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Problem A
Bring Them There
Input File: bring.in

By the year 3141, the human civilization has spread all over the galaxy. The special hypertunnels are used to travel from one star system to another. To use the hypertunnel, you fly to a special location near the source star using your spaceship, activate the hyperjumper, fly through the hypertunnel, get out near your destination star and fly to the planet you need. The whole process takes exactly one day. A small drawback of the system is that for each tunnel every day only one spaceship can travel using this tunnel.

You are working in the transportation department of the “Intergalaxy Business Machines” company. This morning your boss has assigned a new task to you. To run the programming contest IBM needs to deliver K supercomputers from Earth where the company headquarters are located to the planet Eisiem. Since supercomputers are very large, one needs the whole spaceship to carry each supercomputer. You are asked to find a plan to deliver the supercomputers that takes as few days as possible. Since IBM is a very powerful corporation, you may assume that any time you need some tunnel for hyperjump, it is at your service. However, you still can use each tunnel only once a day.

Input

The first line of the input file contains the number of test cases.

The first line of each case contains five numbers N , M , K , S and T ($2 \leq N \leq 50$, $1 \leq M \leq 200$, $1 \leq K \leq 50$, $1 \leq S, T \leq N$, $S \neq T$), which represents the number of star systems in the galaxy, the number of tunnels, the number of supercomputers to be delivered, the number of the solar system (the system where planet Earth is) and the number of the star system where planet Eisiem is, respectively.

Next M lines contain two different integer numbers each and describe tunnels. For each tunnel the numbers of star systems that it connects are given. The tunnel can be traveled in both directions, but remember that each day only one ship can travel through it, in particular, two ships cannot simultaneously travel through the same tunnel in opposite directions. No tunnel connects a star to itself and any two stars are connected by at most one tunnel.

Output

For each case, first print L , which is the fewest number of days needed to deliver K supercomputers from star system S to star system T using hypertunnels. Next L lines must describe the process. Each line must start with C_i , which indicates the number of ships that travel from one system to another this day. C_i pairs of integer numbers must follow, where pair A, B means that the ship number A travels from its current star system to star system B . Print a blank line between two cases.

It is guaranteed that there is a way to travel from star system S to star system T .

Sample Input

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

Output for the Sample Input

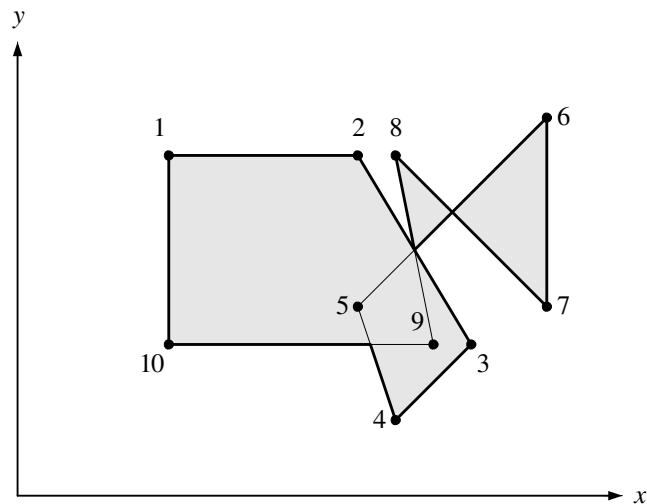
```
4
2 1 2 2 4
3 1 3 2 6 3 4
3 1 5 3 6 4 4
2 1 6 4 6
```

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Problem B
Find the Border
Input File: find.in

Closed polyline (with possible self-intersections) partitions a plane into a number of regions. One of the regions is unbounded — it is an *exterior* of the polyline. All the bounded regions together with the polyline itself form an *interior* of the polyline (shaded in the picture below). The *border* of the interior (bold line in the picture) is a polyline as well. This polyline has the same interior as the original one. Your task is to find the border of the interior of the given polyline.



To guarantee the uniqueness (up to the starting point) of the polyline representing the border, we require that the following conditions are satisfied:

- It has no self-intersections, although may have self-touchings.
- No adjacent vertices of the border coincide.
- No adjacent edges of the border are collinear.
- When traversing the border, its interior is always to the left of its edges.

