Problem A
A Classic Problem

Time limit: 5 seconds
Memory limit: 1024 megabytes

Problem Description

Classic problems in competitive programming are problems frequently appearing in programming contests. This problem is also a very classic one in the field of computational geometry. It is about to answer which points are covered by a given simple polygon.

To state the problem precisely, we first give the definition of a polygon. A polygon of n edges is described by n straight line segments $e_1, e_2, \ldots, e_n$ connected to form a closed chain. That is, there exists a sequence of vertices $v_1 = (x_1, y_1), v_2 = (x_2, y_2), \ldots, v_n = (x_n, y_n)$ such that $e_n = \overline{v_n v_1}$ and $e_i = \overline{v_i v_{i+1}}$ for $1 \leq i < n$. Note that we can define a polygon with a sequence of vertices mentioned above.

A simple polygon is a polygon that does not intersect itself. That is, any two line segments may only meet each other on their endpoints. Therefore, a simple polygon encloses a region call its interior. A point p is covered by a simple polygon P if and only if p lies on some edge of P or the interior of P.

In this problem, you are given a simple polygon of n edges defined by a sequence of vertices and m points on 2D-plane. Please write a program to determine which points are covered by the givin simple polygon.

Input Format

The first line contains two space-separated positive integers n and m. n is the number of edges of the simple polygon, and m is the number of points. Then $n+m$ lines follow. For $1 \leq i \leq n$, the $(i+1)$-th line of the input contains two space-separated integers x_i and y_i where $v_i = (x_i, y_i)$ is the i-th item of the sequence describing the simple polygon. For $1 \leq j \leq m$, the $(1+n+j)$-th line of the input contains two space-separated integers X_j and Y_j where $p_j = (X_j, Y_j)$ is the j-th point to be tested whether it is covered by the simple polygon.

Output Format

Output m lines. On the j-th line of the output, print `YES` if p_j is covered by the simple polygon defined by the sequence $v_1, v_2, \ldots, v_n$. Otherwise, print `NO`.

Technical Specification

- $3 \leq n \leq 10^5$
- $1 \leq m \leq 10^5$
- The sequence $v_1, v_2, \ldots, v_n$ always defines a simple polygon.
- $x_i, y_i \in [-10^9, 10^9]$ for $1 \leq i \leq n$
- $X_j, Y_j \in [-10^9, 10^9]$ for $1 \leq j \leq m$

Sample Input 1

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

Sample Output 1

```
YES
NO
YES
```

Sample Input 2

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

Sample Output 2

```
NO
YES
YES
YES
```

Problem B
Best Substring

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

You are given a string $s = s_1 s_2 s_3 ... s_n$. Let $f(s, i)$ denotes the starting position of the best length-i substring. For two equal-length substring a and b, the one has smaller lexicographically order is better. If the two substring are the same, the one has smaller starting position is better.

Let $h(s) = \sum_{i=1}^{n} i \times f(s, i)$. Your task is to find $h(s)$.

Input Format

First line contains the number of testcases T. Each testcase is a line containing a string s.

Output Format

For each testcase, output $h(s)$ in one line.

Technical Specification

- $1 \leq T \leq 10^5$
- $1 \leq |s| \leq 2 \times 10^5$
- the total length of strings is at most 2×10^6

Sample Input 1

```
3
apple
banana
abcdabcd
```

Sample Output 1

```
15
36
36
```

Problem C
Camp

Time limit: 1 second
Memory limit: 1024 megabytes

Problem Description

In Gakuentoshi, everyone has their own unique skill. Uiharu and Shirai are holding a learning event to let their friends to teach each other their skills and make new friends. Uiharu and her friends are red team. Shirai and her friends are white team.

Each one in red team will pick one of white team's members as student. And each one in white team will pick one of red team's members as students. Everyone will pick a student and can only be one person' s student. First, red team will teach their students their own skill. And white team will teach their students their own skill. Everyone learn one new skill now. Then red team will teach their students the new skill they just learned and so does white team. This won't stop until they cannot learn new skill.

