National Taiwan University
Final PK 2015

- There are 10 problems and 22 pages.
- Please use stdin for input, and stdout for output.
- The time limit and memory limit of each problem are on the judge system.
- This problemset is very “easy”, good luck!

Table 1: Problem List

ID	Name
A	As Easy As Possible
B	Be Friends
C	Coprime Heaven
D	Drawing Hell
E	Easiest Game
F	Flying Motorcycle
G	Game Again
H	Hash Collision
I	Increasing or Decreasing
J	Just Convolution

A. As Easy As Possible

Problem ID: easy

As we know, the NTU Final PK contest usually tends to be pretty hard. Many teams got frustrated when participating NTU Final PK contest. So I decide to make the first problem as "easy" as possible. But how to know how easy is a problem? To make our life easier, we just consider how easy is a string.

Here, we introduce a sane definition of "easiness". The easiness of a string is the maximum times of "easy" as a subsequence of it. For example, the easiness of "eeaseyaesasyy" is 2. Since "easyeasy" is a subsequence of it, but "easyeasyeasy" is too easy.

How to calculate easiness seems to be very easy. So here is a string s consists of only 'e', 'a', 's', and 'y'. Please answer m queries. The i-th query is a interval $[l_i, r_i]$, and please calculate the easiness of $s[l_i..r_i]$.

Input

The first line contains a string s. The second line contains an integer m. Each of following m lines contains two integers l_i, r_i.

- $1 \leq |s| \leq 10^5$
- $1 \leq m \leq 10^5$
- $1 \leq l_i \leq r_i \leq |s|$
- s consists of only 'e', 'a', 's', and 'y'

Output

For each query, please output the easiness of that substring in one line.

Sample Input 1

```
easy
3
1 4
2 4
1 3
```

Sample Output 1

```
1
0
0
```

Sample Input 2

```
eeaseyaesasyy
4
1 13
2 12
2 10
3 11
```

Sample Output 2

```
2
2
1
0
```

B. Be Friends

Problem ID: loli

There are n lovely lolis in teacher Jiang's class. Each loli has her own personality. For simplicity, we assume that the personality of i-th loli can be represent as an integer p_i.

It is easy to understand that if two lolis have very different personality, they are hard to be direct friends. To formalize this, when the i-th and the j-th loli is a pair of direct friends, there will be a run-in cost of $p_i \oplus p_j$. Here we use $\oplus$ to denote bitwise xor operation.

We say two lolis are indirect friends if there is an "loli path" between them. For example, if $(1, 2), (2, 3), (3, 4)$ are pairs of direct friends, then $(1, 4)$ is a pair of indirect friends.

As a good teacher, Mr. Jiang wants to make all of the lovely lolis to be friends. That is, any two lolis must be either a pair of direct friends of indirect friends. What is the minimum total run-in cost to make this happen?

Input

The first line contains an integer n. The second line contains n integers $p_1, p_2, \ldots, p_n$.

- $1 \leq n \leq 10^5$
- $0 \leq p_i \leq 10^9$

Output

Please output the minimum total run-in cost in one line.

Sample Input 1	Sample Output 1
3 5 1 4	5

Sample Input 2	Sample Output 2
6 1 2 3 5 8 13	20

C. Coprime Heaven

Problem ID: coprime

The math class is too easy for genius like Nozomi. So she wants to play some single player card game during the class. But since she is a genius, normal single player card game like Solitaire is too easy for her. Thus she creates a hard game called "Coprime Heaven".

There are n cards in this game, and the i-th card is written with an integer i. At the beginning, she picks m lucky positive integers $l_1, l_2, \ldots, l_m$ with $\sum_{i=1}^{m} l_i = n$. Then she tries to partition the cards into m circles, such that each pair of adjacent cards are coprime.

For example, if $n = 5, m = 2, l_1 = 2, l_2 = 3$, we can partition the cards into two circles $\langle 5, 2\rangle$ and $\langle 3, 1, 4\rangle$, since all adjacent pairs $(5, 2), (2, 5), (3, 1), (1, 4), (4, 3)$ are coprime. Note that a circle with only one number will always be valid.

