Problem A
Pac-Man

Time limit: 1 second

Memory limit: 1024 megabytes

Problem Description

Pac-Man is a maze-chase video game developed in 1980s. The player controls the character "Pac-Man" to eat dots in a maze while avoiding enemy characters "ghosts." All characters may move in four directions: up, down, left, right. The game ends in two conditions:

- Pac-Man eats all dots in the maze. In this case, the player wins.
- Any ghost catches Pac-Man. In this case, the player loses.

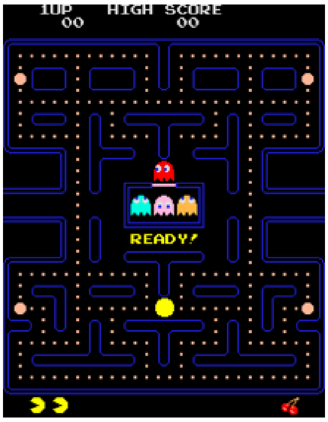

Figure 1: Pac-Man gameplay (image from Wikipedia)

Adam is learning how to create games with modern programming tools. To practice the skills, he tries to make an imitation of the Pac-Man game with some modification. In Adam's game, the playable character is a "ghost," and the enemy character is "Pac-Man." Since he changes the roles of the ghost and Pac-Man, he also changes the ending conditions of the game.

- Pac-Man eats all dots in the maze. In this case, the player loses.
- The ghost controlled by the player catches Pac-Man. In this case, the player wins.

Adam has almost developed the first full functioning version of his game. He wants to test his game and creates a simple stage for testing. The maze of the stage is based on 10-by-10 grid. We label the cell lying at the intersection of row r and column c with (r, c). In this problem, rows and columns are numbered from 0 to 9. Each grid cell contains exact one dot. The exterior boundary of the grid are walls. No characters may move to the area outside of the grid. Inside the grid, there are no walls or obstacles. All characters may move freely from a cell to any cell adjacent to it. Note that two grid cells (r_1, c_1) and (r_2, c_2) are adjacent to each other if and only if $|r_1 - r_2| + |c_1 + c_2| = 1$.

Adam has to prepare the movements of Pac-Man for the testing. He needs a set of trajectory with diversity, but any of the trajectories must satisfy the following requirements.

- Pac-Man can eat all dots in the maze if it follows the trajectory.
- Pac-Man moves at most 10000 steps.

Adam needs your help to generate a trajectory starting at cell (x, y). Please write a program to generate a trajectory of Pac-Man satisfying all requirements above and starting at cell (x, y).

Input Format

The input has exactly one line which consists of two integers x and y separated by a blank. You are asked to generate a trajectory starting at cell (x, y).

Output Format

You must output a requested trajectory in the following format. The trajectory is represented by $m + 1$ lines where m is the number of steps of the trajectory. The i-th line contains two integers r_i and c_j. Pac-Man will be in cell (r_i, c_i) after moving i steps along the trajectory.

Technical Specification

- $m \leq 10000$
- $x, y, r_i, c_i \in \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$ for $i \in \{1, 2, \ldots, m + 1\}$.
- Cells (r_i, c_i) and (r_{i+1}, c_{i+1}) are adjacent to each other for $i \in \{1, 2, \ldots, m\}$.
- $\{(r_1, c_1)\} \cup \{(r_2, c_2)\} \cup \cdots \cup \{(r_{m+1}, c_{m+1})\}$

Sample Input 1

```
0 0
```

Sample Output 1

```
0 0
0 1
0 2
0 3
0 4
0 5
...
...
...
9 3
9 2
9 1
9 0
```

Note

The sample output section does not contain the correct output, since it ignores a large part of the answer. Please download the correct sample test cases from the judge system.

Problem B
Folding

Time limit: 1 second
Memory limit: 1024 megabytes

Problem Description

There is a transparent tape. Its length is exact one meter (10^9 nanometers). In this problem, all numbers are integers, and we use a number to denote a position on the tape. The number p denote the position of the point has a distance p nanometers from the head of tape.

