2012 Mid-Atlantic Regional Programming Contest

This is a courtesy copy of the problem set for the Mid-Atlantic Regional contest. It is an abbreviated version of the problem set provided to the teams. Omitted are several pages of rules and explanations of the contest and judging environment.

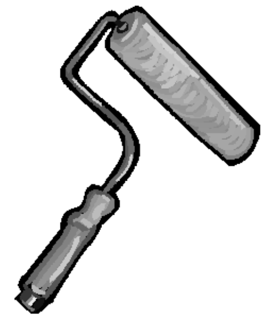
Important:

The creation of this problem set was a collaboration among several Regional Contests scheduled for November 10. These contests will be stating at different times and taking place in different time zones.

In deference to the later starting contests, we ask that you refrain from emailing, blogging, posting, tweeting, or otherwise making any public comments about this problem set until November 11.

Problem	Problem Name	Balloon Color
A	Fifty Coats of Gray	Yellow
B	Component Testing	Green
C	Collision Detection	Silver
D	The Dueling Philosophers Problem	Black
E	Party Games	Pink
F	Funhouse	Orange
G	A Terribly Grimm Problem	Purple
H	Tsunami	Red

Problem A: Fifty Coats of Gray



A contractor is planning to bid on interior painting for an apartment. These apartments are for student housing, so they are to be single-room efficiencies and have basic drywall walls and ceilings, with no particular architectural features like crown molding. He would like to find a quicker way to estimate how much paint it will take to paint the walls and ceilings for each job. The plan for these buildings is to paint the four walls and the ceiling. Of course, no paint is needed for window and door openings. All rooms, windows and doors are rectangular. All rooms will be painted the same color.

The contractor will provide you with information about the dimensions of the rooms, the windows and doors for each floor plan, and the number of apartments. Your team is to write a program that will tell him how many cans of paint he should include in his bid.

Input

There will be several test cases in the input. Each test case begins with a line with 6 integers:

n width length height area m

where n ($1 \leq n \leq 100$) is the number of apartments, width ($8 \leq$ width ≤ 100) is the width of each room, length ($8 \leq$ length ≤ 100) is the length of each room, height ($8 \leq$ height ≤ 30) is the height of each room, area ($100 \leq$ area $\leq 1,000$) is the area in square feet that can be covered by each can of paint, and m ($0 \leq m \leq 10$) is the number of windows and doors.

On each of the next m lines will be two positive integers, width and height, describing a door or window. No window or door will be larger than the largest wall. All linear measures will be expressed in feet. The input will end with a line with six 0s.

Output

For each test case, output a single integer on its own line, indicating the number of cans of paint needed to paint all of the walls and ceilings of all of the apartments.

Example

Given the input

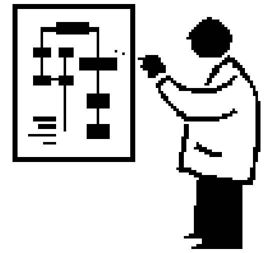
```
50 8 20 8 350 2
6 3
3 3
50 8 20 8 300 3
6 3
5 3
3 3
```

```
0 0 0 0 0 0
```

the output would be

```
83
95
```

Problem B: Component Testing



The engineers at ACM Corp. have just developed some new components. They plan to spend the next two months thoroughly reviewing and testing these new components. The components are categorized into several different classes, depending on their complexity and importance. Components in different classes may require different number of reviewers, whereas components in the same class always require the same number of reviewers.

There are also several different job titles at ACM Corp. Each engineer holds a single job title. All engineers holding a given job title have the same limit on the number of components that they can review. Note that an engineer can be assigned to review any collection of components and will be able to complete the task, regardless of which classes the components belong to. An engineer may review some components of the same class, and others from different classes, but an engineer cannot review the same component more than once.

Can the engineers complete their goal and finish testing all components in two months?

Input

There will be multiple test cases in the input.

The first line of each test case contains two integers n ($1 \leq n \leq 10,000$) and m ($1 \leq m \leq 10,000$), where n is the number of component classes and m is the number of engineer job titles.

Each of the next n lines contains two integers j ($1 \leq j \leq 100,000$) and c ($0 \leq c \leq 100,000$), indicating that there are j components in this class and that each component requires at least c different reviewers.

Then each of the next m lines each contains two integers k ($1 \leq k \leq 100,000$) and d ($0 \leq d \leq 100,000$), indicating that there are k engineers with this job title and that each engineer may be assigned to review at most d components.

