Problem A. Word Combinations

Time Limit 1000 ms

Mem Limit 524288 kB

You are given a string of length n and a dictionary containing k words. In how many ways can you create the string using the words?

Input

The first input line has a string containing n characters between a–z.

The second line has an integer k: the number of words in the dictionary.

Finally there are k lines describing the words. Each word is unique and consists of characters a–z.

Output

Print the number of ways modulo $10^9 + 7$.

Constraints

- $1 \leq n \leq 5000$
- $1 \leq k \leq 10^5$
- the total length of the words is at most 10^6

Example

Input	Output
ababc 4 ab abab c cb	2

Explanation: The possible ways are `ab+ab+c` and `abab+c`.

Problem B. String Matching

Time Limit	1000 ms
Mem Limit	524288 kB

Given a string and a pattern, your task is to count the number of positions where the pattern occurs in the string.

Input

The first input line has a string of length n, and the second input line has a pattern of length m. Both of them consist of characters a–z.

Output

Print one integer: the number of occurrences.

Constraints

- $1 \leq n, m \leq 10^6$

Example

Input	Output
`saippuakauppias` `pp`	`2`

Problem C. Finding Borders

Time Limit 1000 ms
Mem Limit 524288 kB

A *border* of a string is a prefix that is also a suffix of the string but not the whole string. For example, the borders of `abcababcab` are `ab` and `abcab`.

Your task is to find all border lengths of a given string.

Input

The only input line has a string of length n consisting of characters a–z.

Output

Print all border lengths of the string in increasing order.

Constraints

- $1 \leq n \leq 10^6$

Example

Input	Output
abcababcab	2 5

Problem D. Finding Periods

Time Limit 1000 ms

Mem Limit 524288 kB

A *period* of a string is a prefix that can be used to generate the whole string by repeating the prefix. The last repetition may be partial. For example, the periods of `abcabca` are `abc`, `abcabc` and `abcabca`.

Your task is to find all period lengths of a string.

Input

The only input line has a string of length n consisting of characters a–z.

Output

Print all period lengths in increasing order.

Constraints

- $1 \leq n \leq 10^6$

Example

Input	Output
abcabca	3 6 7

Problem E. Minimal Rotation

Time Limit 1000 ms

Mem Limit 524288 kB

A rotation of a string can be generated by moving characters one after another from beginning to end. For example, the rotations of `acab` are `acab`, `caba`, `abac`, and `baca`.

Your task is to determine the lexicographically minimal rotation of a string.

Input

The only input line contains a string of length n. Each character is one of a–z.

Output

Print the lexicographically minimal rotation.

Constraints

- $1 \leq n \leq 10^6$

Example

Input	Output
acab	abac

Problem F. Longest Palindrome

Time Limit 1000 ms
Mem Limit 524288 kB

Given a string, your task is to determine the longest palindromic substring of the string. For example, the longest palindrome in `aybabtu` is `bab`.

Input

The only input line contains a string of length n. Each character is one of a–z.

Output

Print the longest palindrome in the string. If there are several solutions, you may print any of them.

Constraints

- $1 \leq n \leq 10^6$

Example

Input	Output
aybabtu	bab

Problem G. All Palindromes

Time Limit 1000 ms
Mem Limit 524288 kB

Given a string, calculate for each position the length of the longest palindrome that ends at that position.

Input

The only line contains a string of length n. Each character is one of a–z.

Output

Print n numbers: the length of each palindrome.

Constraints

- $1 \leq n \leq 2 \cdot 10^5$

Example

Input	Output
ababbababaa	1 1 3 3 2 4 6 8 5 5 2

Problem H. Required Substring

Time Limit 1000 ms

Mem Limit 524288 kB

Your task is to calculate the number of strings of length n having a given pattern of length m as their substring. All strings consist of characters A–Z.

Input

The first input line has an integer n: the length of the final string.

The second line has a pattern of length m.

Output

Print the number of strings modulo $10^9 + 7$.

Constraints

- $1 \leq n \leq 1000$
- $1 \leq m \leq 100$

Example

Input	Output
6 ABCDB	52

Explanation: The final string will be of the form ABCDBx or xABCDB where x is any character between A–Z.

