Lab Assignment 1 CS202 2024Spring

Problem 1. Echo (10 pts)

Coming to the mountains, we often shout with friends, and hearing the echo of our own voices brings us joy. Next, let's start this semester's learning with a simple echo device.

Input Format

A random string in a single line, and each character is an ASCII character.

Output Format

A string that is the same as the input.

Samples

Sample 1

Input

```
SUSTECH CS202 lab assignment 1.
```

output

```
SUSTECH CS202 lab assignment 1.
```

Sample 2

Input

```
-- How are you?   -- I am fine, thank you. And you?
```

output

```
-- How are you?   -- I am fine, thank you. And you?
```

Problem 2. Fibonacci Sequence (40 pts)

The Fibonacci sequence is a well-known sequence that we are familiar with. We know that the first few terms of this sequence are as follows: `1, 1, 2, 3, 5, 8, 13, 21, 34, ...`. Now your task is to count how many numbers are included in the Fibonacci sequence within a given range.

Input Format

The input consists of a single line, which includes two integers, l and r ($0 \le l \le r \le 2^{10}$). They define the range of integers $[l, r]$, for which the task is being queried.

Output Format

An integer n represents the number of integers in the input range that are part of the Fibonacci sequence.

Samples

Sample 1

Input

```
0
1
```

output

```
1
```

Sample 2

Input

```
1
8
```

output

```
5
```

Hint

The input for all test cases satisfies the constraint $l \le r$.

Problem 3. Cracked password (50 pts)

Substitution cipher is a simple classical encryption algorithm, and rearranging the alphabet is the most basic form of substitution. In simple terms, each letter in the alphabet is always replaced by another specific letter, and no two letters can be replaced by the same letter. Figure 1 illustrates the encryption process of a specific method using rearranged alphabet cipher.

Original alphabet	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
New alphabet	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B

Figure 1(a): Table of Alphabet Rearrangement Rules

Plaintext	L I F E	W A S	L I K E	A	B O X	O F	C H O C O L A T E S
Ciphertext	N K H G	Y C U	N K M G	C	D Q Z	Q H	E J Q E Q N C V G U

Figure 1(b): Plaintext and Ciphertext

From this example, we can observe that the encrypted ciphertext is no longer readable, achieving the effect of encryption. However, in cryptography, there is a technique called known-plaintext attack that can easily decrypt ciphertext encrypted using this method. In this type of attack, cryptographer first try to obtain a known phrase or sentence from the original text, and then use observations of the ciphertext to deduce the encryption method.

Now, as an assistant to the expert, you can provide some basic ciphertext analysis for your colleagues. Suppose you have obtained the following ciphertext: `"NKHG YCU NKMG C DQZ QH EJQEQNCVGU"`. Upon observation, you notice a single-letter word `"C"` in this text. In English text, the number of single-letter words is limited, so we can start by considering the word `"a"` or `"I".` By replacing the `"C"` in the ciphertext with the word `"a"` (NOTE: all letters here are in uppercase), and extending this pattern throughout the entire ciphertext, we find that the decrypted text is `"LIFE WAS LIKE A BOX OF CHOCOLATES"`. We have successfully decrypted it!

Next, you can share the alphabet substitution pattern with your colleagues who will be working on subsequent tasks. We can establish a simple convention for expressing the substitution pattern to facilitate communication of the pattern information. In the example, the plaintext is `"A"`, and the ciphertext is `"C"`. The original alphabet is replaced by the letter that is **2** positions ahead of it. Therefore, the pattern for this substitution scheme can be represented as `"2"`.

Of course, not all single-letter words are `"a"`. Let's consider the case where the single-letter word is `"I"`. Suppose we have a ciphertext segment `"H ZL AZBJ"`, where the first word is the single-letter word `"H"`. If we replace it with `"I"`, the letter substitution rule would be as shown in Figure 2. The entire ciphertext can be decrypted as `"I AM BACK"`. We have succeeded again!

Original alphabet	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
New alphabet	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

Figure 2

So, when we perform the substitution, should we decrypt single-letter words as `a` or `I`? To simplify the work, let's establish a simple rule: single-letter words appearing at the beginning of a sentence should be decrypted as `I`, while single-letter words appearing within a sentence should be decrypted as `a`. We guarantee that there will not be both a single-letter word at the beginning of the sentence and a single-letter word in the middle of the sentence in the same ciphertext. However, we do not guarantee that a ciphertext segment will always contain single-letter words. If such a situation occurs, you can only provide the next colleague with a rule denoted as `-1`.

Input Format

The input consists of a single line of ciphertext. The ciphertext only contains uppercase letters and spaces, and does not include any other characters.

Output Format

An integer n represents the pattern of the alphabet rearrangement rule. ($-1 \leq n \leq 25$)

Samples

Sample 1

Input

```
NKHG YCU NKMG C DQZ QH EJQEQNCVGU
```

output

```
2
```

Sample 2

Input

```
H ZL AZBJ
```

output

```
25
```

Sample 3

Input

```
VJGTG KU PQVJKPI
```

output

```
-1
```