Both red team and white team have N people. M people already choose a student. Uiharu wonders how many possibilities are left so everyone could learn all the skill the attendee has. Can you help her?

Two possibility are considered different if anyone choose a different student.

Input Format

First line contains one integer T. There are T test data followed by. In each test, the first line contains two numbers N and M separated by blanks. There are N people in each team. M people have chosen their students. Then M lines follows. The i-th of following lines contains one letter and two number C_i, u_i, and v_i. C_i could be `R` or `W`. `R` means that the u_i-th member of red team chooses the v_i-th member of white team. `W` means that the u_i-th member of white team chooses the v_i-th red team. Everyone will at most choose one student.

Output Format

For each test data, output the number of possibilities that everyone could learn all the skills the attendees have.

Technical Specification

- $1 \leq T \leq 100$
- $1 \leq N \leq 7$
- $0 \leq M \leq 2N$
- C_i is either `R` or `W`.
- $1 \leq u_i \leq N$
- $1 \leq v_i \leq N$

Sample Input 1

```
2
1 1
R 1 1
3 2
R 3 1
W 2 2
```

Sample Output 1

```
1
1
```

Problem D
Discovering Secrets in Islands

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

Two villages are connected together by a two-way road. In an environment, there are many villages. A traveler starts from a village (source) and moves to a predefined village (destination). To do so, the traveler moves along the roads to visit villages until the traveler reaches the destination. The traveler can find some moon stones at a village. Each road has a travel cost. Determine a path for the traveler so that the traveler takes the lowest cost. If there are two paths with the same cost, the one with the highest amount of moon stones is selected. The total influence cost of a village, v, is the sum of the cost of all the villages in the k-neighborhood of village v. The k-neighborhood of village v does not include the village v itself. For two different villages u and v, village u is a member of the k-neighborhood of village v *iff* there are at most k roads that are visited for moving from village v to village u.

The travel cost from one village v_s to an adjacent village v_a via road r is computed as:

$$\text{Travel cost} = c_t(v_s) + c_r$$

where road r connects villages v_s and v_a, $c_t(v_s)$ is the total influence cost of v_s, and c_r is the cost of the road.

The villages have unique names. A name is formed by four letters in lowercase.

Input Format

The first line contains three numbers, N, M, and k, where N is the total number of villages, M is the total number of roads, and k is the value used for defining the neighborhood of villages. The second line contains the source village name and the destination village name. Then there are N set of village records. Each village record contains: the village name, the number of moon stones of the village, and the influence cost. Then there are M road records. Each road record contains two village names and the road cost.

Output Format

For each problem instance, output the lowest cost and the maximum moon stones.

Technical Specification

- $1 \leq N \leq 10000$
- $1 \leq M \leq 10000$
- $0 \leq k \leq 5$
- $1 \leq c \leq 99$, where c is the cost of a road
- $1 \leq m \leq 8$, where m is the number of moonstones at a village
- $1 \leq f \leq 5$, where f is the influence cost of a village

Sample Input 1

```
6 4 0
nagi nage
nagi 5 1
nagf 7 2
nagh 2 2
nagd 6 5
nagg 5 2
nage 2 5
nagh nagd 96
nagi nagh 25
nagh nagg 49
nagd nage 3
```

Sample Output 1

```
124 15
```

Sample Input 2

```
4 2 1
akko akkm
akko 2 5
akkp 8 2
akkn 1 1
akkm 6 3
akkn akkm 20
akko akkn 3
```

Sample Output 2

```
32 9
```

Sample Input 3

```
6 5 2
gaam gaak
gaak 2 1
gaan 2 3
gaaj 1 2
gaao 5 5
gaal 1 2
gaam 1 3
gaan gaaj 96
gaao gaal 25
gaak gaao 95
gaan gaal 37
gaaj gaam 89
```

Sample Output 3

```
384 12
```

Problem E
Emulation of Numbers

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

X is a positive number and P is a set of positive numbers. Compute the total number of combinations of the P's elements such that the sum of the elements of each combination is equal to X. The elements of P can be reused.