The input will end with a line with two 0s.

Output

For each test case, print a single line containing 1 if it is possible for the engineers to finish testing all of the components and 0 otherwise.

Example

Given the input

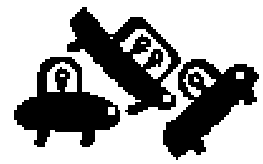
```
3 2
2 3
1 2
2 1
2 2
2 3
```

```
5 2
1 1
1 3
1 1
1 3
1 1
1 20
1 4
0 0
```

the output would be

```
1
0
```

Problem C: Collision Detection



As a preliminary step in developing an autonomous vehicle system, your team is seeking to prove that a central traffic controller can sound an alert when automobiles are likely to collide unless corrective actions are taken.

The test course consists of a number of straight tracks that intersect at a variety of angles. As cars pass sensors mounted on the tracks, their position and speed is recorded and sent to the central controller. The controller remembers its two most recent sets of readings for each car.

There is some built-in uncertainty in this process. The readings provided by the sensors are not exact. Also, simple automated sensors can't tell us what the drivers are thinking and whether they are already alert to the presence of other traffic. The controller can almost never state that a collision is unavoidable, and if it could make such a statement, it would probably not be able to do so in time for the drivers to take evasive action.

We therefore want the controller to sound the alert whenever two cars will pass"dangerously close" to one another any time within the next 30 seconds, assuming that they continue to behave as they have been recently observed to do. For this purpose, we will say that cars are *dangerously close* if they pass within 18 ft. of one another. Cars are considered safe if their closest approach is at least 20 ft. apart. A passage within 18. . . 20 ft. is considered ambiguous and may be treated either as dangerous or safe.

Assume that

- the cars remain on their straight course

- the acceleration (change in speed per unit time) of each car remains constant over the time between observations and for the next 30 sec, with the two exceptions given below. Accelerations may be negative, indicating a car that is slowing down.

  If a car with initial speed s_0 has constant acceleration a, then its speed at the end of a time interval t is

  $$s_t = at + s_0$$

  Over that same time interval, the car would travel a distance

  $$d = \frac{a}{2}t^2 + ts_0$$

- The two exceptions to the assumption that cars will maintain constant acceleration are:

  1. If the car is decelerating, it stops decelerating if its speed reaches zero (cars do not shift into reverse)
  2. If the car is accelerating, it stops accelerating when its speed reaches 80 feet per second (approx 55 m.p.h.)

Input

The input may contain multiple data sets.

Each data set consists of 4 observations, one observation per line. The first two observations are for car 1, the second two are for car 2.

Each observation consists of four floating point numbers t, x, y, s, where

- t is the time of the observation (in seconds), $0 \le t \le 120.0$
- x and y give the position of the car at the time of the observation (in feet), $-5000 \le x, y \le 5000$
- s is the speed in feet per second, $0 \le s \le 80$.

There will be no data sets in which the closest approach within the indicated timer interval falls in the ambiguous 18…20 ft. range. The two observations for a given car will always occur at distinct times, and the first observation time for each car will be earlier than the second observation time for that car.

Input is terminated by an observation consisting of 4 negative numbers.

Output

For each data set, print a single line consisting of either "Dangerous" or "Safe", depending on whether a dangerously close passage is predicted to occur within 30 seconds following the maximum of the 4 observation times.

Example

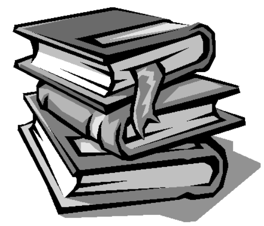
Given the input

```
10 0 0 10
11 7.42 7.42 11
11 41.0 106.0 16
12 56 106 14
0 0 0 50
0.5 21.7 12.5 50.1
0.25 39.0 22.5 50
0.75 60.7 35.0 50.1
-1 -1 -1 -1
```

the output would be

```
Dangerous
Safe
```

Problem D: The Dueling Philosophers Problem



Following a sad and strange incident involving a room full of philosophers, several plates of spaghetti, and one too few forks, the faculty of the Department of Philosophy at ___ University have been going through the papers of a recently deceased colleague. The faculty members were amazed to find numerous unpublished essays. They believe that the essays, collected into one volume, may constitute a major work of scholarship that will give their department some much-needed positive publicity. Naturally, all of the faculty members began to vie for the honor (to say nothing of the fame) of serving as editor of the collection.

