1992 ACM MID-CENTRAL REGIONAL

PROGRAMMING CONTEST

Problem #5 - Super Sphere

Program File: **SPHERE.PAS** or **SPHERE.C**
Input File: **SPHERE.IN**
Output File: **SPHERE.OUT**

Given a set called the Specification Set of points (m-tuples), such as $(x_1, x_2, ..., x_m)$, in an m-dimensional Euclidean space, you are to first find a m-dimensional sphere, S, of minimum diameter which encloses all of the points in the Specification Set. (A 2-dimensional sphere is better known as a circle, while a 3-dimensional sphere corresponds to the standard definition of a sphere.) A point is considered to be "enclosed" if it is either on the surface of S or within the interior of S.

Having found a description for S, your program should then test whether other points, such as $(y_1, y_2, ..., y_m)$, are also enclosed by S. The points like $(y_1, y_2, ..., y_m)$ to be tested are called the Test Set.

The input data file, `SPHERE.IN`, contains several data sets.

The first line of each full set of data contains 3 positive integers: m, K, and L. 'm' is the dimensionality and will be less than 20. 'K' represents the number of points in the Specification Set. 'L' represents the number of points in the Test Set. The values for K and L will not exceed 40. The next K lines contain the points of the Specification Set, one per line. The numbers on these lines are floats (reals) and are separated from each other by 1 space. The next L lines after the Specification Set contain the points of the Test Set, one per line. The numbers on these lines are also floats (reals) and are separated from each other by 1 space.

Any number of other data sets may follow. The last line of the input file contains a single zero to indicate the end of the file.

Since round-off errors may affect the reported answers for test points on or near the surface of S, define $\varepsilon = 0.0001$. Any point within ε of the surface of S is considered to be on the surface. You may also assume that all spheres will have a radius $> \varepsilon$.

Page 2 shows an example of the desired output from a given input file.

Your program should process all data sets and output a report to the file, SPHERE.OUT, in the following form:

```
DATA SET #1
TEST POINT #1 - OUTSIDE
TEST POINT #2 - INSIDE
TEST POINT #3 - INSIDE

DATA SET #2
TEST POINT #1 - INSIDE

ALL DATA SETS HAVE BEEN PROCESSED.
```

The following sample input file should produce the output shown above.

```
2 2 3
1 0
0 1
3 3
-1 0
0.5 0.5
3 3 1
1.5 1.5 1.5
-1.5 -1.5 -1.5
0 0 0
0 0 0
0
```