Input

The input file contains multiple test cases.

The first line of each case contains an integer number n ($3 \leq n \leq 100$), which indicates the number of vertices in the original polyline. Following n lines contain two integer numbers x_i and y_i on a line ($0 \leq x_i, y_i \leq 100$), which represents coordinates of the vertices. All vertices are different and no vertex lies on an edge between two other vertices. Adjacent edges of the polyline are not collinear.

The end of the input file is indicated by $n = 0$.

Output

For each case, write on a line an integer number m , which indicates the number of vertices of the border. Then write m lines with coordinates of the vertices. Coordinates must be written with four digits after the decimal point, and contain an error not greater than 10^{-4} . Write a blank line between two consecutive cases.

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Sample Input

```
10
4 9
9 9
12 4
10 2
9 5
14 10
14 5
10 9
11 4
4 4
0
```

Output for the Sample Input

```
13
9.3333 4.0000
10.0000 2.0000
12.0000 4.0000
10.5000 6.5000
11.5000 7.5000
14.0000 5.0000
14.0000 10.0000
11.5000 7.5000
10.0000 9.0000
10.5000 6.5000
9.0000 9.0000
4.0000 9.0000
4.0000 4.0000
```

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Problem C
Hypertransmission
Input File: hyper.in

The president of the Galactic Federation has recently decided that all planets of the galaxy must establish hyper-radio centers to broadcast their programs. To ensure the process, the government has signed the contract with well known hyper-radio equipment manufacturer Trojan Horse Ltd. By the terms of this contract the company has to provide N hypertransmitters, one for each planet of the Federation.

It is known that there are two main political movements in the galaxy: industrialism and ecologism. On each planet of the galaxy one of these movements has the majority. It is clear that after establishing the hyper-radio station on the planet, the political programs of the station will support the movement that has the majority on this planet.

All transmitters supplied by Trojan Horse Ltd will have the same range, so hyper-radio programs from each planet will be heard at the distance not exceeding R parsecs from it. Since the company director is actually the agent of the Dark Empire, he wants to choose R in such a way, that it would destabilize the political situation in the Galactic Federation.

More precisely, for each planet A let $N^+(A)$ be the number of planets where the same political movement as in A has the majority and hyper-radio programs from A are received, including A itself. Similarly, let $N^-(A)$ be the number of planets where the other political movement has the majority and hyper-radio programs from A are received. The planet A is called *destabilizing* if $N^+(A) < N^-(A)$.

Your task is to choose such R that the number D of destabilizing planets is maximal possible. Since increasing transmitter's range requires more resources for its manufacturing, you must find the smallest possible R maximizing D .

Input

The input file contains multiple test cases.

The first line of each case contains N , which indicates the number of planets in the Galactic Federation ($1 \leq N \leq 1000$). Next N lines contain four integer numbers x_i , y_i , z_i , and p_i each and describe the planets: x_i , y_i , and z_i specify the coordinates of the planet in space, $p_i = 0$ if the industrialists have the majority on the planet and $p_i = 1$ if the ecologists have the majority. All coordinates do not exceed 10000 by their absolute value. No two planets occupy the same point.

The end of the input file is indicated by $N = 0$.

Output

For each case, output an integer D and a non-negative real number R on a line, where D indicates the maximal possible number of destabilizing planets and R indicates the minimal range that hyper-radio transmitters must have so that D planets are destabilizing. R must be output with four decimal digits and accurate within 10^{-4} of the correct answer.

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Sample Input

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

Output for the Sample Input

```
4 1.0000
0 0.0000
```

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Problem D
Interval Arithmetic
Input File: interval.in

Interval arithmetic is a field of math wherein numbers, both constants and variables, are represented not as a single, exact value, but rather as a range or interval with lower and upper bounds. Under normal arithmetic, a scalar value represents a single point on the number line, such as 3.25. Under interval arithmetic, a scalar represents a segment of the number line, perhaps $[3, 5]$.

