upload, an arc of 90 degrees is shaded, and so on).

In this task, the position of the point on the circle will be defined by its polar angle — the angle  $a$  in degrees between the direction from the origin to this point and the positive direction of the  $Ox$  axis ( $0 \leq a < 360$ ).

The point  $s$ , from which the arc is measured, starts at the position with a polar angle of 0 at the beginning of the upload and then moves counterclockwise at a constant angular speed of  $v$  degrees per second throughout the upload.

In other words, consider any moment in time  $t$  between the start and completion of the upload, inclusive. At time  $t$ , the start of the arc is at the current position of point  $s$ , the arc itself has an angular size defined by the current upload percentage, and it is measured from point  $s$  counterclockwise. Only the arc itself (including both of its ends) is shaded at this moment, while other points at time  $t$  are not shaded, even if they were shaded in previous moments.

You are given the time  $d$  in seconds for which the file will be uploaded and the value of  $v$ . Determine how the diagram will look at the moment the upload percentage reaches  $p$ .

### Input

The first line of input contains three integers  $d$ ,  $v$ , and  $p$  ( $10 \leq d \leq 10^9$ ,  $1 \leq v \leq 359$ ,  $1 \leq p \leq 99$ ) — the number of seconds during which the file is uploaded, the angular speed of point  $s$  in the upload animation in degrees per second, and the upload percentage for which the position of the arc needs to be determined.

### Output

Output two numbers — the position of point  $s$ , from which the arc is measured, and the position of the other end of the arc, with an absolute or relative error no worse than  $10^{-4}$ .

### Example

standard input	standard output
2025 10 12	270.000000 313.200000

## Problem I. Inconvenient Journey: IJ

Input file: *standard input*  
Output file: *standard output*  
Time limit: 3 seconds  
Memory limit: 1024 mebibytes

The Berland transport company (BTC) operates express train lines between  $n$  cities. In total, there are  $m$  bidirectional train lines in the BTC timetable. Each line connects two cities, and it is guaranteed that it is possible to travel between any two cities using the BTC lines with zero or more transfers.

The railway station of each city consists of  $m$  platforms. The platforms are numbered with integers from 1 to  $m$ . The departure and arrival platforms for each train line are predefined, meaning that a line is specified by two pairs “city and the platform id of that city’s station”. Note that some platforms may not be present in the BTC timetable, as there are other transport companies in Berland.

If the arrival train and the departure train during a transfer use different platforms of the same station, then passengers are taken by an internal shuttle bus so that they do not have to leave the transfer area. In the case of a transfer at the same platform, the transfer is made on foot through the platform area.

A well-known travel blogger, Iris, plans to travel on BTC trains from city  $s$  to city  $f$ . Iris dislikes shuttle buses, and since all train rides in this journey are sponsored by BTC, she first wants to minimize the number of inter-platform shuttle trips. Only if there are multiple options with the minimum number of shuttle trips, she plans to minimize the number of train rides.

Given the BTC timetable, as well as the starting and ending cities of the journey, determine the minimum number of times Iris will have to take an internal shuttle bus and the minimum number of train rides she must make to get from the starting city to the destination. In the departure and arrival cities, Iris can choose any platform as she travels by taxi.

### Input

The first line of input contains four integers  $n$ ,  $m$ ,  $s$ , and  $f$  ( $2 \leq n \leq 10^5$ ,  $n-1 \leq m \leq 2 \cdot 10^5$ ,  $1 \leq s, f \leq n$ ,  $s \neq f$ ) — the number of cities and the number of train lines in the ICJ timetable, as well as Iris’s starting and ending cities, respectively.

Each of the following  $m$  lines contains a description of one bidirectional train line and consists of four integers  $a_i$ ,  $ta_i$ ,  $b_i$ ,  $tb_i$  ( $1 \leq a_i, b_i \leq n$ ,  $1 \leq ta_i, tb_i \leq m$ ,  $a_i \neq b_i$ ) — the first city number, platform number of the first city’s station, the second city number and platform number of the second city’s station for that line, respectively.

