



South African Computer Olympiad Training DAY 1



Overview

Author	Havenstein	Tian	Loots	Scheepers
Problem	Mazed	Logic	Migrate	Antenna
Executable	mazed.exe	logic.exe	migrate.exe	antenna.exe
Source	mazed.pas mazed.java mazed.cpp	logic.pas logic.java logic.cpp	migrate.pas migrate.java migrate.cpp	antenna.pas antenna.java antenna.cpp
Input file	stdin	Stdin	stdin	stdin
Output files	stdout	Stdout	stdout	stdout
Time limit	5 seconds	5 seconds	1 second	1 second
Num. of tests	10	10	10	10
Points per test	10	10	10	10
Total points	100	100	100	100

The maximum total score for Day1 is 300 points.



South African Computer Olympiad Training DAY 1



Mazed

Author

Ruan Havenstein

Introduction

Alice (from Wonderland) is going to buy a square in Maze-opolis also known as MazeD. (MazC is a town and the other two, MazeA and MazB became ghost towns early in the 80s) Now, because Alice is such a social person, always wanting to go over and drink tea with her friends. Her friends live in ALL the other squares in Maze-opolis.

Task

Alice wants to know where she should buy herself a square so that the sum of “all the shortest paths to all the other squares” from her square, is a minimum.

Example

Here is an example where Maze-opolis is 4x4 blocks.

3	4	1	2
2	1	Z	3
3	2	1	4
4	7	6	5

The black lines represent very high fences or walls you can't walk over. (Alice can't, anyway) The Z marks where Alice should buy her house to minimize the distance sums. The numbers in the blocks are the minimum distance from Z to that specific spot. In other words, their sum is 48. You can check for yourself, if Z were chosen anywhere else, the total sum would be greater.

Your program should output the coordinate of this block as well as the calculated minimum sum.

Coordinates are:

- x, from west to east starting at 1
- y, from north to south starting at 1.

Input format

Line 1: W , the width (blocks from west to east)
 Line 2: H , the height (blocks from north to south)
 Lines 3.. $H+2$: A total of W Space separated byte values. In other words the i^{th} item in row $j+2$

corresponds to the coordinates (i, j) . Note: There are no spaces at the end of a line.

The byte values describe how the walls are configured: Start with 0.

If a block has a wall to the North, add 8

...East, add 4

...South, add 2

...West, add 1.

The input will always be such that there are walls which stop you from “falling off” the maze. You may also assume there is wall symmetry: e.g. if a block has a wall to the north, then the block to the north of it will have a wall to the south. Furthermore, there may be more that one way to get from A to B (in this example there was only a unique route between any two points). Also, there is always a way to get from A to B. (A and B are arbitrarily chosen points on the maze)

Sample Input

```
4
4
9 14 9 12
3 10 4 5
9 10 6 5
7 11 10 6
```

Output format

Line 1: x-coordinate of Z

Line 2: y-coordinate of Z

(the coordinate system is the same as that for the input)

Line 3: the calculated minimum sum

(It is possible that the answer may not be unique, so you may give any square that has the minimum sum property)

Sample Output

```
3
2
48
```

Constraints

1• W • 70 1• H • 70

Time limit

5 seconds.

Scoring

- Full marks (10) if everything is correct.
- Only 5 marks if only the sum is correct
- 0 otherwise.



South African Computer Olympiad Training DAY 1



Logic

Author

Shen Tian

Introduction

The people of Synon are becoming increasingly confused about their language. There are simply too many synonyms for each word, and each in turn has more synonyms. As this goes on, it becomes very confusing.

Task

You are asked to write a program that will determine if given pairs of words are synonyms, given a list of known synonyms.

Assume the following:

- Any word is a synonym of itself.
- if A is a synonym of B, then B is a synonym of A.
- if A is a synonym of B, and B a synonym of C, then A is a synonym of C.

Example

Given:

“car” is a synonym of “auto”.

“vehicle” is a synonym of “car”

“dwelling” is a synonym of “home”

Questions:

Is “auto” a synonym of “vehicle”?

Is “home” a synonym of “car”?

Answers:

Yes

No

Note that “absence of evidence is evidence of absence” is true for the purpose of this problem. If it cannot be deduced that “home” is a synonym of “car”, then it is not.

Input format

Use stdin.

Line 1: Two integers, N and M, separated by a space.

Line 2 to N+1: Each line contains two words, separated by a single space. This is a statement, implying that the two words are synonyms.

Line N+2 to N+M+1: Each line contains two words, separated by a single space. This is a question, asking if the two words are synonyms.

Sample Input

```
3 2
car auto
vehicle car
dwelling home
auto vehicle
home car
```

Output format

Use stdout

M lines, each containing “yes” or “no” (case sensitive), They form the answers to the M questions in the input, in the same order.

Sample Output

```
yes
no
```

Constraints

There can be up to 10000 different words in the language. Each word consists only of small letters a-z (no capitals, no spaces). Each word has at most 10 letters.