There are three kinds of intervals: closed, open and half-closed (or half-open) intervals. A closed interval is an interval that includes its lower and upper endpoints, and is denoted with square brackets like $[3, 5]$. On the other hand, an open interval includes neither of its endpoints, and is denoted with round brackets like $(3, 5)$. A half-closed interval includes either of its endpoints but not both. It is denoted like $[3, 5)$, for example, if the interval includes 3 but not 5. You may find exact values can be represented by closed intervals with identical lower and upper limits.

Arithmetical operations on two intervals involve the pairing of every point in one interval with every point in the other interval and performing the desired operation on each pair of points. The set of all points resulting from the operation form an interval. For example, adding $(3, 5]$ to $[-10, 1]$ yields $(-7, 6]$, the interval where in all possible pairings of the addition of points $(3, 5]$ and $[-10, 1]$ must lie. You are to write a program that can interpret single-line expressions of scalar interval constants with unary minus and the four basic operations of addition, subtraction, multiplication, and division. An example of each operation is shown below.

unary minus:	$-(-3, 5] = [-5, 3)$
addition:	$(3, 5] + [-10, 1] = (-7, 6]$
subtraction:	$(3, 5] - [-10, 1] = (2, 15]$
multiplication:	$(3, 5] \times [-10, 1] = [-50, 5]$
division:	$(3, 5] \div [-10, -0.1] = [-50, -0.3)$

Input

Input to the program consists of one or more scalar intervals of the form like $[\text{min}, \text{max}]$ in infix expressions involving parentheses (which may be nested), unary minus ($-$), and binary addition ($+$), subtraction ($-$), multiplication ($*$) and division ($/$). For the convenience, open and half-closed intervals are represented with angle brackets instead of round brackets; for example, “ $<3, 5>$ ” represents an interval $(3, 5)$. Empty intervals such as $(3, 3)$ do not appear. Spaces may occur within the line, but never between the interval brackets, nor after a unary minus. Your program need *not* handle exponential (E-format) numbers. No line will be longer than 80 characters.

The standard rules of precedence (order of operations) apply; in decreasing precedence:

()	parentheses
-	unary minus
* /	multiplication and division, left to right
+ -	addition and subtraction, left to right

The input is terminated by the end of file.

Output

For each line of input, produce a single line of output that is the resulting interval in the same manner as input, except that the numbers should be printed with three digits after the decimal point. There should be no spaces within the interval. No number should contain an error greater than 0.001. For expressions involving division by an interval that contains or is bounded by zero, output the string “Division by zero” rather than an interval. A number whose absolute value is less than 10^{-8} should be considered as zero.

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Sample Input

```
-<-3,5]
<3,5] + [-10,1]
<3,5]-[-10,1]
<3,5] * [-10,1]
( (<3,5] / [-10,-0.1]) / -[2,2] )
```

Output for the Sample Input

```
[-5.000,3.000>
<-7.000,6.000]
<2.000,15.000]
[-50.000,5.000]
<0.150,25.000]
```


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Problem E
Irrelevant Elements
Input File: irrelevant.in

Young cryptanalyst Georgie is investigating different schemes of generating random integer numbers ranging from 0 to $m - 1$. He thinks that standard random number generators are not good enough, so he has invented his own scheme that is intended to bring more randomness into the generated numbers.

First, Georgie chooses n and generates n random integer numbers ranging from 0 to $m - 1$. Let the numbers generated be a_1, a_2, \dots, a_n . After that Georgie calculates the sums of all pairs of adjacent numbers, and replaces the initial array with the array of sums, thus getting $n - 1$ numbers: $a_1 + a_2, a_2 + a_3, \dots, a_{n-1} + a_n$. Then he applies the same procedure to the new array, getting $n - 2$ numbers. The procedure is repeated until only one number is left. This number is then taken modulo m . That gives the result of the generating procedure.

Georgie has proudly presented this scheme to his computer science teacher, but was pointed out that the scheme has many drawbacks. One important drawback is the fact that the result of the procedure sometimes does not even depend on some of the initially generated numbers. For example, if $n = 3$ and $m = 2$, then the result does not depend on a_2 .

Now Georgie wants to investigate this phenomenon. He calls the i -th element of the initial array *irrelevant* if the result of the generating procedure does not depend on a_i . He considers various n and m and wonders which elements are irrelevant for these parameters. Help him to find it out.