After much debate, the faculty members have narrowed the list to two candidates. Both applicants were asked to explain how they would arrange the essays within the final book. Both have noted that many of the essays define terminology and concepts that are explored in other essays, and both have agreed to the basic principle that an essay that *uses* a term must itself *define* that term or appear *after* the essay that defines it.

One of the candidates has presented what he claims is the only possible arrangement of the essays under those constraints, and is arguing that he should be given the job simply because he has already done this major part of the work. The second candidate scoffs at this claim, insisting that there are many possible arrangements of the essays, and that an editor of true skill (himself) is needed to choose the optimal arrangement.

Write a program to determine if zero, one, or more than one arrangement of the essays is possible.

Input

There will be multiple test cases in the input.

Each test case will begin with a line with two integers, n ($1 \le n \le 1,000$) and m ($1 \le m \le 50,000$), where n is the number of essays, and m is the number of relationships between essays caused by sharing terms.

On each of the next m lines will be two integers, d and u ($1 \le u, d \le n$, $d \ne u$) which indicate that a term is defined in essay d and used in essay u.

The input will end with two 0s on their own line.

Output

For each test case, print a single line of output containing a 0 if no arrangement is possible, a 1 if exactly one arrangement is possible, or a 2 if multiple arrangements are possible (the output will be "2" no matter how many arrangements there are).

Example

Given the input

```
5 4
```

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

the output would be

```
2
1
0
```

Problem E: Party Games

You've been invited to a party. The host wants to divide the guests into 2 teams for party games, with exactly the same number of guests on each team. She wants to be able to tell which guest is on which team as she greets them when they arrive. She'd like to do so as easily as possible, without having to take the time to look up each guest's name on a list.

Being a good computer scientist, you have an idea: give her a single string, and all she has to do is compare the guest's name alphabetically to that string. To make this even easier, you would like the string to be as short as possible.

Given the unique names of n party guests (n is even), find the shortest possible string S such that exactly half the names are less than or equal to S, and exactly half are greater than S. If there are multiple strings of the same shortest possible length, choose the alphabetically smallest string from among them.

Input

There may be multiple test cases in the input.

Each test case will begin with an even integer n ($2 \leq n \leq 1,000$) on its own line.

On the next n lines will be names, one per line. Each name will be a single word consisting only of capital letters and will be no longer than 30 letters.

The input will end with a 0 on its own line.

Output

For each case, print a single line containing the shortest possible string (with ties broken in favor of the alphabetically smallest) that your host could use to separate her guests. The strings should be printed in all capital letters.

Example

Given the input

```
4
FRED
SAM
JOE
MARGARET
2
FRED
FREDDIE
2
JOSEPHINE
JERRY
```

```
2
LARHONDA
LARSEN
0
```

the output would be

```
K
FRED
JF
LARI
```

Problem F: Funhouse

An amusement park is building a new walk-through funhouse. It is being built in a large space: 1000ft x 1000ft. The park will build walls in the space, separating it into rooms. Some walls will have doors so that guests can move between rooms. Guests will enter through specially marked entrances, and exit through specially marked exits. They can move through the space as they wish - in fact, there may be many different ways of moving from the entrance to the exit. Of course, there will be many amusing things along the way.

The park designers want to install *shakerboards*, which are moving floors, to surprise the guests. To enhance the surprise factor, wherever they install shakerboards, they'll fill the whole room with them. That way, the boards won't stand out.

The designers want every guest in the funhouse to experience shakerboards, but, as you can imagine, shakerboards are expensive, so the park wants to cover as little space with them as possible.

Given a description of a funhouse design, what's the smallest area that must be covered with shakerboards to assure that every guest experiences them?

Input

There will be several data sets. Each data set will begin with a line with one integer n ($3 \leq n \leq 1,000$), which is the number of walls.

Each of the next n lines will describe a wall, like this:

$$x_1\ y_1\ x_2\ y_2\ \text{EXDW}$$

where (x_1, y_1) and (x_2, y_2) are the endpoints of the wall, and EXDW is a single capital letter: 'E' for an entrance, 'X' for an exit, 'D' for an interior wall with a door, and 'W' for any wall without a door. 'E' and 'X' are guaranteed to only appear on exterior walls, and 'D' is guaranteed to only appear on interior walls. 'W' may appear on either.