The followings are three examples. Example One: $X = 6, P = \{2, 3, 7\}$. The number of combinations is 2. The combinations are: 1) $\{2, 2, 2\}$; and 2) $\{3, 3\}$.

Example Two: $X = 7, P = \{2, 7, 3\}$. The number of combinations is 2. The combinations are: 1) $\{2, 3, 2\}$; and 2) $\{7\}$.

Example Three: $X = 9, P = \{2, 3, 7, 3\}$. The number of combinations is 3. The combinations are: 1) $\{2, 7\}$; 2) $\{2, 2, 2, 3\}$; and 3) $\{3, 3, 3\}$.

Input Format

The first line contains the positive number X. The second line is the number of elements of P, N. The third lines contain N positive numbers which are the elements of P.

Output Format

Print the number of all possible combinations. If there is no combination, print `0`.

Technical Specification

$1 \leq X \leq 1000000$, $2 \leq N \leq 9$, and $[X/1000] + 2 \leq p \leq 2 * [X/1000] + 7$, where p is an element of P, and $[X/1000]$ is the largest integer that is smaller than or equal to $X/1000$. The elements of P are not unique. The maximum number of combinations is smaller than 10^{16}.

Sample Input 1

```
6
3
2 7 3
```

Sample Output 1

```
2
```

Sample Input 2

```
7
3
2 7 3
```

Sample Output 2

```
2
```

Sample Input 3

```
9
4
```

Sample Output 3

```
3
```

```
2 3 7 3
```

Problem F
Fast and Hairy

Time limit: 5 seconds
Memory limit: 1024 megabytes

Problem Description

Uiharu and Misaka are running a barbershop. There are N customers every day. Everyone wants a different hair style so the work load w_i would be different. Uiharu and Misaka have different skills to speed up their work. Uiharu could program the hair clipper to work faster. She can finish U unit of work per second. Misaka could control the electricity and operate the hair clipper without hands. She can finish M unit of work per second. Each customer can only be serviced by one barber. Uiharu and Misaka want to getting off work together. They'll go home after the last customer leave. They need to distribute the work load evenly. Right now, they are busy on preparing their equipment. Can you help them find out what is the least time to finish today's work? If the last customer leaves in the middle of a second, we say the work finishes at the end of the second.

Input Format

First line contains one integer T. There are T test data followed by. In each test, the first line contains three numbers N, U, and M separated by blanks. The second line contains N numbers $w_1, w_2, \ldots, w_N$.

Output Format

For each test data, output one number representing the least time to finish today's work.

Technical Specification

- $1 \leq T \leq 100$
- $1 \leq N \leq 10000$
- $1 \leq U \leq 10000$
- $1 \leq M \leq 10000$
- $1 \leq w_i \leq 100$ for $i \in \{1, 2, \ldots, N\}$.

Sample Input 1

```
1
5 2 3
2 7 3 6 6
```

Sample Output 1

```
5
```

Problem G
Garden

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

There is a grassland in front of Alice's house with some beautiful flowers. Alice wants to fence up all of the flowers to be her garden.

The grassland is a 2D plane, and there are m flowers on the grassland. The j-th flower is on the integer position (x_j, y_j). There are also n wood piles on the grassland. The i-th wood pile is on the integer position (X_i, Y_i). She wants her gardan is a *convex polygon*, that means if she wants to move from one place to another place in her garden, she can go in a straight line without leaving her garden. The garden should have a positive area and all of the vertices should be a wood pile on the grassland. All of the flowers should be *strictly* inside the garden, that means the flower can not be outside the garden or on the border of the garden. She needs some fences to fence up her garden, and she wants to minimize the total length of the fences. If she wants to put the fences between the a-th wood pile and the b-th wood pile, she needs $\sqrt{(X_a - X_b)^2 + (Y_a - Y_b)^2}$ length of fences.

She is curious if she can to use the i-th wood piles as one of the vertices in her garden. What is the minimal length of fences she needs? Can you help her?