We also want to be as smart as Nozomi, so here are T coprime heaven puzzles for you.

Input

The first line contains an integer T. Each of following T lines contains lucky numbers of one coprime heaven puzzle.

- $1 \leq T \leq 2000$
- $1 \leq m \leq 4$
- $1 \leq l_i \leq 500$
- l_i is sorted in non-decreasing order

Output

For each puzzle, please print a line with "QQ" if there is no valid partition. Otherwise, please print a line with "^_<". Followed by m lines denote a valid partition. Note that the order of circles should be same as lucky numbers.

Sample Input 1	Sample Output 1
4 1 2 3 4 5 6 7 8 9 10	^_< 1 ^_< 2 3 5 1 4 ^_< 1 14 15 8 6 11 12 5 13 10 7 4 9 2 3 QQ

D. Drawing Hell

Problem ID: draw

You feel tired after solving many coprime heaven puzzles. Nozomi thinks coprime heaven is also too easy for her now, and single player card game is too boring. So she want to play a interesting two player game called "Drawing Hell" with you.

At the beginning, you and Nozomi draw n lucky points on a blank page of the textbook. You and Nozomi move in turns. Nozomi goes first. In each turn, one can draw a straight segment to connect two lucky points, if it does not cross over any existing segment and/or lucky points. The player who cannot move loses. Note that you can connect a point more than once, and the first game in sample input will finish in three turns.

You and Nozomi will play this game T times during the class. As we know, Nozomi is very smart and will play optimally. Is there any chance you will win the game?

Input

The first line contains an integer T, followed by the input of T games. Each game starts with a line contains an integer n. Each of the following n lines contains two integer x_i, y_i denoting the coordinates of each lucky points.

- $1 \leq T \leq 1000$
- $1 \leq n \leq 1000$
- $0 \leq |x_i|, |y_i| \leq 1000$
- All the lucky points are distinct.

Output

For each game, please output "`OwO`" if you may win even when Nozomi plays optimally. Otherwise, please output "`T^T`".

Sample Input 1	Sample Output 1
3 3 0 0 0 4 4 0 4 0 0 0 4 4 0 1 1 4 0 0 0 4 4 0 2 2	T^T OwO T^T

E. Easiest Game

Problem ID: knight

After school, you complete all homeworks in 10 minutes. Though most classes are easy and boring, you are still looking forward to the classes tomorrow. Because you like to playing games with Nozomi. Maybe you have fallen in love with her?

To make the classes tomorrow more interesting, you are researching a cool game called "Knight Garden", and want to share this game with her tomorrow.

The game is played on a $n \times m$ board. There is a (r, s)-knight starts from the upper left corner. In each move, this knight can jump from (x, y) to $(x \pm r, y \pm s)$ or $(x \pm s, y \pm r)$, if the position lies in the board. For example, if a $(1, 2)$-knight is at position $(3, 3)$ of a 5×5 board, the knight has eight possible moves.

We say a (r, s)-knight on a $n \times m$ board is lucky if it can visit all positions on the board. Note that each position can be visited multiple times. You think that just to check whether a knight is lucky is too easy for Nozomi. So you want to know when n, m are given, how many integer pairs (r, s) such that $1 \leq r \leq s \leq \max(n, m)$ and (r, s)-knight is lucky on a $n \times m$ board? As usual, there are T similar questions.

Input

The first line contains an integer T.

Each of the following T lines contains two integers n, m.

- $1 \leq T \leq 5000$
- $1 \leq n, m \leq 10^7$

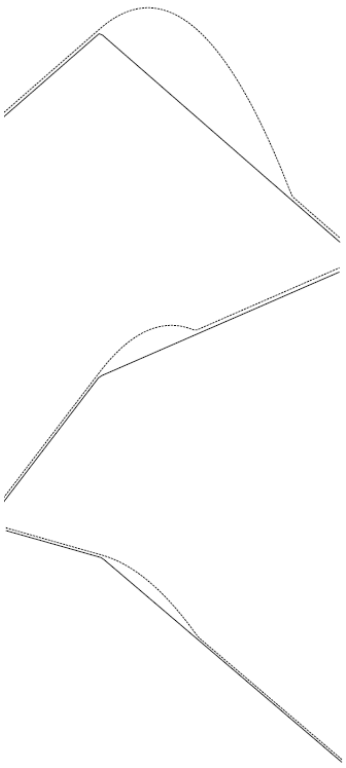
Output

For each question, please output the number of lucky knights on that board.