The endpoint coordinates will be integers, with values between 0 and $1,000$ inclusive. Walls will never intersect each other in any way or be coincident, except for sharing endpoints. Every endpoint will be coincident with another wall's endpoint. No wall will have zero length. There is guaranteed to be at least one way to get from every entrance to some exit and to every exit from some entrance. The funhouse will consist of a single building. In order to provide power throughout the building, every interior wall is connected to an exterior wall either directly or indirectly via a series of other walls.

End of input will be marked by a line with a single 0.

Output

For each test case, print a single line containing the smallest area that the park owners must cover with shakerboards so that every guest in the funhouse will experience them. This should be printed as a floating point number to one decimal digit precision.

Example

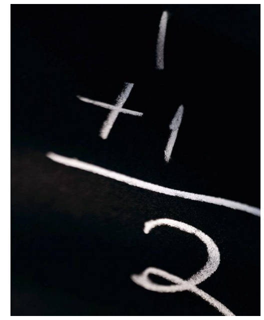
Given the input

```
6
0 0 100 0 W
0 0 0 100 E
0 100 100 100 W
100 0 100 100 D
100 0 200 0 W
200 0 100 100 X
14
0 0 100 0 W
100 0 110 0 E
110 0 190 0 W
190 0 200 0 E
0 0 0 100 W
100 0 100 100 D
200 0 200 100 W
0 100 100 100 D
100 100 200 100 D
0 100 0 150 X
100 100 100 150 D
200 100 200 150 X
0 150 100 150 W
100 150 200 150 W
0
```

the output would be

```
5000.0
10000.0
```

Problem G: A Terribly Grimm Problem



Grimm's conjecture states that to each element of a set of consecutive composite numbers one can assign a distinct prime that divides it.

For example, for the range 242 to 250, one can assign distinct primes as follows:

242	243	244	245	246	247	248	249	250
2	3	61	7	41	13	31	83	5

Given the lower and upper bounds of a sequence of composite numbers, find a distinct prime for each. If there is more than one such assignment, output the one with the smallest first prime. If there is still more than one, output the one with the smallest second prime, and so on.

Input

There may be several data sets.

Each data set will consist of a single line with two integers, L and H ($4 \leq L < H \leq 10^{10}$). It is guaranteed that all the numbers in the range from $L \ldots H$, inclusive, are composite.

The input will end with a line with two 0s.

Output

For each data set, print a single line containing the set of unique primes, in order, separated by a single space.

Example

Given the input

```
242 250
8 10
0 0
```

the output would be

```
2 3 61 7 41 13 31 83 5
2 3 5
```

Problem H: Tsunami

The country of Cartesia can be described simply by a Cartesian plane. The x-axis is a shoreline. The positive y half-plane is land, and the negative y half-plane is ocean. Several large cities dot the mainland. Their positions can be described by coordinates (x, y), with $y > 0$. Unfortunately, there are sometimes tsunamis in the ocean near Cartesia. When this happens, the entire country can flood. The waters will start at $y = 0$ and advance uniformly in the positive y direction.

Cartesia is trying to develop a tsunami warning system. The warning system consists of two components: a single meteorological center which can detect a tsunami miles out, and wired connections which can carry the warning from city to city in straight lines. (No wireless communication!!)

A city is considered *safe* if it either has the meteorological center, or if it has a direct wire connection to another *safe* city (i.e. if it has a multi-hop cable path to the meteorological center).

The transmission time along the cables and through each city is negligible. Nonetheless, a simple engineering problem is made more complicated by politics! If a city A receives the warning via a wire from city B, and city B is further away from the shore than city A, then city A's leaders will complain! We're closer to the ocean than city B, so we should have gotten the word first! With a sigh, you agree to find a solution where no city will get the warning via a wire from a city that's further from the shore.

Given a description of Cartesia, find the least amount of cable necessary to build a tsunami warning system where every city is safe, and no city will receive the warning via a wire another city that is further from the shore.

Input

There may be several test cases in the input.

Each test case will begin an integer n ($1 \leq n \leq 1,000$) on its own line, indicating the number of cities.

On each of the next n lines will be a pair of integers x and y ($-1,000 \leq x \leq 1,000, 0 < y \leq 1,000$), each of which is the (x, y) location of a city.

The input will end with a line containing a single 0.

Output

For each test case, print a single line containing the minimum amount of cable which must be used to build the tsunami warning system. This should be printed as a floating point number to two decimal places precision.

Example

Given the input

```
3
100 10
300 10
200 110
4
100 10
300 10
200 110
200 60
0
```

the output should be

```
341.42
361.80
```