Questions of ITP course at Shahid-Beheshti-University

Part 4

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Programmer's Day

Programmer's Day is celebrated on the 256th day of the year.

256 is the largest power of 2 that is less than the length of the year. Write a function that, by receiving the length of the year in a planet, calculates the programmer's day of that planet. Some hacker is going to abuse your program... so make your function safe so that it can only be used twice and after the second time it returns a negative value of one regardless of the input.

Tip: To make the function safe, use a static variable. (You don't have the right to use global variables)

Entrance

In one line, a number of natural numbers are entered, each representing the length of the year in a planet.

$$1 \le a_i \le 1000000000$$

The last number entered is zero.

Output

On a line of standard output, separate the function outputs with spaces and print them.

Tara's problem

Tara has traveled to a new country to study and decides to work at the Golden Post Company alongside her studies. The areas under the supervision of this company have the following characteristics:

All are located on a straight line and are coded from 1 to n.

There is only one direct route from each area to the next, which requires one liter of fuel to navigate.

There is a gas station in every district and the price of gas in Kam city is k dollars.

In the first zone, Tara's engine fuel tank is empty and she is going to the nth zone, and every time she passes through three consecutive zones, she buys a bottle of soft drink for one dollar.

Write a program that calculates the minimum cost spent by Tara.

Entrance

In one line, two numbers nnn and vvv are written, which show the number of cities and the capacity of the fuel tank, respectively.

$$2 \le n, v \le 100$$

Output

On one line of standard output, print the minimum amount of money Tara must spend.

Clean triangles

Implement the following functions and use them in a program to determine the type of a triangle.

1. A function that determines whether a triangle is right-angled.

   bool is_right_tri(int x1, int y1, int x2, int y2, int x3, int y3);

2. A function that determines whether a triangle is isosceles.
   bool is_Isosceles_tri(int x1, int y1, int x2, int y2, int x3, int y3);

3. A function that returns the Euclidean distance of two points or its square power.
   double oq_distance_2(int x1, int y1, int x2, int y2);

Entrance

In one line, six integers x1, y1, x2, y2, x3 and y3 are written, each pair representing the coordinates of one of the vertices of the triangle.

$$-20 \leq x1, y1, x2, y2, x3, y3 \leq 20$$

It is guaranteed that the entry points do not lie on the same line.

Output

As an example, print two bits on one line of standard output, the first bit for orthogonality and the second bit for isosceles.

Heavenly hands

The migration from clocks to digital clocks has started for a long time.

But in this question, you have to implement a function that by receiving the hour and minute values and assuming that the second is zero, calculates the acute angle between the hour and minute hands (in a hand clock!!!) in terms of degrees.

The user using the app may enter the minutes incorrectly. For example, instead of twelve o'clock, say ten, one hundred and twenty minutes. So keep this in mind in your plan.

Entrance

In one line, two numbers h and mmm are written, which show the hours and minutes, respectively.

$$0 \leq h \leq 12$$

$$0 \leq m \leq 500$$

Output

On one line of standard output, print the angle between the hour and minute hands to two decimal places.

Pattern finding

Write a function that receives a natural number using bitwise operators without base conversion and finds the number of 101 patterns in its binary structure. Be careful, overlapping modes should be considered. For example, in both expressions 10101 and 101101, the pattern 101 is repeated twice.

Entrance

In one line, the natural number n is written.

$$1 \leq n \leq 1000$$

Output

On one line of standard output, print the desired number of patterns in the binary number structure.

Regular approximation

Memory is one of the most valuable resources of a computer. Keeping this in mind, write a program that, upon receiving three decimal numbers, sorts and approximates them. You must have implemented the following functions in your program:

1. A function that moves the value of two variables without an additional variable.
   void swap(double &a, double &b);

2. A function that sorts three variables from largest to smallest using the swap function.
   void sort(double &a, double &b, double &c);

3. A function that rounds a decimal number. So that the values above 0.3 are rounded up and the remaining values are rounded down.
   void round(double &a);

Pay attention to the following points:

- For efficiency, you can define a function or functions inline.
- In the whole program, you only have the right to define three decimal variables.

Entrance

In one line, three decimal numbers a, b and c are written with a maximum of five decimal digits.

$$0 \le a, b, c \le 10000$$

Output

Print the sorted and rounded numbers in order according to the examples in three lines of standard output.