Problem I. Palindrome Queries

Time Limit	1000 ms
Mem Limit	524288 kB

You are given a string that consists of n characters between a–z. The positions of the string are indexed $1, 2, \dots, n$.

Your task is to process m operations of the following types:

1. Change the character at position k to x
2. Check if the substring from position a to position b is a palindrome

Input

The first input line has two integers n and m: the length of the string and the number of operations.

The next line has a string that consists of n characters.

Finally, there are m lines that describe the operations. Each line is of the form "1 k x" or "2 a b".

Output

For each operation 2, print YES if the substring is a palindrome and NO otherwise.

Constraints

- $1 \leq n, m \leq 2 \cdot 10^5$
- $1 \leq k \leq n$
- $1 \leq a \leq b \leq n$

Example

Input	Output
7 5 aybabtu 2 3 5 1 3 x 2 3 5 1 5 x 2 3 5	YES NO YES

Problem J. Finding Patterns

Time Limit	1000 ms
Mem Limit	524288 kB

Given a string and patterns, check for each pattern if it appears in the string.

Input

The first input line has a string of length n.

The next input line has an integer k: the number of patterns. Finally, there are k lines that describe the patterns.

The string and the patterns consist of characters a–z.

Output

For each pattern, print "YES" if it appears in the string and "NO" otherwise.

Constraints

- $1 \le n \le 10^5$
- $1 \le k \le 5 \cdot 10^5$
- the total length of the patterns is at most $5 \cdot 10^5$

Example

Input	Output

`aybabtu`
`3`
`bab`
`abc`
`ayba`
	`YES`
	`NO`
	`YES`

Problem K. Counting Patterns

Time Limit	1000 ms
Mem Limit	524288 kB

Given a string and patterns, count for each pattern the number of positions where it appears in the string.

Input

The first input line has a string of length n.

The next input line has an integer k: the number of patterns. Finally, there are k lines that describe the patterns.

The string and the patterns consist of characters a–z.

Output

For each pattern, print the number of positions.

Constraints

- $1 \leq n \leq 10^5$
- $1 \leq k \leq 5 \cdot 10^5$
- the total length of the patterns is at most $5 \cdot 10^5$

Example

Input	Output

`aybabtu`
`3`
`bab`
`abc`
`a`
	`1`
	`0`
	`2`

Problem L. Pattern Positions

Time Limit 1000 ms

Mem Limit 524288 kB

Given a string and patterns, find for each pattern the first position (1-indexed) where it appears in the string.

Input

The first input line has a string of length n.

The next input line has an integer k: the number of patterns. Finally, there are k lines that describe the patterns.

The string and the patterns consist of characters a–z.

Output

Print the first position for each pattern (or -1 if it does not appear at all).

Constraints

- $1 \le n \le 10^5$
- $1 \le k \le 5 \cdot 10^5$
- the total length of the patterns is at most $5 \cdot 10^5$

Example

Input	Output
aybabtu 3 bab abc a	3 -1 1

Problem M. Distinct Substrings

Time Limit 1000 ms

Mem Limit 524288 kB

Count the number of distinct substrings that appear in a string.

Input

The only input line has a string of length n that consists of characters a–z.

Output

Print one integer: the number of substrings.

Constraints

- $1 \leq n \leq 10^5$

Example

Input	Output
abaa	8

Explanation: the substrings are `a`, `b`, `aa`, `ab`, `ba`, `aba`, `baa` and `abaa`.

Problem N. Distinct Subsequences

Time Limit 1000 ms

Mem Limit 524288 kB

You are given a string. You can remove any number of characters from it, but you cannot change the order of the remaining characters.

How many different strings can you generate?

Input

The first input line contains a string of size n. Each character is one of a–z.

Output

Print one integer: the number of strings modulo $10^9 + 7$.

Constraints

- $1 \le n \le 5 \cdot 10^5$

Example

Input	Output
`aybabtu`	`103`

Problem O. Repeating Substring

Time Limit	1000 ms
Mem Limit	524288 kB

A repeating substring is a substring that occurs in two (or more) locations in the string. Your task is to find the longest repeating substring in a given string.

Input

The only input line has a string of length n that consists of characters a–z.

Output

Print the longest repeating substring. If there are several possibilities, you can print any of them. If there is no repeating substring, print -1.

