

Problem A

Adhoc Translation

Practice Contest I, Tokyo
21 Feb 2009

One day, during daily web surfing, you encountered a web page which was written in a language you've never seen. The character set of the language was the same as your native language; moreover, the grammar and words seemed almost the same. Excitedly, you started to "decipher" the web page. The first approach you tried was to guess the meaning of each word by selecting a similar word from a dictionary of your native language. The closer two words (although from the different languages) are, the more similar meaning they will have.

You decided to adopt edit distance for the measurement of similarity between two words. The edit distance between two character sequences is defined as the minimum number of insertions, deletions and substitutions required to morph one sequence into the other. For example, the pair of "point" and "spoon" has the edit distance of 3: the latter can be obtained from the former by deleting 't', substituting 'i' to 'o', and finally inserting 's' at the beginning.

You wanted to assign a word in your language to each word in the web text so that the entire assignment has the minimum edit distance. The edit distance of an assignment is calculated as the total sum of edit distances between each word in the text and its counterpart in your language. Words appearing more than once in the text should be counted by the number of appearances.

The translation must be consistent across the entire text; you may not match different words from your dictionary for different occurrences of any word in the text. Similarly, different words in the text should not have the same meaning in your language.

Suppose the web page says "qwerty asdf zxcv" and your dictionary contains the words "qwerty", "asdf", "tyui", "zxcvb" and "ghjk". In this case, you can match the words in the page as follows, and the edit distance of this translation is 3: "qwerty" for "qwerty", "asdf" for "asdf" and "zxcvb" for "zxcv".

Write a program to calculate the minimum possible edit distance among all translations, for given a web page text and a word set in the dictionary.

► Input

The first line of the input contains two integers N and M .

The following N lines represent the text from the web page you've found. This text contains only lowercase alphabets and white spaces. Then M lines, each containing a word, describe the dictionary to use. Every word consists of lowercase alphabets only, and does not contain more than 20 characters.

It is guaranteed that $1 \leq N \leq 100$ and $1 \leq M \leq 400$. Also it is guaranteed that the dictionary is made up of many enough words, which means the number of words in the dictionary is no less than the kinds of words in the text to translate. The length of each line in the text does not exceed 1000.

► Output

Output the minimum possible edit distance in a line.

► Sample Input and Output

Input #1:

1 5

qwerty asdf zxcv

qwerty

asf

tyui

zxcvb

ghjk

Output #1:

3

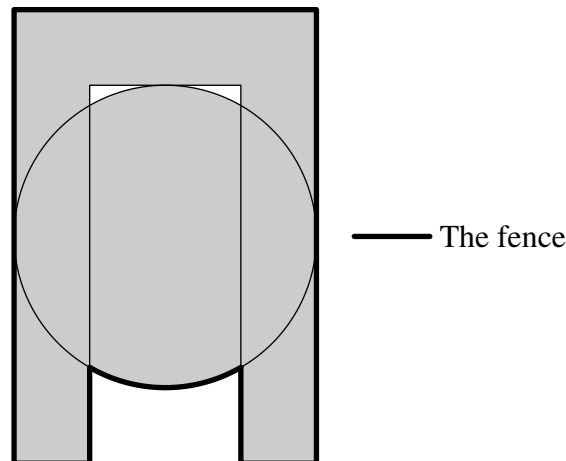
Problem B Artistic Art Museum

Practice Contest I, Tokyo
21 Feb 2009

Mr. Knight is a chief architect of the project to build a new art museum. One day, he was struggling to determine the design of the building. He believed that a brilliant art museum must have an artistic building, so he started to search for a good motif of his building. The art museum has one big theme: "nature and human beings." To reflect the theme, he decided to adopt a combination of a cylinder and a prism, which symbolize nature and human beings respectively (between these figures and the theme, there is a profound relationship that only he knows).

Shortly after his decision, he remembered that he has to tell an estimate of the cost required to build to the financial manager. He unwillingly calculated it, and he returned home after he finished his report. However, you, an able secretary of Mr. Knight, have found that one field is missing in his report: the length of the fence required to surround the building. Fortunately you are also a good programmer, so you have decided to write a program that calculates the length of the fence.

To be specific, the form of his building is union of a cylinder and a prism. You may consider the two-dimensional projection of the form, i.e. the shape of the building is considered to be union of a circle C and a polygon P . The fence surrounds the outside of the building. The shape of the building may have a hole in it, and the fence is *not* needed inside the building. An example is shown in the figure below.



► Input

The input contains one test case.

A test case has the following format:

$$R$$
$$N \ x_1 \ y_1 \ x_2 \ y_2 \ \dots \ x_n \ y_n$$

R is an integer that indicates the radius of C ($1 \leq R \leq 1000$), whose center is located at the origin. N is the number of vertices of P , and (x_i, y_i) is the coordinate of the i -th vertex of P . N , x_i and y_i are all integers satisfying the following conditions: $3 \leq N \leq 100$, $|x_i| \leq 1000$ and $|y_i| \leq 1000$.