Input

Each line of the input file contains n and m ($1 \leq n \leq 100000$, $2 \leq m \leq 10^9$). The end of the input file is indicated by $n = m = 0$.

Output

On the first line for each case output the number of irrelevant elements of the initial array for given n and m . On the second line output all such i that i -th element is irrelevant. Numbers on the second line must be printed in the ascending order and must be separated by spaces. Print a blank line between two cases.

Sample Input

Output for the Sample Input

3 2	1
0 0	2

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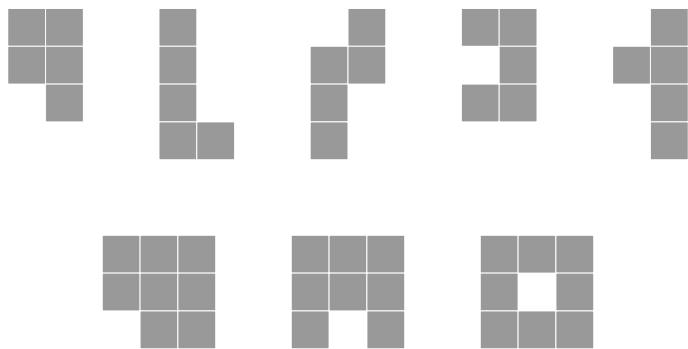
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Problem F
Lattice Animals
Input File: lattice.in

Lattice animal is a set of connected sites on a lattice. Lattice animals on a square lattice are especially popular subject of study and are also known as polyominoes. Polyomino is usually represented as a set of sidewise connected squares. Polyomino with n squares is called n -polyomino.

In this problem you are to find a number of distinct free n -polyominoes that fit into rectangle $w \times h$. Free polyominoes can be rotated and flipped over, so that their rotations and mirror images are considered to be the same.

For example, there are five different pentominoes (5-polyominoes) that fit into 2×4 rectangle and three different octominoes (8-polyominoes) that fit into 3×3 rectangle.



Input

The input file consists of a number of lines. Each line contains three integer numbers n , w , and h ($1 \leq n \leq 10$, $1 \leq w, h \leq n$). The end of input is indicated by a line with three zeros.

Output

For each case, write on a line a single integer number indicating the number of distinct free n -polyominoes that fit into rectangle $w \times h$.

Sample Input

5 1 4
5 2 4
5 3 4
5 5 5
8 3 3
0 0 0

Output for the Sample Input

0
5
11
2
3

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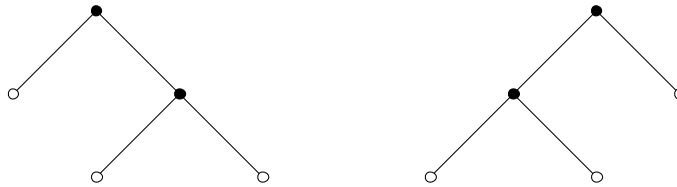
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Problem G

Which is Next?

Input File: next.in

Every computer science student knows binary trees. Here is one of many possible definitions of binary trees. Binary trees are defined inductively. A binary tree t is either an external node (leaf) \circ or an ordered pair $t = (t_1, t_2)$ representing an internal node \bullet with two subtrees attached, left subtree t_1 and right subtree t_2 . Under this definition the number of nodes in any binary tree is odd. Given an odd integer n , let $\mathcal{B}(n)$ denote the set of all binary trees with n nodes, both internal and external. For instance $\mathcal{B}(1)$ consists of only one tree \circ , $\mathcal{B}(3) = \{(\circ, \circ)\}$ and $\mathcal{B}(5) = \{(\circ, (\circ, \circ)), ((\circ, \circ), \circ)\}$. The trees of $\mathcal{B}(5)$ are depicted in the figure below.