You may assume that it is possible to travel between any two cities using BTC and that any two cities are directly connected by no more than one BTC train line.

### Output

Print two integers — the minimum number of internal shuttle bus trips Iris will have to take during her journey and the minimum number of train rides that can be made with that number of shuttle trips.

### Example

<i>standard input</i>	<i>standard output</i>
3 3 3 1 1 1 2 1 3 1 2 2 1 2 3 3	0 1

## Problem J. Just One Attempt To Hack

Input file:            **standard input**  
Output file:           **standard output**  
Time limit:            1 second  
Memory limit:         1024 megabytes

*This is an interactive problem*

...In the Galaxy Far Far Away, the Emperor tried to open his safe and realized that he had forgotten the current password. The password was a Fibonacci number not exceeding  $2^{61}$ . As a hint, the sum of the digits of the number was provided. Additionally, there were two buttons on the safe: + and -. The first button would give the sum of the digits of the next Fibonacci number, while the second would give the sum of the digits of the previous Fibonacci number. However, if the previous number does not exist or if the next number exceeds  $2^{61}$ , the contents of the safe would be destroyed. After pressing exactly one of the buttons, there would be one last attempt to recover the original password.

The Emperor realized that he was in a hopeless situation. There was one last chance — Darth Vader surely must have known this password. He had to go to Darth Vader and ask for help. Darth Vader looked at the hint, pressed one of the buttons, and then entered the password. The safe opened.

In fact, Darth Vader did not know the password – he simply recovered it. But will two hints be enough for you?

In this problem, the Fibonacci sequence is constructed as follows:  $f_0 = 1$ ,  $f_1 = 2$ ,  $f_i = f_{i-1} + f_{i-2}$  for  $i \geq 2$ .

### Interaction Protocol

The interaction starts with the jury program outputting a single integer — the sum of the digits in the decimal representation of the hidden Fibonacci number  $f(x)$ . After that, you can output one of two strings — + or -. When you output +, the jury program will return the sum of the digits in the decimal representation of the number  $f(x + 1)$ . If  $f(x + 1) > 2^{61}$ , you will receive a Wrong Answer verdict. When you output -, the jury program will return the sum of the digits in the decimal representation of the number  $f(x - 1)$ . If  $x = 0$ , you will also receive a Wrong Answer verdict. After this, you must output the value of  $f(x)$ .

Do not forget to output a newline character after the commands + and -, as well as after outputting the answer, and also flush the input-output buffer by calling the `flush` function of the programming language you are using.

### Example

standard input	standard output
2	
	+
3	
	2

## Problem K. Keyword and Numeral

Input file: *standard input*  
Output file: *standard output*  
Time limit: 1 second  
Memory limit: 1024 mebibytes

You are given an expression of the form  $a = b + c$ , where  $a$  is a keyword (a non-empty string of digits and lowercase or uppercase English letters, starting with a letter), and  $b$  and  $c$  can be either a keyword or a positive integer numeral in decimal notation (a non-empty string of digits from 0 to 9, starting with a non-zero digit).

You need to place apostrophes in all numerals in the expression, if they are present. The first apostrophe is placed between the third rightmost and fourth rightmost digits (if both digits are present), the second between the sixth rightmost and seventh rightmost (if both digits are present), in general, the  $k$ -th apostrophe is placed between the  $3k$ -th rightmost and  $3k + 1$ -th rightmost digits (if both digits are present).

### Input

The input consists of a single line of the form  $a=b+c$ , where  $a$  is a non-empty string composed of lowercase and uppercase English letters and digits, starting with a letter, and each of  $b$  and  $c$  is either a non-empty string composed of lowercase and uppercase Latin letters and digits, starting with a letter, or a non-empty string of digits starting with a non-zero digit. The length of each of the strings  $a$ ,  $b$ , and  $c$  does not exceed 1000 characters. There are no spaces between the strings and the characters  $+$  and  $=$ .

### Output

Output the expression obtained from the original by inserting apostrophes into the numerals. No other changes (such as inserting spaces) are allowed.