Bob is a master dyer, so he can color the tape precisely in nanometer scale. He colors two sectors $[p_1, q_1]$ and $[p_2, q_2]$ into red. The color of the tape at the position in the range from p_1 to q_1 is red. The color of the tape at the position in the range from p_2 to q_2 is also red. And the rest part remains transparent.

To verify Bob's skill, we ask Ben, the tape folding master, to help us. Ben can fold the tape perfectly at any position. If Ben fold the tape at x, then the new position of a certain point p will be one of the following cases.

- If $p = x$, then it becomes the new head of tape, i.e, it becomes 0.
- If $p > x$, then it becomes $p - x$.
- If $p < x$, then it becomes $x - p$.

After Ben folds the tape, we measure the total length of the red part of the new tape. If the red part has the expected length, then we will believe Bob and Ben are both masters in their skills. Obviously, the color of some position of the new tape is determined by the colors of the corresponding positions of the old tape. A position of the new tape is colored in red if one of the corresponding positions in the old tape is colored in red.

Bob has already colored the tape, and Ben has proposed the positions to be folded. Please write a program to compute the expected lengths colored in red.

Input Format

The first line contains four integers p_1, q_1, p_2, q_2 separated by blanks. Bob has colored the sectors $[p_1, q_1]$ and $[p_2, q_2]$. The second line contains an integer q indicating the number of positions to be folded by Ben. Each of the remaining q lines contains an integer x indicating the positions to be folded by Ben.

Output Format

For each position, output the expected total length of the new tape where are colored in red.

Technical Specification

- $0 \le p_1 < q_1 < p_2 < q_2 \le 10^9$
- $0 \le x \le 10^9$

- $q \leq 10^6$

Sample Input 1

```
1 3 8 9
10
1
2
3
4
5
6
7
8
9
10
```

Sample Output 1

```
3
2
3
3
2
3
3
3
3
3
```

Problem C
Circles

Time limit: 2 seconds

Memory limit: 1024 megabytes

Problem Description

There are n magical circles on a plane. They are centered at $(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)$, respectively. In the beginning, the radius of each circle is 0. The radius of all magical circles will grow at the same rate until they touch another magical circle. Write a program calculate the total area of the sum of all magical circles at the end of growing.

Input Format

The first line contains an integer n to indicate the number of magical circles. The i-th of the following n lines contains two integers x_i and y_i indicating that the i-th magical circle is centered at (x_i, y_i).

Output Format

Output the total area of the circles. A relative error of 10^{-6} is acceptable.

Technical Specification

- $n \leq 2000$
- $x_i, y_i \in [-10^5, 10^5]$ for $i \in \{1, 2, \ldots, n\}$.

Sample Input 1

```
4
0 0
1 0
1 1
0 1
```

Sample Output 1

```
3.14159265359
```

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Problem D
Last Will

Time limit: 1 second

Memory limit: 1024 megabytes

Problem Description

Input Format

Output Format

Technical Specification

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Problem E
Exact Length

Time limit: 3 seconds

Memory limit: 1024 megabytes

Problem Description

Input Format

Output Format

Technical Specification

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Problem F
Homework

Time limit: 3 seconds

Memory limit: 1024 megabytes

Problem Description

There are n children (numbered from 1 to n) who are learning the arithmetic operations, which include *addition* "+", *subtraction* "−", *multiplication* "×", and *division* "÷", on rational numbers. Each child has a paper sheet with only one zero on it. Their teacher, Frank, will give out q operations. The i-th operation consists of an operator c_i and an integer x_i. However, Frank only wants some children to perform the operation. Only children $\ell_i, \ell_{i+1}, \ldots, r_i$ are asked to append the operator c_i and the number x_i to their paper sheet. After Frank's assignment, every child has an expression to evaluate.

For example, let $n = 3$, $q = 2$, c_1 be "+", $x_1 = 1$, $\ell_1 = 1$, $r_1 = 2$, c_2 be "−", $x_2 = 2$, $\ell_2 = 2$, $r_2 = 3$. The expressions of children 1, 2 and 3 are $0 + 1$, $0 + 1 - 2$ and $0 - 2$, respectively.