Input Format

The first line contains one integer n indicating the number of wood piles. Following contains n lines. The i-th line contains two integers X_i, Y_i separated with one space indicating the position of the i-th wood piles. Next line contains one integer m indicating the number of flowers. Following contains m lines. The j-th line contains two integers x_j, y_j separated with one space indicating the position of j-th flowers. Guarantee no three wood piles are collinear and all the positions of flowers and wood piles are distinct.

Output Format

Print n floating number, the i-th number indicates the minimal length of fences if Alice wants to use the i-th wood pile as one of the vertices in her garden. If it is impossible to fence up her garden with the i-th wood pile, please print -1. The answer is considered as correct if its absolute or relative error doesn't exceed 10^{-6}. Namely, if your answer is a, and the jury's answer is b, then your answer is accepted, if $\frac{|a-b|}{max(1,|b|)} \leq 10^{-6}$

Technical Specification

- $1 \leq n \leq 100$
- $-10^9 \leq X_i, Y_i \leq 10^9$
- $1 \leq m \leq 10^5$

- $-10^9 \leq x_j, y_j \leq 10^9$

Sample Input 1

```
5
0 0
2 2
-2 -2
2 -2
-2 2
4
1 1
-1 -1
1 -1
-1 1
```

Sample Output 1

```
-1 16 16 16 16
```

Problem H
Hand Gestures

Time limit: 1 second
Memory limit: 1024 megabytes

Problem Description

Nowadays, many games are moving toward the gesture control system rather than the old joystick controls. Figure 1 presents an image collection of hand gestures for some English alphabet.

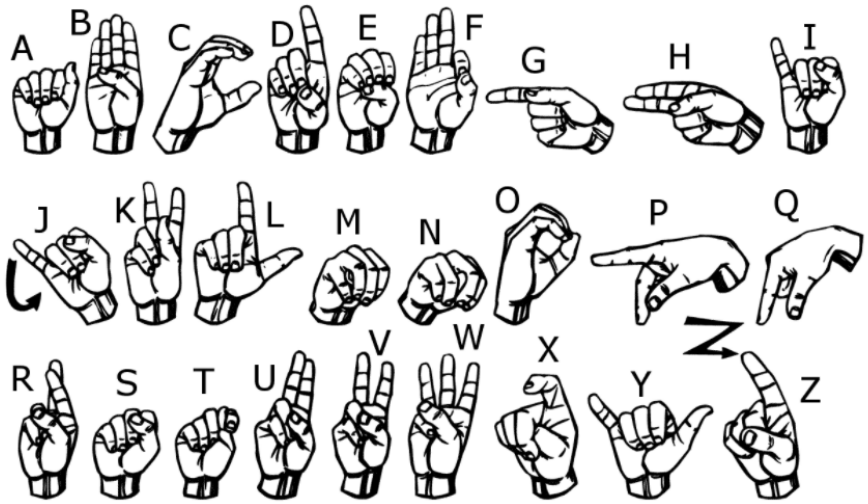

Figure 1: Hand Gestures for the English Alphabet

Hank wants to write a program to recognize English alphabets using sign language. He found that Modified National Institute of Standards and Technology (MNIST) database provides sing language datasets. All samples in a dataset are byte vectors of dimension d. That is, every sample can be represented by a vector $(x_1, x_2, \ldots, x_d)$ where x_i is a byte (from 0 to 255) for $1 \leq i \leq d$. Hank plans to use them to train a model and to test his program. He builds two sets of data. One is for training and another is for testing.

Hank is an outstanding data scientist, but his data processing skill is awful. He accidental puts some of the training data into the testing dataset. This will affect the evaluation result of Hank's program. Please write a program to help Hank to remove the training data from the testing dataset.

Input Format

The first line contains three space-separated positive integers n, m and d. n is the number of the labeled samples in the training data. m is the number of the labeled samples in the testing data. d is the dimension of the labeled samples. Then $n + m$ lines follow. Each of the first n of them represents a labeled sample in the training data, and each the last m of them represents a labeled sample in the testing data. Every labeled sample is a line containing $d + 1$ space-separated positive integer $t, x_1, x_2, \ldots, x_d$.

