

# ACM North Central North America Programming Contest

## November 10, 2001

### Problem 5: Unlicensed Transmitter Hunt

Radio broadcasting is normally done only by stations licensed by governments. In some parts of the world, however, clandestine unlicensed transmitters are operated by groups at odds with the broadcasting standards imposed by the licensing governments. You have been employed by one of these governments to locate some of these illegal transmitters.

You are provided with data from mobile tracking stations, each capable of determining its distance from a radio signal's point of origin (the transmitter). Given the data from three of these tracking stations (for each unlicensed transmitter) and a map of the country, you are to determine the distance and direction of the particular unlicensed transmitter from the nearest city.

#### Input

The input will consist of a two-dimensional map using Cartesian coordinates, followed by the number of transmitters that must be located, and the corresponding number of sets of data from tracking stations.

In the map, the data for each city will appear on a separate line. The data for each city will consist of a fifteen character name followed by the city's  $x$  and  $y$  coordinates and a radius, all real numbers representing measurements in kilometers. The  $x$  and  $y$  coordinates give the location of the city's geographical center, while the radius gives the distance from the center of the city to the city limits (for this problem, all cities are considered to be circular). There will be no more than 50 cities, and the last city on the map will be located at the origin  $(0, 0)$ .

Following the map is a single integer that gives the number of unlicensed transmitters to be located. For each transmitter there will be readings from three tracking stations. Each of these readings consists of the  $x$  and  $y$  coordinates of the tracking station and the distance to the unlicensed transmitter, all real numbers representing measurements in kilometers. The three tracking station locations will not be collinear, and will be at least 10 kilometers from each other. No city will be located more than 6,000 kilometers from the origin.

#### Output

Your program should process the set of readings for each unlicensed transmitter and produce a single line of output that specifies the distance from the unlicensed transmitter to the city limits (not the geographical center) of the nearest city, the principal compass direction of the unlicensed transmitter from the nearest city (north, northeast, east, southeast, south, southwest, west, or northwest), and the name of the nearest city.

The distance should be correct to within 0.02 kilometers and displayed with two significant digits. To determine the compass direction of the unlicensed transmitter from the nearest city, each of the eight principal directions should be considered to be at the center of a 45-degree arc in that direction. Unlicensed transmitters that fall anywhere in a particular arc are considered to be in that direction. Thus if due north is at zero degrees, a transmitter that is at an angle between 22 and 67 degrees, inclusive, will be considered northeast of the city, while a transmitter that is at an angle between 68 and 112 degrees, inclusive, would be considered east of the city. When determining the direction of the unlicensed transmitter, an angle should be rounded to the nearest whole degree.

Unlicensed transmitters that are located inside a city's radius are to be reported as originating from that city, with no distance or directional information reported.

Each unlicensed transmitter report should include the transmitter identification number (starting with transmitter 1). Leave one blank line between the reports.

### Sample Input

```
Pleasantville 937.8 1277.34 4.9
Avion          494.17 -483.06 12.7
Caniama        -803.24 1351.68 6.53
Kingstons Falls -554.45 -300.0 1.82
Otisburg       0.0 0.0 3.6
5
286.91 1538.6 676.989 1627.84 1450.3 1026.29 1140.4 451.47 705.152
-1021.9 -1064.67 2164.66 1089.23 0.0 1796.91 993.94 -1516.17 2882.78
200.0 -295.6 824.776 -683.94 -1118.64 998.19 474.16 1729.8 2145.37
-173.21 -700.2 695.308 -202.87 191.04 971.421 1407.9 525.65 1369.38
747.02 419.61 628.79 0.0 -582.19 645.469 -987.65 294.3 1300.12
```

### Expected Output

```
Unlicensed transmitter 1 is located 354.65 km southwest of Pleasantville

Unlicensed transmitter 2 is located 524.55 km southeast of Caniama

Unlicensed transmitter 3 is located 182.27 km north of Kingstons Falls

Unlicensed transmitter 4 is located in Avion

Unlicensed transmitter 5 is located 275.12 km east of Otisburg
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