### Examples

<i>standard input</i>	<i>standard output</i>
ledger2026=cityTax+987654321012345	ledger2026=cityTax+987'654'321'012'345
Festival2027=Booth42+Prize314159	Festival2027=Booth42+Prize314159

## Problem L. Long and Random

Input file: *standard input*  
Output file: *standard output*  
Time limit: 4 seconds  
Memory limit: 1024 mebibytes

There is an array  $a$  of length  $n$  consisting of independent uniformly random integers  $a_i$  ( $1 \leq a_i \leq 10^9$ ). Also, there is an array  $b$  of length  $n$  consisting of independent uniformly random integers  $b_i$  ( $0 \leq b_i \leq 1$ ). Laura wants to erase some (possibly zero) elements from array  $a$ , then take the prefix of array  $b$  with the matching length, and maximize the resulting dot product of the arrays (i.e.  $\sum_{i=1}^m a_i \cdot b_i$ ). Help her to do that.

### Input

In the first line, there is one integer  $n$  ( $1 \leq n \leq 4 \cdot 10^5$ )— the length of the arrays  $a$  and  $b$ .

In the second line, there are  $n$  integers  $a_1, \dots, a_n$  ( $1 \leq a_i \leq 10^9$ ) — the elements of the array  $a$ .

In the third line, there are  $n$  integers  $b_1, \dots, b_n$  ( $0 \leq b_i \leq 1$ ) — the elements of the array  $b$ .

It is guaranteed that in all tests, except for the first one (from the examples), all numbers  $a_i$  and  $b_i$  are generated independently from a uniform distribution over the corresponding ranges.

It is guaranteed that there are no more than 20 tests in total.

### Output

Print one number — the maximum possible dot product after erasing some elements from array  $a$ .

### Examples

<i>standard input</i>	<i>standard output</i>
10 4 23 7 18 5 16 2 29 11 13 1 0 1 0 1 0 0 1 0 0	70
4 927461835 184739206 603918572 756204391 1 1 1 0	2287584798

### Note

In the first example, we can erase the first, fifth and sixth elements from  $a$ . The result will be equal to the dot product of the arrays  $[4, 6, 5, 3, 6]$  and  $[1, 0, 1, 0, 1]$  which equals  $4 \cdot 1 + 6 \cdot 0 + 5 \cdot 1 + 3 \cdot 0 + 6 \cdot 1 = 15$ .

## Problem M. Math, Nero and Seneca

Input file:            standard input  
Output file:           standard output  
Time limit:            3 seconds  
Memory limit:         1024 megabytes

Ancient Roman philosopher Seneca was the tutor of the future emperor Nero. Nero once asked him how great a number may be. Seneca answered that there are numbers so large that even the wisest citizens of Rome cannot imagine them; for example, numbers that can be created by multiplying usual Roman numbers greater than 1. To avoid the possible ambiguity, Nero decided that only the integers that have a unique representation in this form are counted.

Now a modern artist decided to create an installation dedicated to Nero and Seneca and wants to use some positive integers not exceeding  $10^{18}$  in it. But he wants to be sure that they can be uniquely represented as a product of one or several numbers greater than 1 in Roman numeral representation (more formally, the representations are counted as one representation if they are identical as the multisets, so the representations  $4 \cdot 2$  and  $2 \cdot 4$  are the same representation).

Any positive integer strictly less than 4000, and only them, has a unique representation in Roman numerals; other rules for writing Roman numerals are well known to all participants, so they will not be provided here for brevity.

### Input

The first line of the input contains one integer  $t$  ( $1 \leq t \leq 2 \cdot 10^5$ ) — the number of the testcases.

Each of the following  $t$  lines describes one testcase and contains one integer  $n$  ( $2 \leq n \leq 10^{18}$ ) that needs to be checked.

### Output

For each request, print 1 on a separate line if the number can be uniquely represented as a product of Roman numerals greater than 1, and 0 otherwise.

### Example

standard input	standard output
4	0
2024	0
2025	0
2026	1
2027	