Problem 1

Factoring a Polynomial

Problem Description

Let $\mathbf{Z}[x]$ be the set of all polynomials in x with integer coefficients. Let $f(x) = a_n x^n + a_{n-1}x^{n-1} + \ldots + a_1 x + a_0$ be a polynomial in $\mathbf{Z}[x]$. If a_n is not zero, then the *degree* of $f(x)$ is n, and a_n is called the *leading coefficient* of $f(x)$.

A polynomial $f(x)$ in $\mathbf{Z}[x]$ is *composite* if there are polynomials $g(x)$ and $h(x)$ in $\mathbf{Z}[x]$, with degree at least 1, such that $f(x) = g(x)h(x)$. We call $g(x)$ and $h(x)$ the *factors* of $f(x)$. A polynomial is *prime* if it is not composite. Given a polynomial $f(x)$ with degree at most 3, find its prime factors.

Input Format

Input data contains a set of polynomials of degree at most 3. Each polynomial $f(x) = a_3x^3 + a_2x^2 + a_1x + a_0$ is represented by its coefficients a_3, a_2, a_1, and a_0. Assume that the absolute values of all the coefficient are no more than 10000. The last polynomial is followed by 0, 0, 0, 0, indicating the end of input data.

Output Format

For each polynomial $f(x)$, print its prime factors. When the greatest common divisor of the coefficient is not 1, print the greatest common divisor before its prime factors. It is laso required that the leading coefficient of each prime factor is positive.

Sample Input

```
0 1 2 1
0 -2 4 2
-1 3 -3 1
0 0 0 0
```

Sample Output

```
(x + 1)(x + 1)
-2(x^2 - 2x - 1)
-1(x + 1)(x + 1)(x + 1)
```

Problem 2

Least Common Multiple

Problem Description

A least common multiple of three positive integers a, b, and c is the smallest positive integer m which is a multiple of a, b, and c. Given a positive integer n, find three positive integers a, b, and c such that $n = a + b + c$ and the least common multiple of a, b, and c is minimized.

Input Format

Input data contains a set of positive numbers. Assume that all the numbers are no more than 10000. The last data is followed by 0, indicating the end of input data.

Output Format

For each positive integer n in the input file, print three positive integers a, b, and c, $a \leq b \leq c$, such that the least common multiple of a, b, and c is as small as possible.

Sample Input

```
35
100
9999
0
```

Sample Output

```
35=7+14+14
100=20+40+40
9999=3333+3333+3333
```

Problem 3

Wu-Zi-Qi ( )

Problem Description

The game "wu-zi-qi"( ) is a game played by two people. The two player A and B take turns marking a dot at the unmarked intersection of an 20×20 grid. The color of the dots marked by A is black and the color of the dots marked by B is white. Initially, the chessboard is empty, which means that all the intersetions of the 20 grid are unmarked. The player who first marks 5 dots consecutively in a line wins. The line on which the winning player marked can be a horizontal line, a verticle line, or a diagonal line with slop 1 or -1.

Assume that the coordinates of the intersection of the 20×20 grid is denoted by (x, y), where $0 \leq x, y \leq 19$. Given a set of coordinates of the black dots, and a set of coordinates of the write dots, write a program to determine who wins the game.

Input Format

The inpute file contains many sets of test data. Each test data contains two lines, and each line conatins a set of coodinates of the dots marked by the player. The first line is for the player A and the second line is for player B. The last test data set is followed by (0, 0) (0, 0), indicating the end of the file.

Output Format

For each test data set, print the winner of the game.

Sample Input

```
(2,3) (2,4) (2,5) (2,6) (2,7)
(3,3) (3,4) (2,5) (2,6)
(3,2) (4,2) (5,2) (6,2) (7,7)
(3,3) (4,3) (5,3) (6,3) (7,3)
(3,3) (4,4) (5,5) (6,6) (7,7)
(3,2) (4,2) (5,2) (6,2)
(3,2) (4,2) (5,2) (6,2)(1,1)
(2,14) (3,13) (4,12) (5,11) (6,10)
(0,0) (0,0)
```

Sample Output

```
A wins
B wins
A wins
B wins
```

Problem 4

Long Integer Multiplication

Problem Description

In this problem, you will implement the multiplication of two integers. The integers considered in this problem may be very large. Its value may be too large to be stored in a fixed amount of bytes or words in memory. Thus, you cannot use any data type in any language in this programming contest to store and manipulate the integers. You must design a proper data structure to store an integer and write all the operations to do the multiplication of two integers.

Input Format

Input data contains a set of two integers A and B. The last line of the input file contains two 0's, indicating the end of the input.

Output Format

For each pair of integrs A and B in the input file, print is product $C(= A \times B)$.

Sample Input

```
123456789012345678901234567890 111
-2567 111
-111 -123456789012345678901234567890
0 0
```

Sample Output

```
13703703580370370358037036l6
-284937
13703703580370370358037036l6
```