2005 Canadian Computing Competition
Day 1, Question 3

Input file: `news.in`

Output file: none

Source file: `n:\news\news.`___

That's news to me

You have a grid (of maximum size 11 by 11) with one distinguished location at some unknown position (X, Y) (where both X and Y are integers in the range 0..10).

Not all the grid positions are eligible to contain the distinguished location. A polygon is marked on the grid. This polygon indicates the possible locations for the distinguished location. The polygon is *closed*, has no interior holes, and is convex. It also has the property that every edge of the polygon runs in one of the eight directions {N, S, E, W, NW, SE, NE, SW}.

Recall that a polygon is convex when it contains (encloses) all the line segments connecting any pair of its points.

Luckily for you, the Oracle knows where the distinguished point is. You are trying to identify the distinguished location by asking questions of the Oracle. Each question consists of:

"I'm thinking of a line running {N/S,E/W,NW/SE,NE/SW} through location (x,y)"

Each question is answered by:

"The distinguished point is {to the left of, to the right of, on} the line."

There are two procedures contained in a library named `newsLib`. The library has two operations, outlined below.

The oracle is implemented by a procedure `Oracle` which expects three parameters:
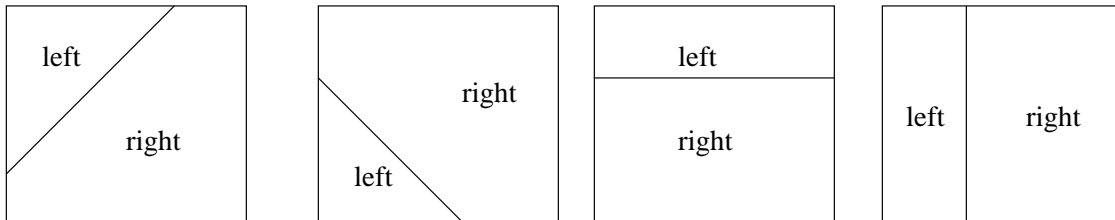
1. the integer x ($0 \le x \le 10$)

2. the integer y ($0 \le y \le 10$)

3. an integer {1,2,3,4}, where:

   - 1 corresponds to a line going North/South through the point (x, y) (that is, the slope of the line is ∞)

   - 2 corresponds to a line going North-East/South-West through the point (x, y) (that is, the slope of the line is 1)

   - 3 corresponds to a line going East/West through the point (x, y) (that is, the slope of the line is 0)

- 4 corresponds to a line going North-West/South-East through the point (x, y) (that is, the slope of the line is -1)

The procedure `Oracle` returns one of three integer values:

- -1 if the point is to the "left" of the line

- 0 if the point is on the line

- 1 if the point is to the "right" of the line

For each case, the diagram below should explain what is meant by "left" and "right":

There is also a procedure `Decide` which takes two parameters

- the integer X ($0 \leq X \leq 10$)

- the integer Y ($0 \leq Y \leq 10$)

This procedure indicates to the library that your program has determined the distinguished location (X, Y). This routine also terminates your program.

The Oracle is very busy. Your program should ask **as few questions as possible** to `Oracle` until you are certain of the distinguished location. That is, you should minimize the maximum possible number of questions asked, regardless of the distinguished location. Once you have determined the distinguished location, you must call `Decide`.

Program Input

Your program will read from the file `news.in`. The first line of input is two integers, X and Y (in that order) indicating the width and height of the grid.

The next Y lines consist of X characters, either "." or "X", the "X"s marking the initial polygon which obeys the above rules.

Testing your program

The library reads the values of X and Y (in that order) from the file named `oracle.in`. This represents the value of the secret distinguished location. You can modify the values in this file in order to test your program. Do not read from this file directly. After the simulation has finished, the library outputs two files. The first file, named `news.out`, contains the two integers X and Y that your program passed to the `Decide` routine. The other file output by the library is a log file, `news.log`, describing the calls that your program made to the library routines.

Example

contents of `news.in`:

```
10 10
......X...
.....XXX..
....XXXXX.
...XXXXXXX
..XXXXXXXX
.XXXXXXXX.
XXXXXXXX..
.XXXXXX..
..XXXX...
...XX....
```

contents of `oracle.in`:

```
4 6
```

possible sequence of library calls:

1. `Oracle(5,5,1)` returns -1

2. `Oracle(2,5,3)` returns -1

3. `Oracle(2,5,3)` returns -1

4. `Oracle(2,6,3)` returns 0

5. `Oracle(4,6,1)` returns 0

6. `Decide(4,6)` stops the program

contents of `news.out` after the above library calls

```
4 6
```

contents of `news.log` after the above library calls

```
Oracle (x=5, y=5, slope=1);
returns -1
Oracle (x=2, y=5, slope=3);
returns -1
Oracle (x=2, y=5, slope=3);
returns -1
Oracle (x=2, y=6, slope=3);
returns 0
Oracle (x=4, y=6, slope=1);
returns 0
Decide (x=4, y=6);
CORRECT!
```

Instructions for Pascal Programmers

To access the library, your program must contain the statement

```
uses newsLib;
```

For your information, here are the function and procedure declarations:

```
function Oracle( x:integer, y:integer, slope:integer ) : integer ;
procedure Decide( X:integer, Y:integer ) ;
```

Instructions for C/C++ Programmers

Use the instruction

```
#include "newsLib.h"
```

in your source code. Use the "Open Project..." command to create a new project. Add your source file `news.c` (or `news.cpp`) and the module `newsLib.o` to your project. For your information, the function headers are:

```
int Oracle( int x, int y, int slope) ;
void Decide( int X, int Y ) ;
```

Additional Information

Your program is not allowed to read from or write to any files other than `news.in`.