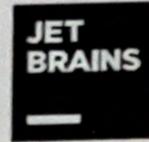


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Official Problem Set



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Problems

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Problem A Even Substrings

Time Limit: 7 seconds

You are given a string $s[1..n]$ consisting of the first 6 lowercase English letters between a and f. A substring is called *even* if every distinct letter in it appears an even number of times. For example, in abbacac there are 4 even substrings: abba, bb, acac, bbacac. If a same substring appears at different locations, they shall be counted multiple times, e.g. the string aaa has 2 even substrings aa.

You are to process q queries of the following two types:

1. Given a range specified by two integers l and r , count the number of even substrings in $s[l..r]$, the substring of s starting at $s[l]$ and ending at $s[r]$ (both ends are inclusive).
2. Given an index i and a letter x between a and f, change $s[i]$ to x .

Input

The first line of input has a single string $s[1..n]$ ($1 \leq n \leq 2 \cdot 10^5$) consisting of letters between a and f. The second line of input has a single integer q ($1 \leq q \leq 2 \cdot 10^5$), the number of queries. Each of the next q lines gives one query:

- Type 1 query has 1 l r ($1 \leq l \leq r \leq n$).
- Type 2 query has 2 i x ($1 \leq i \leq n$), where x is a letter between a and f.

There is at least one query of type 1.

Output

For each type 1 query output the number of even substrings on a single line.

Sample Input 1

```
abbacac
8
1 1 7
2 5 a
1 4 6
1 1 7
2 6 b
1 2 6
1 5 7
1 1 1
```

Sample Output 1

```
4
2
6
4
0
0
```



Image from theconversation.com



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Problem B Tree Number Generator

Time Limit: 13 seconds

One day Young Anna comes up with a whimsical idea of using a tree to create a number generator. The generator is created with a modulus m and an internal tree of n nodes numbered from 1 to n . Each tree node is assigned a single digit between 0 to 9. The generator provides a method $Get(a, b)$ that can be used to produce an integer in $[0, m]$. The two arguments a and b specify two tree nodes. The generator walks the path from a to b in the tree, concatenates all the digits along the path (including the digits of node a and b), and obtains a decimal integer v as a result of such digit concatenation. Note that v can be quite large and may contain leading zeroes. The return value of $Get(a, b)$ is v modulo m .

Given a tree and the value of m to be used by Anna's number generator, calculate the return values of q queries $Get(a, b)$.



Input

The first line of input has three integers n ($2 \leq n \leq 2 \cdot 10^5$), m ($1 \leq m \leq 10^9$), and q ($1 \leq q \leq 2 \cdot 10^5$). The next $n - 1$ lines describe the tree edges. Each line has two integers x, y ($1 \leq x, y \leq n$) listing an edge connecting node x and node y . It is guaranteed that those edges form a tree. The next n lines each have a single digit between 0 to 9. The i th digit is assigned to node i . The next q lines each have two integers a, b ($1 \leq a, b \leq n$) specifying a query $Get(a, b)$.

Output

For each $Get(a, b)$ query output its return value on a single line.

Sample Input 1

```
5 100 4
1 2
1 3
1 4
5 3
1
2
3
0
4
1 5
5 1
4 2
3 3
```

Sample Output 1

```
34
31
12
3
```



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Problem C Subprime

Time Limit: 2 seconds

There is an open math problem: Is every non-negative integer a substring of at least one prime number when expressed in base ten?

A positive integer is a prime number if it is greater than one and not a product of two smaller positive integers. Integer a is a substring of integer b if it is equal to an integer derived from b by deleting zero or more consecutive digits of the most and least significant digits of b . For example, 123 is a substring of: 123, 56123, 123789, 50182312365, 41237912123.

Given two integers l and h along with an integer p , you are to check how many primes between the l th smallest prime and the h th smallest prime (both ends are inclusive) contain a substring that equals p . We are interested in substrings that may include significant leading zeroes, and thus p may have leading zeroes. A prime shall be counted only once even if the integer p occurs more than once as its substring.

For example, consider $l = 1, h = 10$ and $p = 9$. This is a search from the 1st smallest prime (2) to the 10th smallest prime (29) for any prime containing the substring "9". There are 2 such primes: 19 and 29.

