Task 1

A maze of rectangular rooms is represented on a two dimensional grid as illustrated in figure 1a. Each point of the grid is represented by a character. The points of room walls are marked by the same character which can be any printable character different than `*', `_' and space. In figure 1 this character is `X'. All the other points of the grid are marked by spaces.

```
XXXXXXXXXXXXXXXXXXXXX        XXXXXXXXXXXXXXXXXXXXX
X   X   X   X   X   X        X###X###X###X   X   X
X           X   X   X        X###########X   X   X
X   X   X   X   X   X        X###X###X###X   X   X
XXXXXX XXX XXXXXXXXXX        XXXXXX#XXX#XXXXXXXXXX
X   X   X   X   X   X        X   X###X###X###X###X
X   X     *         X        X   X###############X
X   X   X   X   X   X        X   X###X###X###X###X
XXXXXXXXXXXXXXXXXXXXX        XXXXXXXXXXXXXXXXXXXXX
```

a) Initial maze b) Painted maze

Figure 1. Mazes of rectangular rooms

All rooms of the maze are equal sized with all walls 3 points wide and 1 point thick as illustrated in figure 2. In addition, a wall is shared on its full length by the separated rooms. The rooms can communicate through doors, which are positioned in the middle of walls. There are no outdoor doors.

```
      door
        |
      XX XX
      X . X   measured from within the room
door - ...--  walls are 3 points wide
      X . X__
      XXXXX  |
        |___  walls are one point thick
```

Figure 2. A room with 3 doors

Your problem is to paint all rooms of a maze which can be visited starting from a given room, called the `start room' which is marked by a star (`*') positioned in the middle of the room. A room can be visited from another room if there is a door on the wall which separates the rooms. By convention, a room is painted if its entire surface, including the doors, is marked by the character `#' as shown in figure 1b.

Input

The program input is a text file structured as follows:

1. The first line contains a positive integer which shows the number of mazes to be painted.
2. The rest of the file contains the mazes.

The lines of the input file can be of different length. The text which represents a maze is terminated by a separation line full of underscores (`_'). There are at most 30 lines and at most 80 characters in a line for each maze. The program reads the mazes from the input file, paints them and writes the painted mazes on the standard output.

Output

The output text of a painted maze has the same format as that which has been read for that maze, including the separation lines. The example below illustrates a simple input which contains a single maze and the corresponding output.

<table>
<tr><th>Input</th><th>Output</th></tr>
<tr><td><pre>
3
XXXXXXXXX
X   X   X
X *   X
X   X   X
XXXXXXXXX
X   X
X   X
X   X
XXXXX
_____

AAAAAAAAA
A   A   A
A * A   A
A   A   A
AAAAAAAAA
____

BBBBB   BBBBB
B   B   B   B
B * B   B   B
B   B   B   B
BBBBB   BBBBB
____
</pre></td><td><pre>
XXXXXXXXX
X###X###X
X#######X
X###X###X
XXXXXXXXX
X   X
X   X
X   X
XXXXX
_____

AAAAAAAAA
A###A   A
A###A   A
A###A   A
AAAAAAAAA
____

BBBBB   BBBBB
B###B   B   B
B###B   B   B
B###B   B   B
BBBBB   BBBBB
____
</pre></td></tr>
</table>

Task 2

Many new buildings are under construction on the campus of the University of Waterloo. The university has hired bricklayers, electricians, plumbers, and a computer programmer. A computer programmer? Yes, you have been hired to ensure that each building is connected to every other building (directly or indirectly) through the campus network of communication cables.

We will treat each building as a point specified by an x-coordinate and a y-coordinate. Each communication cable connects exactly two buildings, following a straight line between the buildings. Information travels along a cable in both directions. Cables can freely cross each other, but they are only connected together at their endpoints (at buildings).

You have been given a campus map which shows the locations of all buildings and existing communication cables. You must not alter the existing cables. Determine where to install new communication cables so that all buildings are connected. Of course, the university wants you to minimize the amount of new cable that you use.

Input

The input file describes several test case. The description of each test case is given below:

The first line of each test case contains the number of buildings **N (1<=N<=750)**. The buildings are labeled from **1** to **N**. The next **N** lines give the **x** and **y** coordinates of the buildings. These coordinates are integers with absolute values at most **10000**. No two buildings occupy the same point. After that there is a line containing the number of existing cables **M (0 <= M <= 1000)** followed by **M** lines describing the existing cables. Each cable is represented by two integers: the building numbers which are directly connected by the cable. There is at most one cable directly connecting each pair of buildings.

Output

For each set of input, output in a single line the total length of the new cables that you plan to use, rounded to two decimal places.

<table>
<tr><th>Input</th><th>Output</th></tr>
<tr><td>4
103 104
104 100
104 103
100 100
1
4 2

4
0 0
0 1
1 0
1 1
2
1 2
3 4

4
103 104
104 100
104 103
100 100
3
1 2
1 3
2 3</td><td>4.41

1.00

4.00</td></tr>
</table>