$1 \leq M \leq 10$

$1 \leq N \leq 10000$

Time limit

5 seconds per case.

Scoring

A total is obtained as follows: 1 point per right answer, -1 point per wrong answer. The score will be $10 * \max(\text{total}, 0) / M$, rounded to the nearest integer. Invalid output format will score 0.



South African Computer Olympiad Training DAY 1



Migrate

Author

Linsen Loots

Introduction

There has been a drought all across the farm, and the cows have decided to leave for greener pastures. The chaos of the drought has caused many of the fences to become dilapidated, giving the cows free passage through the fields. Unfortunately there is very little edible grass left, and the cows are near the point of starvation. They must leave the farm, but can only go for a certain distance before they must eat again. They need your help to find their way out of the farm.

Task

You are given a map of the farm, in the form of a rectangular grid. Each block is either clear, edible grass or a fence. You must find the shortest way to get from the given starting point (S) to the given end point (E). The cows can only travel for 4 steps on non-edible grass, and can only travel to squares adjacent to their current positions. The starting point counts as edible grass.

Example

	1	2	3	4	5
A		X		G	X
B	X	X	G	X	X
C	G				E
D	X		X	X	X
E				G	S

This is a map of the farm. S represents the starting point, E the end point, X's fences and G's edible patches of grass. The best path for this example would be: 4E, 3E, 2E, 2D, 2C, 1C, 2C, 3C 4C, 5C.

Input format

The first line contains two integers, X and Y, separated by a space, specifying the size of the farm.

The second line contains two space-separated integers giving the x and y co-ordinates of the starting point. x and y co-ordinates are always measured right and down from the top left square.

The next line contains the x and y co-ordinates of the end point in the same format.

The next Y lines each contain X digits, separated by spaces. These are as follows: a '0' for open field, a '1' for edible grass and a '2' for a fence.

Sample Input

```
5 5
5 5
5 3
0 2 0 1 2
2 2 1 2 2
1 0 0 0 0
2 0 2 2 2
0 0 0 1 0
```

Output format

First the length L of the path. This includes the end square but not the starting square.

On the next L lines the x and y co-ordinates of the steps in the path, beginning with the first square moved onto and ending with the given end square.

Sample Output

```
10
4 5
3 5
2 5
2 4
2 3
1 3
2 3
3 3
4 3
5 3
```

Constraints

X• 50; Y•50

There is always a possible path from the start to the finish.

Time limit

1 second.

Scoring

- ◇ 0 out of 10: If the path is invalid for any reason, particularly if it doesn't get from the start to the finish, moves more than one square at a time, travels through a fence or travels for more than 4 squares without moving onto edible grass.
- ◇ 10 out of 10: If the given path is of optimal length
- ◇ $2 \cdot (5 - X)$ out of 10: otherwise, where X is the number of moves the given path is larger than the optimal path. There will never be negative marks given.



South African Computer Olympiad Training DAY 1



Radio Antenna

Author

Christiaan Scheepers

Introduction

NASA has decided that it's time to construct a new radio antenna and they need your help to do it. To simplify your job NASA has already located a site with adequate connector poles for the antenna. The radio antenna's wire needs to be connected by using the existing poles to form the largest possible antenna. The antenna wire's route must thus be the shortest route that surrounds all the unused connector poles.

Task

Your task is to write an algorithm that will select the connector poles to be used in the construction of the antenna. Since the pole wire connectors are quite expensive you should use the minimum amount of connector poles without sacrificing the size of the antenna. Each connector pole may be used only once. If a diagonal line links any two selected connector poles the connecting line may not cross the antenna wire's route.

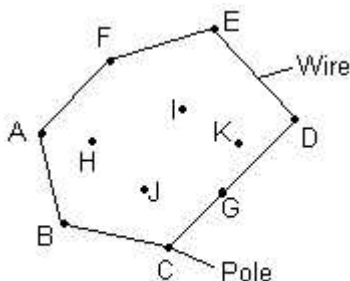


Figure 1

In figure 1 for instance the optimal route for the wire would be A B C D E F A.

G can be left out without decreasing the size of the antenna.

G, H, I, J, and K are all poles that will not be used.

Input format

The input will consist of an integer N on the first line followed by N lines containing the X and Y coordinates of the connector poles separated by a single space.

Sample Input

```
6
5 0
0 2
3 3
7 3
9 2
5 1
```

Output format

The output must be an integer M followed by a list of M integers. The integers represent the position of the pole in the input file numbered 1 through N . The list must be in the order that the poles need to be connected. The first pole and last pole listed must be the same e.g. if your list starts with pole 3 then it must also end with pole 3.

Sample Output

```
6
3
4
5
1
2
3
```

Constraints

$5 < N < 30001$

$-32000 < X < 32000$

$-32000 < Y < 32000$

The antenna's area > 0

Every pole will have a unique coordinate.

Time limit

1 second.

Scoring

- A correct solution will score 100%.
- A solution will score 50% if the route found is the correct distance but uses more than the necessary poles.
- Incorrect formatted output and invalid routes will score 0%.