

Problem 6: Clustering

A psychologist tests N different individuals. The score for each individual is a pair of real numbers, x and y , that the psychologist treats as points in a plane. The psychologist then wants to separate the individuals into at least 2 groups, with at least 2 individuals in each group, based on the proximity of their scores. The decision is made to use the Euclidian distance between two scores as a measure of their proximity. That is, for two scores (x_1, y_1) and (x_2, y_2) , their proximity is defined by the value of the expression

$$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}.$$

To place the individuals in groups, the psychologist decides to use the following steps. (1) The two individuals whose scores are closest together are placed in group 1; call them A and B. (2) The next two individuals (not in group 1) with the closest scores are placed in group 2; call them C and D. (Clearly at least four individuals must be tested.) (3) The next ungrouped individual, called E, to be included in a group is the one closest to any individual already in a group or any other ungrouped individual. If E is closer to A or B than to C, D, or any other ungrouped individual, then E joins group 1. Likewise, if E is closer to C or D than to A, B, or any other ungrouped individual, then E joins group 2. Finally, if E is closer to another ungrouped individual, say F, than A, B, C, or D, then a new group is formed from E and F. If the shortest distance to an existing group is within 0.001 of the shortest distance to an ungrouped individual, or doesn't uniquely identify the group in which E should be placed, then E is placed in the existing group created earliest that has a member closest to E. This step (3) is repeated for all remaining ungrouped individuals.

Input

There will be multiple cases. For each case there appears an integer N specifying the number of individuals tested; N will be at least 4, but no larger than 100. There will then follow N pairs of real x and y values, one for each individual. The first pair is for individual 1, the second pair is for individual 2, and so forth.

Output

For each case, first display the case number (they're numbered sequentially starting with 1) on a line by itself. Then display the identity of the individuals in each group, one line per group. Use the format shown in the samples below. Specifically, output lines must be no longer than 79 characters, indentation (as shown in the samples) is required, and commas are required between the individual identity numbers.

Sample Input

```
4
  0.0 0.0 0.0 3.0 4.0 0.0 3.0 5.0
6
  0.0 0.0 0.0 3.0 4.0 0.0 3.0 5.0 2.0 6.0 3.0 1.0
25
  1 0 1 1 100 100 100 101 1 2 1 3 1 4 1 5 1 6 1 7 1 8 1 9
  1 10 1 11 1 12 1 13 1 14 1 15 1 16 1 17 1 18 1 19 1 20 1 21 1 22
0
```

Expected Output

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Case 1:
  Group 1: 1, 2
  Group 2: 3, 4
Case 2:
  Group 1: 3, 6
  Group 2: 4, 5
  Group 3: 1, 2
Case 3:
  Group 1: 1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20,
          21, 22, 23, 24, 25
  Group 2: 3, 4
```