Constraints

- $1 \leq n \leq 10^5$

Example

Input	Output
`cabababc`	`abab`

Problem P. String Functions

Time Limit 1000 ms

Mem Limit 524288 kB

We consider a string of n characters, indexed $1, 2, \ldots, n$. Your task is to calculate all values of the following functions:

- $z(i)$ denotes the maximum length of a substring that begins at position i and is a prefix of the string. In addition, $z(1) = 0$.
- $\pi(i)$ denotes the maximum length of a substring that ends at position i, is a prefix of the string, and whose length is at most $i - 1$.

Note that the function z is used in the Z-algorithm, and the function π is used in the KMP algorithm.

Input

The only input line has a string of length n. Each character is between a–z.

Output

Print two lines: first the values of the z function, and then the values of the π function.

Constraints

- $1 \le n \le 10^6$

Example

Input	Output

`abaabca`	`0 0 1 2 0 0 1`
	`0 0 1 1 2 0 1`

Problem Q. Inverse Suffix Array

Time Limit	1000 ms
Mem Limit	524288 kB

Given a suffix array of a string, your task is to reconstruct the string.

The suffix array of a string of length n is a permutation of numbers $1, 2, \ldots, n$ that presents the lexicographical order of the suffixes.

Input

The first line has an integer n: the length of the string.

The next line has n integers: the suffix array.

Output

Print a string that corresponds to the suffix array. The string must consist of characters a–z. If there are several possible strings, you can print any of them.

If no string corresponds to the suffix array, print -1.

Constraints

- $1 \leq n \leq 10^5$

Example

Input	Output
7 4 1 3 5 6 7 2	aybabtu

Problem R. String Transform

Time Limit 1000 ms

Mem Limit 524288 kB

Consider the following string transformation:

1. append the character # to the string (we assume that # is lexicographically smaller than all other characters of the string)
2. generate all rotations of the string
3. sort the rotations in increasing order
4. based on this order, construct a new string that contains the last character of each rotation

For example, the string `babc` becomes `babc#`. Then, the sorted list of rotations is `#babc`, `abc#b`, `babc#`, `bc#ba`, and `c#bab`. This yields a string `cb#ab`.

Input

The only input line contains the transformed string of length $n+1$. Each character of the original string is one of a–z.

Output

Print the original string of length n.

Constraints

- $1 \le n \le 10^6$

Example

Input	Output
`cb#ab`	`babc`

Problem S. Substring Order I

Time Limit 1000 ms

Mem Limit 524288 kB

You are given a string of length n. If all of its distinct substrings are ordered lexicographically, what is the kth smallest of them?

Input

The first input line has a string of length n that consists of characters a–z.

The second input line has an integer k.

Output

Print the kth smallest distinct substring in lexicographical order.

Constraints

- $1 \leq n \leq 10^5$
- $1 \leq k \leq \frac{n(n+1)}{2}$
- It is guaranteed that k does not exceed the number of distinct substrings.

Example

Input	Output

`babaacbaab`
`10`
	`aba`

Explanation: The 10 smallest distinct substrings in order are a, aa, aab, aac, aacb, aacba, aacbaa, aacbaab, ab, and aba.

Problem T. Substring Order II

Time Limit	1000 ms
Mem Limit	524288 kB

You are given a string of length n. If all of its substrings (not necessarily distinct) are ordered lexicographically, what is the kth smallest of them?

Input

The first input line has a string of length n that consists of characters a–z.

The second input line has an integer k.

Output

Print the kth smallest substring in lexicographical order.

Constraints

- $1 \leq n \leq 10^5$
- $1 \leq k \leq \frac{n(n+1)}{2}$

Example

Input	Output
baabaa 10	ab

Explanation: The 10 smallest substrings in order are a, a, a, a, aa, aa, aab, aaba, aabaa, and ab.

Problem U. Substring Distribution

Time Limit 1000 ms

Mem Limit 524288 kB

You are given a string of length n. For every integer between $1 \ldots n$ you need to print the number of distinct substrings of that length.

Input

The only input line has a string of length n that consists of characters a–z.

Output

For each integer between $1 \ldots n$ print the number of distinct substrings of that length.

Constraints

- $1 \leq n \leq 10^5$

Example

Input	Output
abab	2 2 2 1