Denote by $|t|$ the number of nodes in a tree t . Given a tree t , we define its unique integer identifier $\mathcal{N}(t)$ as follows:

$$\mathcal{N}(\circ) = 0$$

$$\mathcal{N}(t_1, t_2) = 2^{|t_1|+|t_2|} + 2^{|t_2|} \cdot \mathcal{N}(t_1) + \mathcal{N}(t_2)$$

For instance,

$$\mathcal{N}(\circ, \circ) = 2^2 + 2^1 \cdot 0 + 0 = 4$$

$$\mathcal{N}(\circ, (\circ, \circ)) = 2^4 + 2^3 \cdot 0 + 4 = 20$$

$$\mathcal{N}((\circ, \circ), \circ) = 2^4 + 2^1 \cdot 4 + 0 = 24$$

Consider the following linear order on all binary trees:

$$\circ \leq t$$

$$(t_1, t_2) \leq (u_1, u_2), \text{ when } t_1 < u_1 \text{ or } t_1 = u_1 \text{ and } t_2 \leq u_2$$

In this order a single leaf \circ is the smallest tree and given two nonleaf trees, the smaller one is that with the smallest left tree, if the left subtrees are different, and that with the smaller right subtree, otherwise. Hence for instance $(\circ, (\circ, \circ)) < ((\circ, \circ), \circ)$, since we have $\circ < (\circ, \circ)$. Assume now that the trees in $\mathcal{B}(n)$ were sorted using the relation \leq . Then, for each tree t in $\mathcal{B}(n)$ we define the successor of t as the tree that immediately follows t in $\mathcal{B}(n)$. If t is the largest one in $\mathcal{B}(n)$ then the successor of t is the smallest tree in set $\mathcal{B}(n)$. For instance, the successor of (\circ, \circ) in $\mathcal{B}(3)$ is the same tree (\circ, \circ) and the successor of $(\circ, (\circ, \circ))$ in $\mathcal{B}(5)$ is $((\circ, \circ), \circ)$.

Given the integer identifier of some tree t , can you give the identifier of the successor of t in $\mathcal{B}(|t|)$?

Input

Each line of the input contains one integer n ($0 \leq n \leq 2^{30}$) indicating the identifier of some binary tree t . The end of input is indicated by -1 .

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Output

For each case, output a line that contains one integer s representing the identifier of the successor of t in $\mathcal{B}(|t|)$.
No blank line should appear.

Sample Input

20 -1	24
----------	----

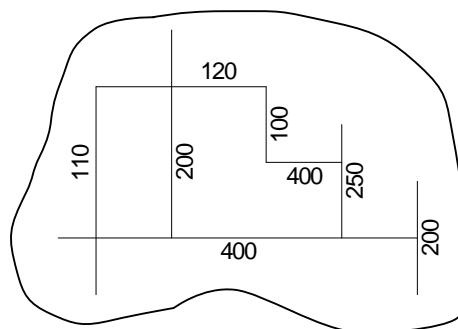
Output for the Sample Input

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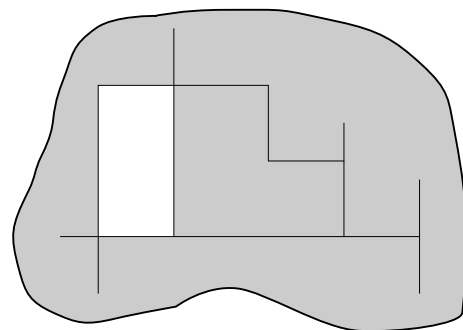
Problem H
Zing Zhu's Oyster Farm
Input File: oyster.in

Zing Zhu owns an island that is a piece of flat land. Everyday, when the tide rises, the island is flooded by sea water. After much thinking and asking advice from members of his family, Zing Zhu decided to set up an oyster farm in the island. Zing Zhu uses a sophisticated system of plastic watertight modular fences to control the areas that will be flooded and the areas that will not be flooded during the rise of the tide. The fences used by Zing Zhu are either horizontal or vertical and come in strips that have different lengths and heights. Two fences can intersect in at most one point, not necessarily in their ends.

You have been contacted by Zing Zhu to calculate, given the height the tide will reach and the position and height of all fence strips, the total area of land which will *not* be flooded during the high tide. You may assume that the widths of fence strips are so thin compared to the size of the land that, for the purpose of calculating the total area, fence strips may be considered as having widths equal to zero.



