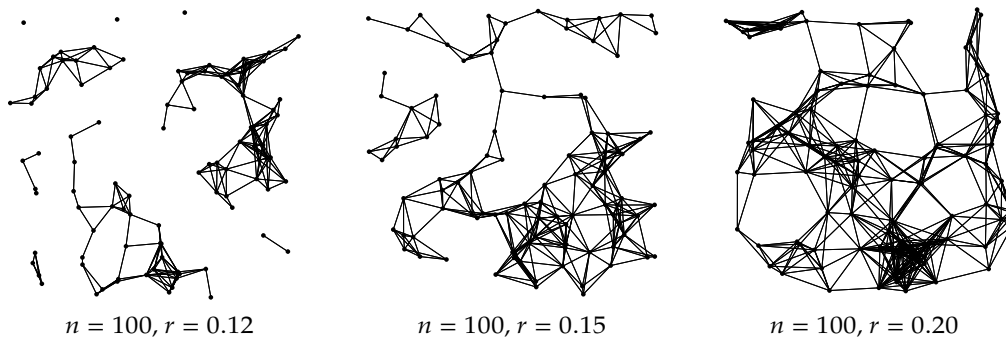


Random geometric graphs

P34324_en

Professor J. Díaz is interested in random geometric graphs. To construct a random geometric graph $G(n, r)$ with n vertices and radius r , Prof. Díaz proceeds as follows. First, he chooses n points $V = \{v_1, \dots, v_n\}$ uniformly distributed at random in the unit square $[0, 1]^2$. These points correspond to the vertices of the graph. Then, he joins with an edge any pair of points whose Euclidean distance is at most r . The following figures illustrate three such random geometric graphs.



It is not difficult to see that the expected number of edges in a random geometric graph $G(n, r)$ tends to $\pi r^2 n$ for large n . Moreover, recent theoretical results show that random geometric graphs exhibit a threshold phenomenon regarding their connectivity: When r is slightly larger than $\Theta(\sqrt{\log n/n})$, such graphs tend to have just one connected component, whereas when r is slightly smaller than this value, graphs tend to have many connected components. (In this problem, $\log n$ denotes the natural logarithm of n .)

Let $r(c, n) = \sqrt{c \log n/n}$. In order to help Prof. Díaz to better understand this threshold behavior, please write an efficient program to determine whether a random geometric graph $G(n, r(c, n))$ is connected or not, given the n coordinates of its vertices and the value c .

Input

Input consists of several cases. Every case begins with n and c , followed by n real numbers: the x -coordinates of the vertices. Follow n real numbers: the y -coordinates of the vertices in the same order. Assume $2 \leq n \leq 2 \cdot 10^4$, $0 < c < 2$, and that all coordinates were uniformly generated at random between 0 and 1. The input cases have no precision issues.

Output

For every case, tell if the given random geometric graph $G(n, r(c, n))$ is connected or not.

Sample input 1

```
4 0.8
0.41 0.2 0.97 0.47
0.45 0.05 0.33 0.28
8 0.3
0.549918 0.669204 0.782035 0.715593 0.606206 0.126883 0.290046 0.357151
0.17341 0.910579 0.350634 0.757528 0.309185 0.690387 0.25063 0.818279
```

Sample output 1

```
YES
NO
```

Problem information

Author: Jordi Petit

Generation: 2026-01-25T10:21:13.049Z

© *Jutge.org*, 2006–2026.
<https://jutge.org>