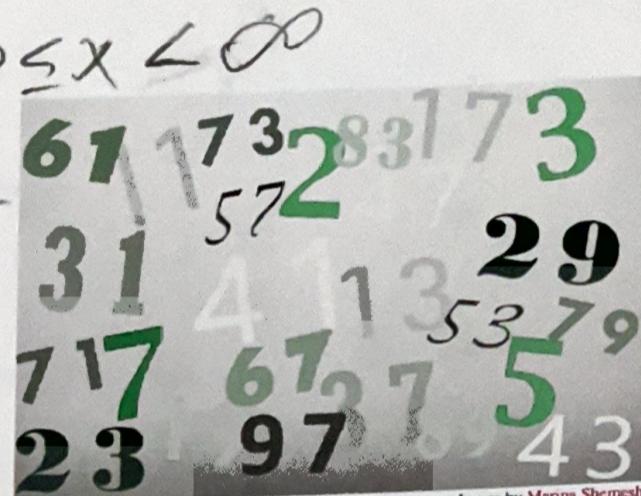


Image by Marina Shemesh

Input

The first line of input has two integers l and h ($1 \leq l \leq h \leq 10^5$). The second line has a sequence of 1 to 6 digits giving the integer p , which may be zero or have significant leading zeroes.

Output

Output the count of prime numbers in the given range that contain p as a substring.

Sample Input 1

1 10	9
------	---

Sample Output 1

2

Sample Input 2

500 1000	43
----------	----

Sample Output 2

26

Sample Input 3

1 1000	00
--------	----

Sample Output 3

10



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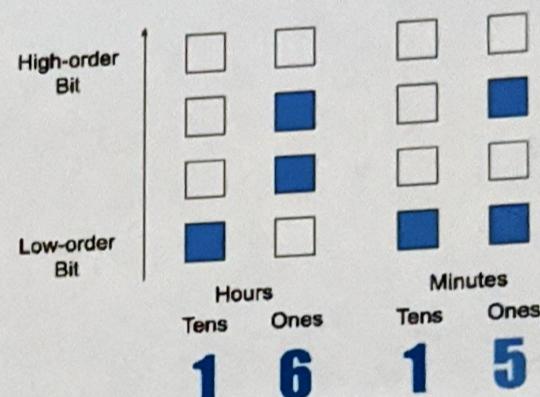
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Problem D Ultimate Binary Watch

Time Limit: 1 second

The Ultimate Binary Watch is a maker project that uses small LEDs to display time on a watch face. The display uses four columns of four LEDs each, with each column representing one digit of the current time in hours and minutes. Time is displayed in 24-hour format, with the 1st (left-most) column displaying the tens position for hours, the 2nd column displaying the ones position for hours, the 3rd column displaying the tens position for minutes, and the last (right-most) column displaying the ones position for minutes. The bottom LED of each column shows the lowest-order bit of its represented digit, with the bit positions increasing moving up the column. For example, the time 1615 would be displayed as shown in the figure.

Write a program that will take a 24-hour time and print the corresponding watch face.



Input

The input has a single line with 4 digits describing a valid 24-hour time between 0000 and 2359.

Output

Output four lines with a representation of the watch face displaying the given time. The tens of hours shall be in the 1st column, the single hours in the 3rd, the tens of minutes in the 7th, and the single minutes in the 9th. Use asterisks to represent bits that are set and periods to represent bits that are clear. Columns not used are to be filled with spaces. No extra whitespace are to appear at the beginning or end of any output line.

Sample Input 1

1615

Sample Output 1

.	.	.	.
.	*	.	*
.	*	.	.
*	.	*	*

Sample Input 2

1900

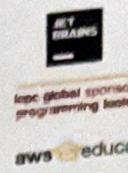
Sample Output 2

.	*	.	.
.	.	.	.
.	.	.	.
*	*	.	.



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Sample Input 3

0830

Sample Output 3

```
.*. .  
. . . .  
. . * .  
. . * .
```



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Problem E Land Equality

Time Limit: 1 second

There is a kingdom where the old King wants to divide his land into two pieces and give them to his two descendants. The King's land is a grid of r rows and c columns. Each cell in the grid has an integer value representing the prosperity of the cell, which can be 0 (deserted), 1 (regular), or 2 (fertile). Two cells are connected if they share a side horizontally or vertically.

Each descendant shall receive a single connected piece of land with at least one cell, in which all cells must be directly connected or indirectly connected via other cells. There shall be no leftover cells, which means that each cell must be given to one descendant. The *prosperity* of a piece of land is the product of all the prosperity values of its cells. The King wants the absolute difference between the prosperity of the two descendants' land to be as small as possible. He has asked his best counselor to devise a land division plan between the two descendants.