You may assume that C and P have one or more intersections.

► Output

Print the length of the fence required to surround the building. The output value should have four fractional digits, and may not contain an absolute error more than 10^{-4} .

It is guaranteed that the answer does not change by more than 10^{-6} when R is changed by up to 10^{-9} .

► Sample Input and Output

Input #1:

2
8 -1 2 1 2 1 -3 2 -3 2 3 -2 3 -2 -3 -1 -3

Output #1:

22.6303

Problem C

Complex Integer Solutions

Practice Contest I, Tokyo
21 Feb 2009

Let $f(x) = a_0 + a_1x + a_2x^2 + \dots + a_dx^d$ be the function where each a_i ($0 \leq i \leq d$) is a constant integer (and a_d is non-zero) and x is a variable. Your task is to write a program that finds all *complex integer solutions* of the equation $f(x) = 0$ for a given $f(x)$. Here, by complex integers, we mean complex numbers whose real and imaginary parts are both integers.

► Input

The input consists of two lines. The first line of the input contains d , the degree of $f(x)$. The second line contains $(d + 1)$ integers a_0, \dots, a_d , the coefficients of the equation. You may assume all the following: $1 \leq d \leq 10$, $|a_i| \leq 10^6$ and $a_d \neq 0$.

► Output

There should be two lines in the output. In the first line, print the number m of complex integer solutions. In the second line, print m solutions separated by space. Each solution should be counted and printed exactly once even if it is a multiple root. The solutions should be printed in ascending order of their real parts then their imaginary parts, and in the following fashion: 0, -2, i, -3i, 2+i, and 3-4i.

► Sample Input and Output

Input #1:

```
4  
-2 0 0 0 2
```

Input #2:

```
8  
0 0 25 15 17 -10 1 -1 1
```

Output #1:

```
4  
-1 -i i 1
```

Output #2:

```
5  
-1-2i -1+2i 0 2-i 2+i
```

Problem D Dial Key

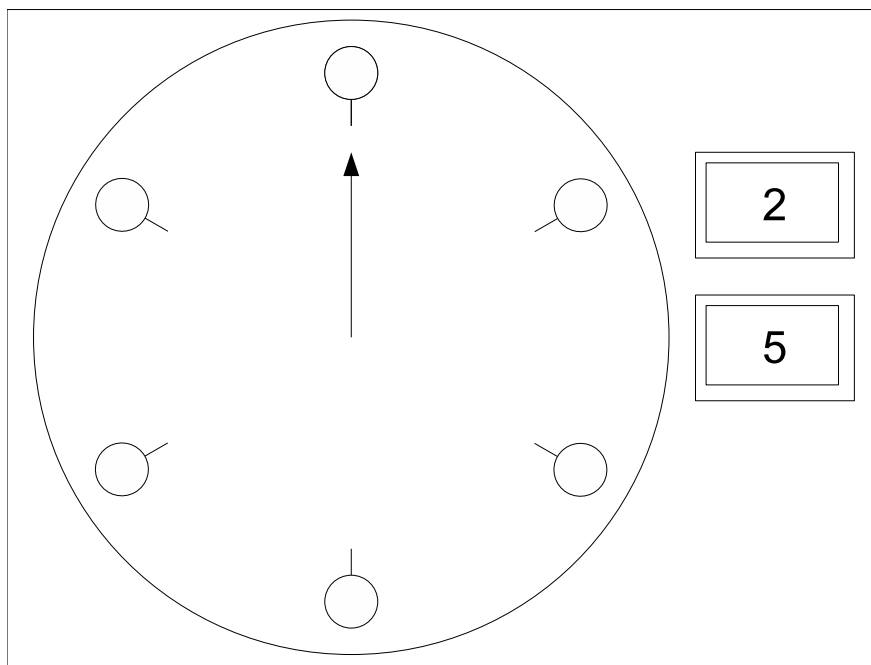
Practice Contest I, Tokyo
21 Feb 2009

You are a secret agent from the Intelligence Center of Peacemaking Committee. You've just sneaked into a secret laboratory of an evil company, Automated Crime Machines.

Your mission is to get a confidential document kept in the laboratory. To reach the document, you need to unlock the door to the safe where it is kept. You have to unlock the door in a correct way and with a great care; otherwise an alarm would ring and you would be caught by the secret police.

The lock has a circular dial with N lights around it and a hand pointing to one of them. The lock also has M buttons to control the hand. Each button has a number L_i printed on it.

Initially, all the lights around the dial are turned off. When the i -th button is pressed, the hand revolves clockwise by L_i lights, and the pointed light is turned on. You are allowed to press the buttons exactly N times. The lock opens only when you make all the lights turned on.