Output Format

For each sample in the testing data, output one line. If the sample is in the training data, print `BAD`. Otherwise, print `GOOD`.

Technical Specification

- $1 \leq n \leq m \leq 10^5$
- $0 < m \times d \leq 10^6$
- For every sample, $0 \leq t \leq 25$ and $0 \leq x_i \leq 255$ for $1 \leq i \leq d$.

Sample Input 1

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

Sample Output 1

```
BAD
BAD
GOOD
```

Problem I
Infosys Tennis Platform

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

Tennis is a racket sport that can be played individually against a single opponent (singles) or between two teams of two players each (doubles). A tennis match is composed of points, games, and sets. A set consists of a number of games, which in turn each consist of points. Typical tennis rules are as follows:

- A set is won by the first side to win 6 games, with a margin of at least 2 games over the other side (e.g. 6–3 or 7–5).
- A game is won by the first side to win 4 points, with a margin of at least 2 points over the other side (e.g. 4–1 or 9–7).

Tennis is a sport that has been played for decades. With the devoloping techonologies such as AI and big data, tennis matches are evolving. Infosys Tennis Platform is the digital brain of professional tennis technology experience. The system is an open-source polycloud platform architected to be plug-and-play. Harnessing every data source, aggregating multiple applications and serving any tournament need, the system is the future of convergent and unified sporting experiences.

As a professional analyst and an amateur tennis player, you are asked to verify if the system is reliable. Given the numbers of total points won in a set by both sides, determine if the record is reasonable for the left side to win the set according to the above rules.

Input Format

The first line contains an integer n indicating the number of sets to verify. Each of the following lines contains two dash seperated integers L_i and R_i indicating the number of total points won from both sides winthin a set.

Output Format

Output one line for each set. Output `YES` if it is possible that the set is won by the left side. Otherwise, output `NO` instead.

Technical Specification

- $1 \leq n \leq 5000$
- $0 \leq L_i, R_i \leq 80$

Sample Input 1

```
6
23-10
```

Sample Output 1

```
NO
YES
```

```
24-12
24-24
24-30
26-30
60-30
```

```
YES
NO
YES
NO
```

Problem J
Juniper Networks

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

Juniper Networks, Inc. is an American multinational corporation headquartered in Sunnyvale, California. The company develops and markets networking products, including routers, switches, network management software, network security products, and software-defined networking technology.

Aston Martin Lagonda, one of the most prestigious British sport car brands, deployed Juniper networking at its headquarters and around the world, empowering automotive designers and engineers to build new iconic British cars. Consistent network infrastructure supports diverse requirements at offices, manufacturing facilities, engineering centers, and performance centers. The simplicity of Juniper empowers the IT team to operate at the speed of business.

The network company has developed a new routing system, where there are n routers indexed from 1 to n. Each router is protected by two keys P_i and Q_i. To initialize the system, the terminal has to send packets to unlock the routers sequentially.. A packet holding two keys is sent from the terminal each time, which is able to unlock any number of the remaining routers matching at least one key value. As a professional computer scientist, you are asked to minimalize the network usage for the system. Given the keys on each router, determine the minimum number of packets needed to initialize to system.

Input Format

The first line contains an integer n indicating the number of routers. Each of the following lines contains two space seperated integers P_i and Q_i indicating the key values on each router.

Output Format

Output a single integer, the minimum number of packets needed to initialize the system.

Technical Specification

- $1 \leq n \leq 10000$
- $1 \leq P_i \leq Q_i \leq 2n$

Sample Input 1

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

Sample Output 1

```
3
```

Sample Input 2

```
5
1 2
3 4
2 6
4 5
2 4
```

Sample Output 2

```
1
```

Problem K
KOVID-21

Time limit: 2 seconds
Memory limit: 1024 megabytes

Problem Description

There is an epidemic of KOVID-21 spreading around the world. People's lives are severely affected by the KOVID-21. Especially the people like to travel around the world.

