Algorithm Development and Programming Fundamentals

Termwork

1. The Collatz function is defined for a positive integer n as follows.

```
f(n) =      3n+1 if n is odd,
            n/2  if n is even
```

We consider the repeated application of the Collatz function starting with a given integer n, as follows:

```
f(n), f(f(n)), f(f(f(n))), …
```

It is conjectured that no matter which positive integer n you start from, this sequence eventually will have 1 in it.

e.g. If n=7, the sequence is

```
1)   f(7)       = 22
2)   f(f(7))    = f(22) = 11
3)   f(11)      = 34
4)   f(34)      = 17
5)   f(17)      = 52
6)   f(52)      = 26
7)   f(26)      = 13
8)   f(13)      = 40
9)   f(40)      = 20
10)  f(20)      = 10
11)  f(10)      = 5
12)  f(5)       = 16
13)  f(16)      = 8
14)  f(8)       = 4
15)  f(4)       = 2
16)  f(2)       = 1
```

Thus if you start from n=7, you need to apply f 16 times in order to first get 1.

In this question, you will be given a positive number <= 32,000. You have to output how many times f has to be applied repeatedly in order to first reach 1.

	Input	Expected Output
Test Case 1	101	25
Test Case 2	100	25
Test Case 3	2463	208

2. Write a recursive program that inputs a line of characters from the user. The line may contain blanks. It outputs the line with the characters reversed. The input ends with EOF (end of file).
NOTE: You have to use recursion to solve this, and are NOT allowed to use array to store the input!!

Example:

INPUT

```
This is easy
```

OUTPUT

```
ysae si sihT
```

	Input	Expected Output
Test Case 1	`visible`	`elbisiv`
Test Case 2	`xyzyx`	`xyzyx`

3. We say that a string 's' is an anagram of another string 't' if the letters in 's' can be rearranged to form 't'.
For example, "butterfly" is an anagram of "flutterby", since a rearrangement of the first word results in the second.
We say that a position 'i' in 's' and 't' match, if 's' is an anagram of 't', and s[i]==t[i].
In this question, you will be given two words, 's' and 't'. You have to output the number of matching positions if s is an anagram of t, and -1 if s is not an anagram of t.

Input

The input consists of two lines. The first line contains the first string, with length <= 100 characters. The second line contains the second string, with length <=100 characters.

Output

If the first string is an anagram of the second string, then output the number of matching positions. Otherwise, print -1.

Sample Input 1

```
butterfly
flutterby
```

Sample Output 1

```
2
```

Sample Input 2

```
home
come
```

Sample Output 2

```
-1
```

	Input	Expected Output
Test Case 1	anarchy anerchy	-1
Test Case 2	cyclonepic enolcyccpi	1
Test Case 3	turingmachine turingmachime	-1
Test Case 4	abacbstuvab baabctsuavb	3

4. In a string, a "run" is a substring consisting of consecutive occurrences of the same character. For example, the string "mississippi" contains the following runs - "ss", "ss" and "pp".
In this question, given a string, you have to output the length of the longest run in the string.

Input

A string, having length at most 100. The string is guaranteed to have at least one run.

Output

The length of the longest run in the string.

Sample Input

```
abbaaacccc
```

Sample Output

```
4
```

	Input	Expected Output
Test Case 1	pqrsssspppqqpttttt	5
Test Case 2	pprdfgeerjimcndddgeejkcj jdjsssssrrtthsa	5
Test Case 3	ppqqqyrtgfdreeennnnnnssg grrjfhg	6

5. In this question, you are given two positive integers M and N, where M < N. You may assume that N is less than or equal to 100.

The orbit of M with respect to N is defined to be the sequence

```
M, (2*M) mod N, (2^2*M) mod N, ...
```

There are at most N elements in the sequence, but for some M, the number of elements in this sequence may be fewer.

You have to output the maximum number of distinct integers in the orbit of M.

For example, if M=5 and N=8, then the orbit of 5 with respect to 8 is

```
5, 2*5 mod 8, 4*5 mod 8, 8*5 mod 8
```

which is equal to

```
5, 2, 4, 0.
```

Hence the number of distinct integers in the orbit of 5 is 4.

	Input	Expected Output
Test Case 1	2 5	4
Test Case 2	4 6	2

6. You will be given an NxN matrix. You have to determine whether the matrix is a triangular matrix.

   The diagonal of the matrix M of size NxN is the set of entries M(0,0), M(1,1), M(2,2), ..., M(N,N).

   A matrix is upper triangular if every entry below the diagonal is 0. For example,
   1 1 1
   0 0 1
   0 0 2
   is an upper triangular matrix. (The diagonal itself, and the entries above and below the diagonals can be zeroes or non-zero integers.)

   A matrix is lower triangular if every entry above the diagonal is 0. For example,
   2 0 0
   3 1 0
   4 2 2
   is a lower triangular matrix.

   A matrix is triangular if it is either upper triangular or lower triangular or both.

   You may not use arrays for this program.

   Input
   First, you will be given N, which is the size of the matrix.

   Then you will be given N rows of integers, where each row consists of N integers separated by spaces.

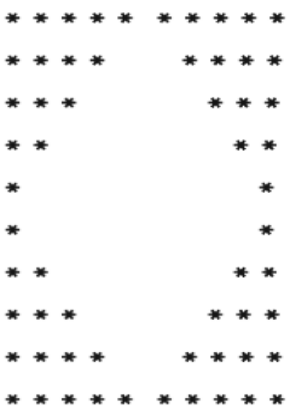
   Output
   If the input matrix is triangular, then print yes. Otherwise, print no.

Sample Test Cases	**Input**	**Output**

Test Case 1	3 1 0 0 0 1 0 1 1 2	yes
Test Case 2	7 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1	yes
Test Case 3	7 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 1 0 0 0 0 0 1 1	no
Test Case 4	2 1 1 0 1	yes

7. Write Program to generate following pattern for input size N.

   For N = 5 output is:



8. Write Program to generate following pattern for input size N.

   For N=3 output is:

```
*
* 1 *
* 1 2 1 *
* 1 2 3 2 1 *
* 1 2 1 *
* 1 *
*
```

9. Write Program to generate the following pattern for input size N(rows).

```
        1
      1   1
    1   2   1
  1   3   3   1
1   4   6   4   1
1 5  10  10  5  1
```

10. Write a C program to find G.C.D of a Number - N using Recursion.
11. Write a C program to print Fibonacci Series upto N terms using Recursion.