Map of fence strips installed in the farm,
showing fence strip heights in centimeters



Non-flooded areas (shown in white) if the
tide rises 110 centimeters

Input

The input contains several test cases. The first line of a test case contains an integer N indicating the number of fence strips in the island ($1 \leq N \leq 2000$). Each of the next N lines contains five integers X_1 , Y_1 , X_2 , Y_2 and H , representing respectively the start point of the strip (X_1 , Y_1), the end point of the strip (X_2 , Y_2) and the strip height (H). The last line of a test case contains an integer W representing the tide height. Coordinates are given in meters, heights in centimeters. Furthermore, $X_1 = X_2$ or $Y_1 = Y_2$ (but not both); $-500 \leq X_1, Y_1, X_2, Y_2 \leq 500$ and $1 \leq W, H \leq 1000$. The end of input is indicated by $N = 0$.

Output

For each test case in the input your program must produce one line of output, containing one integer representing the total area (in m^2) of the land which will not be flooded.

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Sample Input

```
4
-20 20 20 20 200
20 20 20 -20 200
0 0 0 20 100
-10 0 20 0 200
100
4
-20 20 20 20 200
20 20 20 -20 200
0 0 0 20 100
-10 0 20 0 200
101
0
```

Output for the Sample Input

```
400
0
```


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Problem I

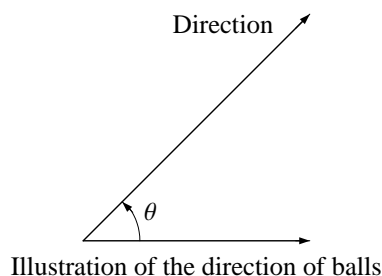
Petanque

Input File: petanque.in

Petanque, a game which uses balls (some *boules* and one *coche*), was developed in the small town of La Ciotat, near Marseilles, France. The aim of the game is simple. If playing football is kicking a ball into the opposite goal and keeping it out of your own, playing petanque is placing your boules nearer to the coche and keeping your opponent's boules away.

One simplified version of the game is played between two players, one against the other, with some boules each. The players are located in a plane and one of them starts the game by throwing the coche forward. The player who throws the coche also throws the first boule. The opposing player throws the second boule. From then on, the player who has not thrown the boule which is the nearest to the coche throws the next boule (you may assume that there will be only one boule nearest to the coche). This continues until one player has thrown all his boules. After this, the other player throws all his remaining boules. The winner is the player who has thrown the ball which in the end is nearest to the coche (again, you may assume that there will be only one boule nearest to the coche). The winning player claims as many points as there are boules thrown by him nearer the coche than any other opposing boules.

You are invited to simulate some games of Petanque. For simulation purposes, we will consider that the playing floor is a plane and the balls are adimensional (they can be considered as points). You will be given the names of the two players. The first player given will be the first to play. For each ball (coche or boules) thrown, you will be given the starting position of the ball, its direction and how many meters it will roll. You may assume that the starting position of the balls are inside the playing floor, the balls will never leave the floor and the starting position of a ball will never coincide with the current position of another ball in the playing floor. The direction of each ball is given in degrees where the east direction (x -positive) corresponds to zero degrees and the degrees increase in the counter-clockwise direction, as shown in the figure below. When a ball that was thrown knocks another ball in its way, the thrown ball stops. The ball which was still starts moving in the same direction for an amount of meters equal to the quantity of meters that the thrown ball would still roll if there was no ball in its way (this amount will *never* be zero meters). If this ball encounters another one, the procedure is repeated (here again the amount of meters still to roll will never be zero).



Input

The input consists of several test cases. The first line in the input contains an integer N specifying the number of test cases ($1 \leq N \leq 10000$). The first line of a test case contains the name of the two players separated by one space. A player name is composed of at most 20 letters from the English alphabet (from 'A' through 'Z' and 'a' through 'z'). The next line contains M indicating the number of boules each player throws. The next $(2M + 1)$ lines describe the balls in the order they are thrown in the game (first the coche and then the boules thrown by the players according to the rules above). Each line contains four integers X , Y , θ and D representing respectively the starting position of a ball ($-1000 \leq X, Y \leq 1000$), its direction ($0 \leq \theta \leq 360$) and the distance ($0 < D \leq 500$) it will roll if it does not encounter any other ball in its way.

