

Grazing Google Goats

Problem

Farmer John has recently acquired a nice herd of N goats for his field. Each goat i will be tied to a pole at some position P_i using a rope of length L_i . This means that the goat will be able to travel anywhere in the field that is within distance L_i of the point P_i , but nowhere else. (The field is large and flat, so you can think of it as an infinite two-dimensional plane.)

Farmer John already has the pole positions picked out from his last herd of goats, but he has to choose the rope lengths. There are two factors that make this decision tricky:

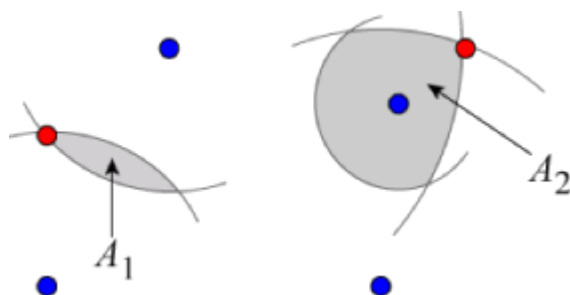
- The goats all need to be able to reach a single water bucket. Farmer John has not yet decided where to place this bucket. He has reduced the choice to a set of positions $\{Q_1, Q_2, \dots, Q_M\}$, but he is not sure which one to use.
- The goats are ill-tempered, and when they get together, they sometimes get in noisy fights. For everyone's peace of mind, Farmer John wants to minimize the area A that can be reached by all the goats.

Unfortunately, Farmer John is not very good at geometry, and he needs your help for this part!

For each bucket position Q_j , you should choose rope lengths so as to minimize the area A_j that can be reached by every goat when the bucket is located at position Q_j . You should then calculate each of these areas A_j .

Example

In the picture below, there are four blue points, corresponding to the pole positions: P_1, P_2, P_3 , and P_4 . There are also two red points, corresponding to the potential bucket positions: Q_1 and Q_2 . You need to calculate A_1 and A_2 , the areas of the two shaded regions.



Input

The first line of the input gives the number of test cases, T . T test cases follow. Each test case begins with a line containing the integers N and M .

The next **N** lines contain the positions P_1, P_2, \dots, P_N , one per line. This is followed by **M** lines, containing the positions Q_1, Q_2, \dots, Q_M , one per line.

Each of these **N + M** lines contains the corresponding position's **x** and **y** coordinates, separated by a single space.

Output

For each test case, output one line containing "Case #x: $A_1 A_2 \dots A_M$ ", where x is the case number (starting from 1), and $A_1 A_2 \dots A_M$ are the values defined above. Answers with a relative or absolute error of at most 10^{-6} will be considered correct.

Limits

Memory limit: 1GB.

All coordinates are integers between -10,000 and 10,000.

The positions $P_1, P_2, \dots, P_N, Q_1, Q_2, \dots, Q_M$ are all distinct and no three are collinear.

Small dataset (Test set 1 - Visible)

Time limit: 30 seconds.

$1 \leq T \leq 100$.

N = 2.

$1 \leq M \leq 10$.

Large dataset (Test set 2 - Hidden)

Time limit: 120 seconds.

$1 \leq T \leq 10$.

$2 \leq N \leq 5,000$.

$1 \leq M \leq 1,000$.

Sample

Sample Input

```
3
2 3
0 20
20 0
-20 10
40 20
0 19
4 2
0 0
100 100
300 0
380 90
400 100
1000 5
3 1
0 0
10 10
```

Sample Output

```
Case #1: 1264.9865911
1713.2741229 0.2939440
Case #2: 1518.9063729
1193932.9692206
Case #3: 0.0
```

20 0
10 5