Questions of ITP course at Shahid-Beheshti-University

Part 5

by Farbod Fooladi

First return

Write a program that recursively determines whether a number is prime or not.

Hint: The return function can have more than one parameter.

Entrance

A natural number n is written in one line.

$$1 \leq n \leq 200$$

Output

If the input number was the first, print the word Yes and otherwise print the word No in the standard output.

B.M.M

Write a program that takes two numbers and recursively calculates their greatest common divisor.

Hint: use the calculation of the difference of two numbers.

Entrance

Two natural numbers a and b are written in one line.

$$1 \leq a, b \leq 100000$$

Output

Calculate two input numbers in one line of BMM standard output.

Smart Residual

Write a program that recursively calculates the remainder of dividing b^n / m by receiving the integers b, n and m.

Hint: In the examples, you will notice that calculating power directly causes Integer Overflow. Therefore, it is necessary to use collocation.

Entrance

In one line of standard input, the numbers b, n and mmm are written respectively.

$$1 \leq m \leq 100000$$

$$0 \leq b, n \leq 100000$$

Output

On one line of standard output, print the result of b^n mod m.

The sequence of 4 powers!

Consider the following sequence:

0, 1, 4, 5, 16, 17, 20, 21, 64, 65, 68, 69, 80, 81, 84, 85, ...

Write a program that calculates n of the first term of this sequence by receiving n.

Hint: Try to find a return relation for the sequence and simply convert it to a return function that returns the n statement of the sequence name.

Entrance

In one line, the number n is written.

$$1 \leq n \leq 50$$

Output

Separate the first to nth sentences of the sequence on a single line with a space and print them on the standard output.

Special Hanoi

As in the ordinary Hanoi problem, we have three rods B, A and C and a number of disks. We want to transfer a number of discs to bar C with the same conditions, except that the odd numbered discs are on bar A and the even numbered discs are on bar B. For example, for four discs, discs number 1 and 3 are on bar A and discs number 2 and 4 are on bar B.

By taking the number of disks, find the minimum number of moves required to move the disks to the C bar.

Pay attention to the following points:

The number of disks is even.

To solve this question, you need to master or maybe use the regular Hanoi problem.

Entrance

In one line, even number n is written.

$$2 \le n \le 20$$

Output

Print the minimum moves required to transfer disks, as shown in the examples, to standard output.

Note: This question uses the tester and it may take longer than usual to check the correctness of your code.

Routing

Consider a table m * n. The goal is to find the number of paths that can be taken from the upper left house to the lower right house, provided that only downward and right movement is allowed. Write a program that recursively finds the number of states.

For example, in the table 2 * 2 in the figure below, there are 6 ways. Example

Tip: Both displacement modes should be considered. The return function does not need to call itself only once.

Fifty marks of this question are points.

Entrance

In one line, the numbers n and mmm are written, which show the number of rows and columns of the table, respectively.

$$1 \le n, m \le 15$$

For the points part, the input is up to 25.

Output

On one line of standard output, print the number of possible paths for the desired permutation.

block (scoring)

We want to color the m block with two colors red and gray provided that the least number of red blocks together is n and each set of red blocks is separated by one or more gray blocks.

The following figure shows the possible states for example:

Entrance

In one line, the numbers mmm and n are written, which respectively show the total number of blocks and the minimum number of red blocks together.

$$1 \leq m \leq 50$$

$$0 \leq n \leq 50$$

Output

Print the number of possible states on one line of standard output.