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Output

For each test case in the input, your program must produce one line containing the name of the player who won the game and how many points she/he scored separated by a single space.

When comparing numbers, numbers whose absolute difference is less than 0.00001 should be considered equal. Moreover, you may suppose that, in the end of the game, the boule of the loser which is nearest to the coche is not at the same distance of any boule of the winner.

Sample Input

```
2
Alex BobNelson
3
0 0 90 30
0 0 90 20
0 0 0 10
-5 0 0 5
0 40 270 18
0 10 90 13
-1 24 315 1
Alice Alex
3
0 0 90 50
0 0 90 20
0 0 180 20
-5 0 0 5
0 40 270 18
0 10 90 13
-1 24 315 1
```

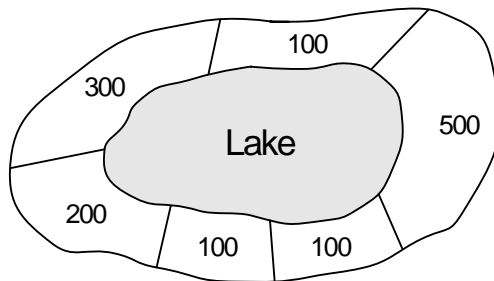
Output for the Sample Input

```
Alex 3
Alice 1
```

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Problem J
Land Division Tax
Input File: tax.in

International Concrete Projects Company (ICPC) is a construction company which specializes in building houses for the high-end market. ICPC is planning a housing development for new homes around a lake. The houses will be built in lots of different sizes, but all lots will be on the lake shore. Additionally, every lot will have exactly two neighbors in the housing development: one to the left and one to the right.



Development plan indicating the sizes of the lots (in units of area) in the new housing development.

ICPC owns the land around the lake and needs to divide it into lots according to the housing development plan. However, the County Council has a curious regulation regarding land tax, intended to discourage the creation of small lots:

1. Land can only be divided using a sequence of *land divisions*;
2. A land division is an operation that divides one piece of land into two pieces of land; and
3. for each land division, a land division tax must be paid.

Denoting by A the area of the largest resulting part of the division, the value of the land division tax is $A \times F$, where F is the *division tax factor* set yearly by the County Council. Note that due to (2), in order to divide a piece of land into N lots, $N - 1$ land divisions must be performed, and therefore $N - 1$ payments must be made to the County Council.

For example, considering the figure above, if the division tax factor is 2.5 and the first land division separates the lot of 500 units of area from the other lots, the land division tax to be paid for this first division is $2.5 \times (300 + 200 + 100 + 100 + 100)$. If the next land division separates the lot of 300 units together with its neighbor lot of 100 units, from the set of the remaining lots, an additional $2.5 \times (300 + 100)$ must be paid in taxes, and so on. Note also that some land divisions are not possible, due to (2). For example, after the first land division mentioned above, it is not possible to make a land division to separate the lot of 300 units together with the lot of 200 units from the remaining three lots, because more than two parts would result from that operation.

Given the areas of all lots around the lake and the current value of the division tax factor, you must write a program to determine the smallest total land division tax that should be paid to divide the land according to the housing development plan.

Input

The input contains several test cases. The first line of a test case contains an integer N and a real F , indicating respectively the number of lots ($1 \leq N \leq 200$) and the land division tax factor (with precision of two decimal digits, $0 < F \leq 5.00$). The second line of a test case contains N integers X_i , representing the areas of contiguous lots in the development plan ($0 < X_i \leq 500$, for $1 \leq i \leq N$); furthermore, X_k is neighbour to X_{k+1} for $1 \leq k \leq N - 1$, and X_N is neighbour to X_1 . The end of input is indicated by $N = F = 0$.

The 2005 ACM Programming Contest Practice Contest for World Finals

Output

For each test case in the input your program must produce a single line of output, containing the minimum total land division tax, as a real number with precision of two decimal digits.

Sample Input

```
4 1.50
2 1 4 1
6 2.50
300 100 500 100 100 200
0 0
```

Output for the Sample Input

```
13.50
4500.00
```