ACM Pacific NW Region Programming Contest
15 November 2003
Problem A: Spin Doctor

You are part of a team working on the simulation of a dynamic system of particles interacting according to classical mechanics − Newtonian physics with gravitational and electromagnetic forces. Your part of the problem solution is to bring the system into a standard orientation following the simulation based on rotating the coordinate system (or, if you like, you can think of it as rotating all of the particles).

In the final coordinate system, the first three particles are to lie in a plane parallel with the XY plane, either on or above the XY plane. In addition, the first particle is to lie in the YZ plane with a non−negative Y coordinate. If the first three points do ***not*** define a plane (that is, they either are not distinct or are collinear), print an error message and go to the next problem.

Subscripting the first particle as subscript 0, the second as 1, and the third as 2, these conditions are summarized thus:

- $z_0 = z_1 = z_2 \geq 0$
- $x_0 = 0$; $y_0 \geq 0$ *note that you **may** have $y_0 = 0$*

Only the coordinate system rotates; the particles retain their positions with respect to each other. If you're thinking of this as a rotation of the particles, it is to be a rigid−body rotation with respect to the origin of the coordinate system.

<u>Input data specification − read from file a.in:</u>

Sets of problem specifications:
(1) Number of particles in the complete system, followed by descriptive textual information (to the end of the line) that needs to be retained for output, preserving any leading blanks and/or tabs.
(2) The required number of triples of numbers, giving the x, y, and z coordinates as white−space delimited numbers (they may be on the same line or on successive lines), without any descriptive text or commas to discard.
(3) A blank line separating problems.

The input data set ends when a system of fewer than three particles is specified. (It will in fact be zero.) This trailer record will terminate with an end−of−line before the end−of−file.

<u>Output data specification</u>

For each valid problem specification, list on separate lines
(1) Number of particles in the complete system, followed by the descriptive textual information from the input file, reproducing <u>exactly</u> the spacing of the input.
(2) The required number of triples of numbers, giving the x, y, and z coordinates, separated by a single blank and with only three digits to the right of the decimal point. Note that you may report a value of "`−0.000`" in case the value is small and negative.
(3) A blank line. This includes a blank line at the end of the file.

For an invalid problem specification, print the following message:
"`Illegal data:  points do not define a plane`"
followed by a blank line.

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Sample input:

```
6  octahedral symmetry obscured by rotation
0.500000 0.500000 −0.707107
−0.146447 0.853553 0.500000
−0.853553 0.146447 −0.500000
−0.500000 −0.500000 0.707107
0.146447 −0.853553 −0.500000
0.853553 −0.146447 0.500000

3   Duplicate point test
1
2
3
 1 2 3
  5
   3
    1

4   null operation test
 0  0  3
 0 −3  3
 2  3  3
−1 −2 −3

0   termination record
```

Matching output:

```
6  octahedral symmetry obscured by rotation
0.000 0.816 0.577
0.707 −0.408 0.577
−0.707 −0.408 0.577
−0.000 −0.816 −0.577
−0.707 0.408 −0.577
0.707 0.408 −0.577

Illegal data:  points do not define a plane

4   null operation test
0.000 0.000 3.000
0.000 −3.000 3.000
2.000 3.000 3.000
−1.000 −2.000 −3.000
```