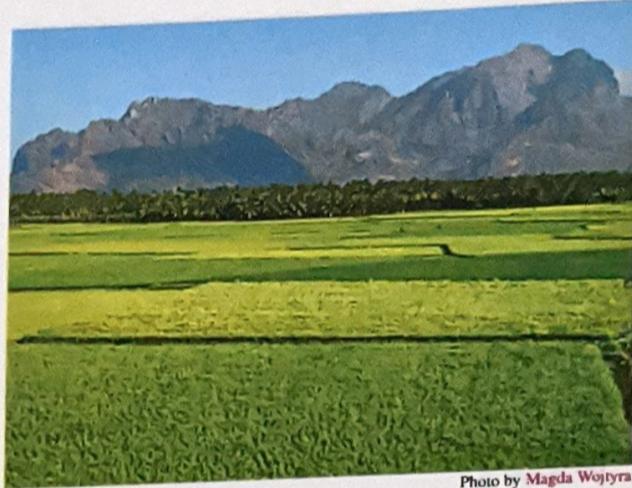


Photo by Magda Wojtyra

Input

The first line of input contains two positive integers r and c ($2 \leq r \times c \leq 64$). The next r lines each have c integers giving the prosperity values of the King's land. All those integers are 0, 1, or 2.

Output

Output the smallest absolute difference between the prosperity of the two descendants' land.

Sample Input 1

3	4		
1	2	1	1
2	2	1	2
1	2	2	2

$$7/2 = 3.5$$
$$3 \cdot 2^3 = 8$$

Sample Output 1

8

Sample Input 2

2	3	
0	1	2
0	1	2

Sample Output 2

0

Sample Input 3

1	3	
2	0	2

Sample Output 3

2



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Problem F Word Puzzle

Time Limit: 11 seconds

Young Anna recently indulges in a word puzzle app on her phone. A word puzzle is a single English word with several blanks. Each blank represents a letter to be filled. For example, the word “programming” may appear as a puzzle p_o_rammin_. When solving a puzzle, Anna first clicks on a blank and then begins typing letters. The app automatically advances to the next blank once Anna types a letter. When there are no more blanks to the right of the filled letter, the app jumps back to the beginning of the word and advances from there. Anna keeps typing until all blanks are filled. To solve the puzzle p_o_rammin_, Anna may click on the first blank and then type rgg. Alternatively, she may click on the second blank and then type ggr.

One day Anna shows you a puzzle that she solved along with the sequence of letters she typed. Could you tell how many different puzzles can be the one that Anna solved? Two puzzles are different if they have blanks at different positions, e.g. if the puzzle word is programming and Anna typed rgg, there can be two possible puzzles: p_o_rammin_ and pro_ammin_. As the answer can be large, output the answer modulo 1 000 000 007.

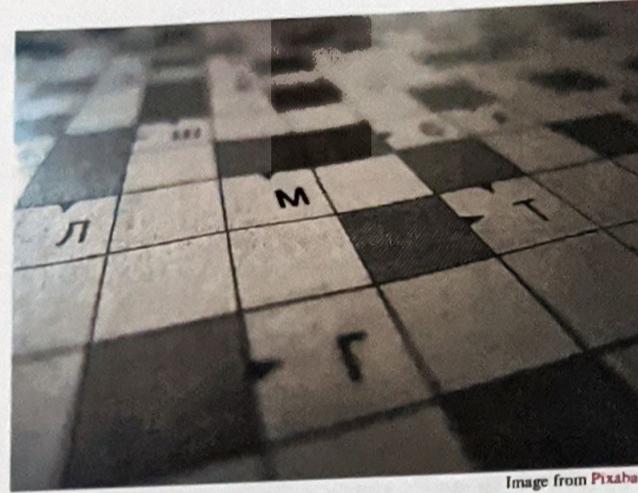


Image from Pixabay

Input

The first line of input has a single string p giving the puzzle word ($1 \leq |p| \leq 10^5$). The second line has a single string s giving the letter sequence that Anna typed ($1 \leq |s| \leq \min(50, |p|)$). Both strings contain only lowercase English letters.

Output

Output the number of different puzzles that can be the one solved by Anna, modulo 1 000 000 007. If Anna can not have typed s to solve the puzzle, output zero.