Fortunately, the vaccine, Hoderna, is coming. Hoderna is so powerful that the person who has been vaccinated with Horderna will not be infected with KOVID-21 at all. But Hoderna is hard to preserve. For convenience, the government wants to find *exactly one* place to be a vaccination station. Finding the place of the vaccination station is a hard problem. If the place of the vaccination station is too far for some person. They will be annoyed with the government.

The country is a 2D plane, there are n residents. The ith resident lives on the (x_i, y_i) of the 2D plane. Guarantee the residents live in the integer position, which means x_i, y_i are integers. In one unit, the person in the position (x, y) can go to one of the eight position $(x-1, y-1), (x-1, y), (x-1, y+1), (x, y-1), (x, y+1), (x+1, y-1), (x+1, y), (x+1, y+1)$. The annoy value of a resident is the number of time units that he needs to spend to go to the vaccination station from their home. Please help the government to *minimize* the *sum* of annoyance with all residents.

Input Format

The first line contains one integer n indicating the number of residents. Following contains n lines. The ith line contains two integer x_i, y_i separated with one space indicating the position of ith resident.

Output Format

print a single integer indicating the minimum sum of annoyance value with all residents.

Technical Specification

- $1 \leq n \leq 10^6$
- $-10^9 \leq x_i, y_i \leq 10^9$

Sample Input 1

```
1
1 1
```

Sample Output 1

```
0
```

Sample Input 2

```
2
0 0
```

Sample Output 2

```
2
```

```
2 2
```

Problem L
Luansheng Divisor

Time limit: 10 seconds
Memory limit: 1024 megabytes

Problem Description

A Luansheng divisor of n is an positive integer x that both x and $x+1$ are divisor of n. For example 6 is a Luansheng divisor of 84 because both 6 and 7 are divisor of 84.

You are given a positive integer n. Your task is to find all Luansheng divisors of n.

Input Format

First line contains the number of testcases T. Each testcase is a line containing a positive integer n.

Output Format

For each testcase, output a line containing all Luansheng divisor of n in increasing order. If n doesn't have any Luansheng divisor, output -1.

Technical Specification

- $1 \leq T \leq 100$
- $1 \leq n \leq 10^{18}$

Sample Input 1

```
4
35
40
50
60
```

Sample Output 1

```
-1
1 4
1
1 2 3 4 5
```

Problem M
Mobile Communication in Flatland

Time limit: 1 second
Memory limit: 1024 megabytes

Problem Description

Our world is spherical, but the world of Flatland is flat! In Flatland, the ground is flat without any curvature, and everywhere has the same height. However, the mobile communication in Flatland and in our world are quite similar. The mobile phone must be in the signal coverage of some base station. Otherwise, the phone cannot communicate with the others.

Mark is a wise Flatlander living in the rural area. He knows there is only one base station in the area where he is living. One day, he finds that the shape of signal coverage of that base station is a ball! Such shape is unusual in Flatland, because a ball is perfectly spherical! Mark wants to figure out the boundary of the signal coverage, but he can only move on the ground. He first moves from his house to the east and finds that his mobile phone is out of service after E kilometers. Then, he moves from his house to the west/south and finds that his mobile phone is out of service after W/S kilometers, respectively.

After learning the numbers E, W, and S, Mark says "Ahh! Now I know the signal coverage of the base station!" Mary, Mark's sister, wonders if Mark really knows. She asks Mark "If you move from your house to the north, after how many kilometers, your mobile phone will be out of service?"

Could you compute the answer for Mary to check whether his brother can answer her correctly?

Input Format

For each test case, there are three numbers E, W, and S separated by blanks.

Output Format

Print the answer in one line. The answer can be a fractional number. It is acceptable if the absolute error or the relative error is less than 10^{-6}.

Technical Specification

- $1 \leq E \leq 10^4$
- $1 \leq W \leq 10^4$
- $1 \leq S \leq 10^4$

Sample Input 1

```
1 1 1
```

Sample Output 1

```
1
```

Sample Input 2

Sample Output 2

`1.1 2.2 2.2`	`1.1`