Sample Input 1	Sample Output 1
4 4 4 4 8 8 8 100 100	1 1 4 518

F. Flying Motorcycle

Problem ID: motor



You got a brand new cool motorcycle as a birthday gift from Nozomi, and you decide to try it on WWW mountain this weekend.

As the name "WWW" hinted, WWW mountain is famous for its precipitous ups and downs. Thus when riding a motorcycle, you may fly off the ground. It's pretty dangerous to riding motorcycle without a detailed planning.

Since this weekend is your first time to ride motorcycle on WWW mountain, you want to try some easy route first. You plan to just go straight. Thus the ground can be seem as a series of slopes. The speed of motorcycle on the ground is a constant v. The motorcycle would fly off the ground when running over the start point of a slope slanting more downward than the current. It then flies along a parabola until reaching the ground, with the gravity equals to 9.8m/s^2.

As a part of the plan, you want to know the length of trace you will run on the ground for each route, and there are T such planned routes.

Input

The first line contains an integer T, followed by the input of T planned routes. Each route starts with a line contains two integers n, v. Then each of the following n lines contains two integers x_i, y_i. The i-th slope is the line segment $(x_i, y_i) - (x_{i+1}, y_{i+1})$. The start of the route is at (x_1, y_1), and the end is at (x_n, y_n). Note that you may fly over the end point, and stop immediately.

- $1 \leq T \leq$ the answer to life the universe and everything $= 42$
- $2 \leq n \leq 10000$
- $1 \leq v \leq 10000$, and given in m/s
- $0 \leq x_i, y_i \leq 10000$, and given in meters
- $x_i < x_{i+1}$
- The distance of x-coordinate between the falling point and any intersection (except where you start flying) is at least 10^{-5} meters.

Output

For each planned route, please output the length of trace you will run on the ground in meters. The answer will be considered correct if the absolute or relative error does not exceed 10^{-8}.

Sample Input 1	Sample Output 1
3 3 1 1 1 2 2 3 4 5 1 0 0 1 1 2 0 3 1 4 0 4 5 0 10000 1 10000 2 0 10000 0	3.650281539873 5.079624224034 9774.123024273687

G. Game Again

Problem ID: tube

The math class is coming again. You can't wait to tell Nozomi the game "Knight Garden", and she return a new game called "YouTube" back to you.

Just like Knight Garden, YouTube is also played on a $n \times m$ board. Each cell may either be empty or broken. There are six types of tubes can be placed on the board: ‖ = ╚ ╔ ╗ ╝. The goal is to place exactly one tube on each empty cell such that all tubes are connected perfectly. That is, all tubes should be closed and form some cycles. Note that you cannot put anything on a broken cell, since it is broken.

But Nozomi thinks it is too easy for her admirer, so she mark some empty cells as lovely cells. She prefer to put L shaped tubes ╚ ╔ ╗ ╝ into lovely cells. It is ok to put a ‖ or = into a lovely cell, but it will produce one unit of unloveliness. As you may already know, your mission is to make them connected perfectly, and minimize the unloveliness. The math class is long enough for you to solve T YouTube puzzles.

Input

The first line contains an integer T, followed by the input of T YouTube puzzles. Each puzzle starts with a line containing two integers n, m. Each of the following n lines contains m characters, denoting the board of puzzle. The character '.' denotes a normal empty cell. The character 'L' denotes a lovely empty cell. The character '#' denotes a broken cell.

- $1 \leq T \leq 100$
- $1 \leq n, m \leq 25$
- No character other than ".L#" will in the board of puzzle.