Sample Input 1

programming
rgg

Sample Output 1

2

Sample Input 2

aabbaa
aba

Sample Output 2

12

Sample Input 3

acca
acac

Sample Output 3

0



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Problem G Code Guessing

Time Limit: 1 second

Alice and Bob are playing a board game with a deck of nine cards. For each digit between 1 to 9, there is one card with that digit on it. Alice and Bob each draw two cards after shuffling the cards, and see the digits on their own cards without revealing the digits to each other. Then Alice gives her two cards to Bob. Bob sees the digits on Alice's cards and lays all the four cards on the table in increasing order by the digits. Cards are laid facing down.

Bob tells Alice the positions of her two cards. The goal of Alice is to guess the digits on Bob's two cards. Can Alice uniquely determine these two digits and guess them correctly?



Input

The input has two integers p, q ($1 \leq p < q \leq 9$) on the first line, giving the digits on Alice's cards. The next line has a string containing two 'A's and two 'B's, giving the positions of Alice's and Bob's cards on the table. It is guaranteed that Bob correctly sorts the cards and gives the correct positions of Alice's cards.

Output

If Alice can uniquely determine the two digits on Bob's cards, output the two digits on a single line, starting with the smaller digit. Otherwise, output -1 .

Sample Input 1

6 9 ABBA	7 8
-------------	-----

Sample Output 1

Sample Input 2

2 5 BAAB	-1
-------------	----

Sample Output 2

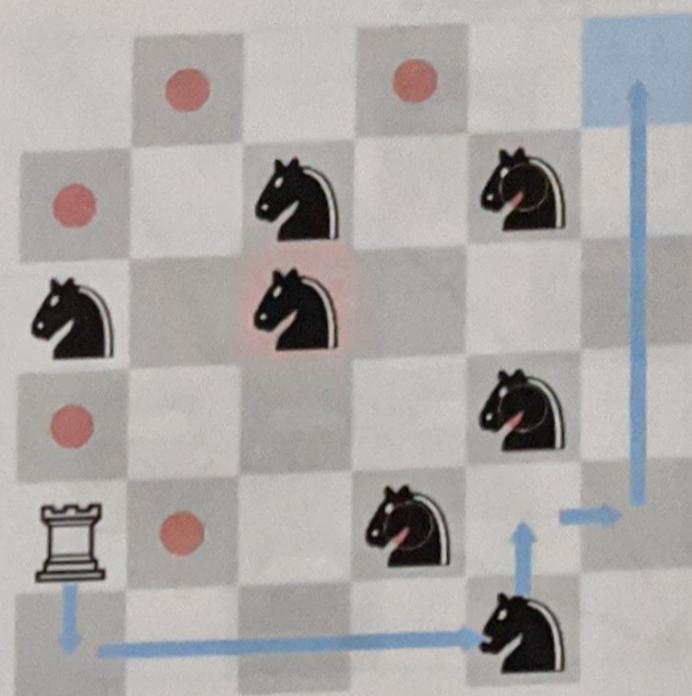
Problem H

Lone Rook

Time Limit: 11 seconds

On a chess board of r rows and c columns there is a lone white rook surrounded by a group of opponent's black knights. Each knight attacks 8 squares as in a typical chess game, which are shown in the figure – the knight on the red square attacks the 8 squares with a red dot. The rook can move horizontally and vertically by any number of squares. The rook can safely pass through an empty square that is attacked by a knight, but it must move to a square that is not attacked by any knight. The rook cannot jump over a knight while moving. If the rook moves to a square that contains a knight, it may capture it and remove it from the board. The black knights never move. Can the rook eventually safely move to the designated target square?

The figure illustrates how the white rook can move to the blue target square at the top-right corner in the first sample case. The rook captures one black knight at the bottom-right of the board on its way.



Rook and knight icons by Churnett

Input

The first line of input contains two integers r and c ($2 \leq r, c \leq 750$). Each of the next r lines describes one row of the board using c characters: the letter 'R' represents the white rook, a 'K' represents a black knight, a dot '.' represents an empty square, and the letter 'T' represents the white rook's target square. There is exactly one 'R', exactly one 'T', and at least one 'K' on the board. It is guaranteed that the white rook starts in a square that is not attacked by any knight. The target square may be attacked by a knight, in which case the knight must be captured before the rook can safely move to the target square.

pathfinding

Output

Output **yes** if the white rook can move to the target square, or **no** otherwise.

Sample Input 1

```
6 6
.....T
..K.K.
K.K...
....K.
R..K..
....K.
```

Sample Output 1

yes