However, Frank is really lazy and wants to verify the answers quickly. So he asks you to calculate the sums of the values of all children's expressions. If the value of the expression assigned to child i is $\frac{a_i}{b_i}$, then you have to use $a \times b^{-1} \mod 10^9 + 7$ instead. b^{-1} is any number satisfying $b \times b^{-1} \equiv 1 \mod 10^9 + 7$. If the sum is greater than $10^9 + 6$, then return the sum modulo $10^9 + 7$ to Frank.

Note: The arithmetic operations has PEMDAS rule, that is, Multiplication/Division before Addition/Subtraction.

Input Format

The first line contains two integers n and q separated by a blank. The i-th of following q lines contains ℓ_i, r_i, c_i, x_i separated by blanks. For convenience, we use $*$ and $/$ to represent multiplication and division operators, respectively.

Output Format

Output the number that you should return to Frank.

Technical Specification

- $1 \le n \le 10^5$
- $1 \le q \le 10^5$
- $\ell_i, r_i \in [1, n]$ for $1 \le i \le q$.
- $c_i \in \{+, -, *, /\}$ for $1 \le i \le q$.
- $x_i \in [0, 10^9 + 7)$ for $1 \le i \le q$.

Sample Input 1

```
3 2
1 2 + 1
2 3 - 2
```

Sample Output 1

```
1000000005
```

Problem G
Cactus

Time limit: 10 seconds

Memory limit: 1024 megabytes

Problem Description

Input Format

Output Format

Technical Specification

Almost blank page

Problem H
In The Name Of Confusion

Time limit: 10 seconds
Memory limit: 1024 megabytes

Problem Description

There's no such thing as public opinion.

Jordan Ellenberg, American Mathematician

In K City lives n residents, they want to build a connection network with each other. However, some residents want the network wire coloured black while the others want the wire coloured white. The opinion of resident i can be quantified as a number a_i. If we build a network wire between residents i and j, the cost of this wire will be $a_i \times a_j$.

The mayor of K City wants to network built such that:

1. There is exactly $n - 1$ wire used.
2. For any two different residents i and j, there exists a sequence $p_1, \cdots, p_k$ such that $p_1 = i$, $p_k = j$ and residents p_ℓ and $p_{\ell+1}$ share a wire for $1 \le \ell < k$.

In other words, the network should be a tree.

You, the renowned mathematician of K City, want to know not only the *minimum* cost to build the network. In the name of confusion, you also want to know the *maximum* cost!

Input Format

The first line begins with a number n indicating the number of residents. The second line contains n numbers $a_1, a_2, \ldots, a_n$. The opinion of resident i is the quantified as a_i.

Output Format

Output two numbers separated by a blank in a line. The numbers are the *minimum* cost and the *maximum* cost to build the network, respectively. Since the numbers may be extremely large, you have to modulo the answer with $10^9 + 7$. Please note that the modulo of a number (defined by Donald Knuth) is $a \mod b = a - b\lfloor \frac{a}{b} \rfloor$. The number output should be non-negetive.

Technical Specification

- $1 \le n \le 10^6$
- $|a_i| \le 10^6$

Sample Input 1

```
10
-5 -10 -7 -7 -3 -1 -7 -5 -8 -6
```

Sample Output 1

```
58 490
```

Sample Input 2

```
10
-5 1 2 -2 -1 1 -5 5 -10 6
```

Sample Output 2

```
999999779 183
```

Sample Input 3

```
10
0 0 0 0 0 0 0 0 0 0
```

Sample Output 3

```
0 0
```

Sample Input 4

```
10
10 8 9 3 8 8 0 5 3 10
```

Sample Output 4

```
0 540
```

Problem I
Table Tennis

Time limit: 4 seconds

Memory limit: 1024 megabytes

Problem Description

Input Format

Output Format

Technical Specification