Output

For each puzzle, print "-1" if it impossible to make all tubes are connected perfectly. Otherwise, print the minimum unloveliness.

Sample Input 1	Sample Output 1
4 3 3 ... ... 3 3 L.L .#. L.L 3 3 .L. .#. ... 4 4 LL## LL## ##LL ##LL	-1 0 1 0

H. Hash Collision

Problem ID: hash

As a lazy guy, Shik uses hash heavily when solving problems related to string. Here is a simple hash function implemented in C.

```
int hash(int n, int m, int p, const char *s) {
    int h = 0;
    for (int i = 0; i < n; i++) h = (h * p + s[i]) % m;
    return h;
}
```

If an (unordered) pair of different strings has the same hash values, we say this pair is a "collision pair". Shik claims that he is very lucky and the probability of hash collision is negligible. To verify his claim, you want to calculate the number of collision pairs given n, m, p. Here we only consider the strings consisting of only uppercase letters 'A' to 'Z'. Note that because n is given, the length of string must be exactly n. Since the number could be very large, you only need to output it modulo $10^6 + 3$.

Input

The input contains exactly one line with three integers n, m, p

- $1 \leq n \leq 10^6$
- $2 \leq p < m \leq 30000$
- m and p are primes.

Output

Please output the number of collision pairs modulo $10^6 + 3$.

Sample Input 1	Sample Output 1
1 3 2	100

Sample Input 2	Sample Output 2
2 3 2	75825

Sample Input 3	Sample Output 3
21 13 5	142108

Sample Input 4	Sample Output 4
50216 9973 131	405787

I. Increasing or Decreasing

Problem ID: monotonic

We all like monotonic things, and solved many problems about that like Longest Increasing Subsequence (LIS). Here is another one which is easier than LIS (in my opinion).

We say an integer is a momo number if its decimal representation is monotonic. For example, 123, 321, 777 and 5566 are momo numbers; But 514, 50216 and 120908 are not.

Please answer m queries. The i-th query is a interval $[l_i, r_i]$, and please calculate the number of momo numbers in it.

Input

The first line contains an integer m.

Each of the following m lines contains two integers l_i, r_i.

- $1 \leq m \leq 10^5$
- $1 \leq l_i \leq r_i \leq 10^{18}$

Output

For each query, please output the number of momo numbers in that range.

Sample Input 1	Sample Output 1
2 1 100 100 200	100 48

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J. Just Convolution

Problem ID: convolution

Do you remember the problem "Just Composite" in NTU Final 2014? Here is another one of "Just" series. Of course, This one is easier. I would even give you a correct (but too slow) implementation in C++.

```
struct Con {
    int x;
    Con(int _x) : x(_x) {}
};
Con operator *(Con a, Con b) { return a.x + b.x; }
void operator +=(Con &a, Con b) { if (b.x > a.x) a.x = b.x; }

void convolution(int n, Con *a, Con *b, Con *c) {
    for (int i = 0; i < n; i++) c[i] = 0;
    for (int i = 0; i < n; i++)
        for (int j = 0; j < n; j++)
            c[(i + j) % n] += a[i] * b[j];
}
```

Input

The first line contains an integer n. The second line contains n integers $a_0, a_1, \ldots, a_{n-1}$. The third line contains n integers $b_0, b_1, \ldots, b_{n-1}$.

- $1 \leq n \leq 2 \times 10^5$
- $0 \leq a_i, b_i < n$
- a is a permutation of $0, 1, \ldots, n-1$
- b is a permutation of $0, 1, \ldots, n-1$
- The permutations a and b are generated randomly to make our life much more easier.

Output

Please output the value of $c_0, c_1, \ldots, c_{n-1}$ in one line.

Sample Input 1

```
5
3 4 2 0 1
2 3 0 4 1
```

Sample Output 1

```
6 6 7 7 8
```

Sample Input 2

```
10
9 2 0 1 6 3 4 5 8 7
3 8 0 9 7 1 4 2 6 5
```

Sample Output 2

```
15 17 16 18 16 14 14 15 15 16
```