Homework Assignment #10: Programming Exercise #2

Note

This assignment constitutes 4% of your grade and is due 2:10PM Friday, June 11, 2010. Please write/type your answers/code on A4 (or similar size) paper. Drop your homework by the due time in Yih-Kuen Tsay's mail box on the first floor of Management College Building II. Late submission will be penalized by 20% for each working day overdue. You may discuss the problems with others, but copying answers/code is strictly forbidden.

Your work will be graded according to its correctness and presentation. Specifically, you should demonstrate evidences showing that your program is correct. You should also organize and document your program in such a way that your classmates, for example, can understand it.

Problem

Solve either Problem G "The Islands" or Problem J "Sharing Chocolate" of the 2010 Annual ACM International Collegiate Programming Contest World Finals (see the appended).

Please prepare an input file with more interesting cases and test your program on the input. In the documentation of your program, you should describe how you have applied the algorithmic techniques, in particular design by induction, learned in class.

Problem G
The Islands
Problem ID: islands

Wen Chen is the captain of a rescue boat. One of his important tasks is to visit a group of islands once a day to check if everything is all right. Captain Wen starts from the west-most island, makes a pass to the east-most island visiting some of the islands, then makes a second pass from the east-most island back to the first one visiting the remaining islands. In each pass Captain Wen moves steadily east (in the first pass) or west (in the second pass), but moves as far north or south as he needs to reach the islands. The only complication is that there are two special islands where Wen gets fuel for his boat, so he must visit them in separate passes. Figure 7 shows the two special islands in pink (1 and 3) and one possible path Captain Wen could take.

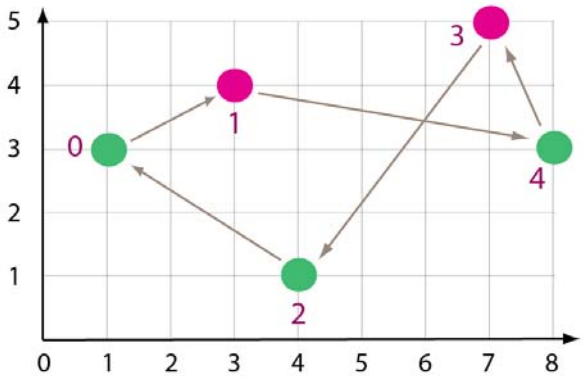

Figure 7

Calculate the length of the shortest path to visit all the islands in two passes when each island's location and the identification of the two special islands are given.

Input

The input consists of multiple test cases. The data for each case begins with a line containing 3 integers n ($4 \le n \le 100$), b_1, and b_2 ($0 < b_1, b_2 < n$-1 and $b_1 \ne b_2$), where n is the number of islands (numbered 0 to n-1) and b_1 and b_2 are the two special islands. Following this, there are n lines containing the integer x- and y-coordinates of each island ($0 \le x, y \le 2000$), starting with island 0. No two islands have the same x-coordinate and they are in order from west-most to east-most (that is, minimum x-coordinate to maximum x-coordinate).

Input for the last case is followed by a line containing 3 zeroes.

Output

For each case, display two lines. The first line contains the case number and the length of the shortest tour Captain Wen can take to visit all the islands, rounded and displayed to the nearest hundredth. The second line contains a space-separated list of the islands in the order that they should be visited, starting with island 0 and 1, and ending with island 0. Each test case will have a unique solution. Follow the format in the sample output.

Sample Input	Output for the Sample Input
5 1 3 1 3 3 4 4 1 7 5 8 3 5 3 2 0 10 3 14 4 7 7 10 8 12 0 0 0	Case 1: 18.18 0 1 4 3 2 0 Case 2: 24.30 0 1 3 4 2 0

Problem J
Sharing Chocolate
Problem ID: chocolate

Chocolate in its many forms is enjoyed by millions of people around the world every day. It is a truly universal candy, available in virtually every country around the world.

You find that the only thing better than eating chocolate is to share it with friends. Unfortunately, your friends are very picky and have different appetites: some would like more and others less of the chocolate that you offer them. You have found it increasingly difficult to determine whether their demands can be met. It is time to write a program that solves the problem once and for all!

Your chocolate comes as a rectangular bar. The bar consists of same-sized rectangular pieces. To share the chocolate, you may break one bar into two pieces along a division between rows or columns of the bar. You may then repeatedly break the resulting pieces in the same manner. Each of your friends insists on a getting a single rectangular portion of the chocolate that has a specified number of pieces. You are a little bit insistent as well: you will break up your bar only if all of it can be distributed to your friends, with none left over.

For example, Figure 9 shows one way that a chocolate bar consisting of 3×4 pieces can be split into 4 parts that contain 6, 3, 2, and 1 pieces respectively, by breaking it 3 times. (This corresponds to the first sample input.)

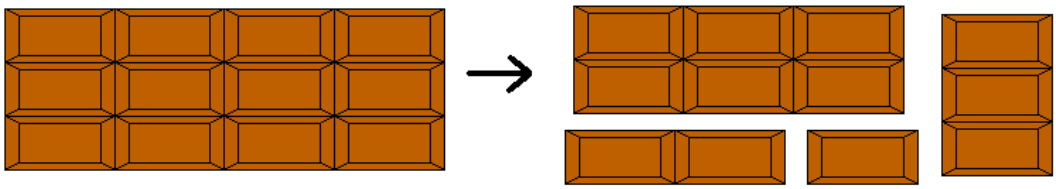

Figure 9

Input

The input consists of multiple test cases, each describing a chocolate bar to share. Each description starts with a line containing a single integer n ($1 \le n \le 15$), the number of parts into which the bar is supposed to be split. This is followed by a line containing two integers x and y ($1 \le x, y \le 100$), the dimensions of the chocolate bar. The next line contains n positive integers, giving the number of pieces that are supposed to be in each of the n parts.

The input is terminated by a line containing the integer zero.

Output

For each test case, first display its case number. Then display whether it is possible to break the chocolate in the desired way: display "`Yes`" if it is possible, and "`No`" otherwise. Follow the format of the sample output.

Sample Input	Output for the Sample Input
4 3 4 6 3 2 1 2 2 3 1 5 0	Case 1: Yes Case 2: No