For example, in the case with $N = 6$, $M = 2$, $L_1 = 2$ and $L_2 = 5$, you can unlock the door by pressing buttons 2, 2, 2, 5, 2 and 2 in this order.

There are a number of doors in the laboratory, and some of them don't seem to be unlockable. Figure out which lock can be opened, given the values N , M , and L_i 's.

► Input

The input starts with a line containing two integers, which represent N and M respectively. M lines follow, each of which contains an integer representing L_i .

It is guaranteed that $1 \leq N \leq 10^9$, $1 \leq M \leq 10^5$, and $1 \leq L_i \leq N$ for each $i = 1, 2, \dots, M$.

► Output

Output a line with “Yes” (without quotes) if the lock can be opened, and “No” otherwise.

► Sample Input and Output

Input #1:

6 2

2

5

Output #1:

Yes

Input #2:

3 1

1

Output #2:

Yes

Input #3:

4 2

2

4

Output #3:

No

Problem E

Dungeon Master

Practice Contest I, Tokyo
21 Feb 2009

Once upon a time, in a fantasy world far, far away, monsters dug caves and dungeons for adventurers. They put some obstacles in their caves so it becomes more difficult and more exciting for the adventurers to reach the goal.

One day, Emils, one of the monsters in the caves, had a question about the caves. How many patterns of a cave can they make, by changing the locations of the obstacles in it?

Here's the detail of the question. A cave consists of $W \times H$ squares. Monsters can put obstacles at some of the squares, so that adventurers can't go into them. The total number of obstacles is fixed, and there can't be two or more obstacles in one square. Adventurers enter the cave from the top-left square, and try to reach the bottom-right square. They can move from one square to any of the four adjacent squares, as long as there are no obstacles in the destination square. There must be at least one path between any two squares that don't have obstacles. There must be no obstacles in the top-left square, nor in right-bottom square. The question is, given the width W and height H of the cave, and the number S of obstacles, how many patterns of the caves the monsters can make. As the obstacles have the same look, they should not be distinguished each other.

It was a very interesting mathematical question. Emils couldn't solve this question by himself, so he told it to his colleagues instead. None of them could answer to it, though. After that, the question soon got popular among the monsters working in the caves, and finally, they became unable to sleep well as they always thought about the question.

You are requested to write a program that answers to the question.

► Input

The input has a line, containing three integers W , H , and S , separated by a space. W and H are the horizontal and vertical sizes of the cave, and S is the number of obstacles to put in the cave. It is guaranteed that $2 \leq W, H \leq 8$, and that $0 \leq S \leq W \times H$.

► Output

Output the number of patterns of the cave, in a line.

► Sample Input and Output

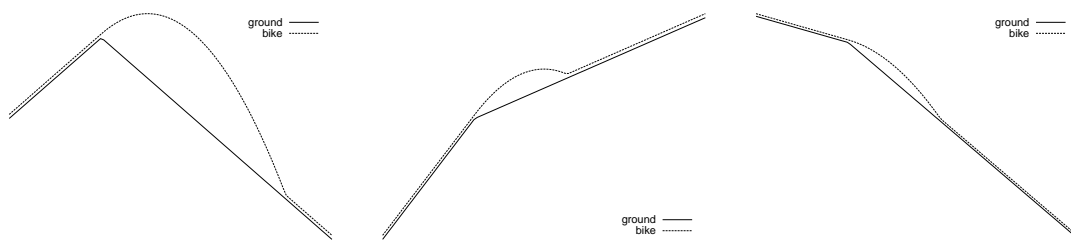
Input #1:	Output #1:
2 2 2	0
Input #2:	Output #2:
2 2 1	2

Problem F Exciting Bicycle

Practice Contest I, Tokyo
21 Feb 2009

You happened to get a special bicycle. You can run with it incredibly fast because it has a turbo engine. You can't wait to try it off road to enjoy the power.

You planned to go straight. The ground is very rough with ups and downs, and can be seen as a series of slopes (line segments) when seen from a lateral view. The bicycle runs on the ground at a constant speed of V . Since running very fast, the bicycle jumps off the ground every time it comes to the beginning point of a slope slanting more downward than the previous, as illustrated below. It then goes along a parabola until reaching the ground, affected by the gravity with the acceleration of 9.8m/s^2 .



It is somewhat scary to ride the bicycle without any preparations — you might crash into rocks or fall into pitfalls. So you decided to perform a computer simulation of the ride.

Given a description of the ground, calculate the trace you will run on the ground by the bicycle. For simplicity, it is sufficient to output its length.

► Input

The first line of the input has two integers N ($2 \leq N \leq 10000$) and V ($1 \leq V \leq 10000$), separated by a space. It is followed by N lines. The i -th line has two integers X_i and Y_i ($0 \leq X_i, Y_i \leq 10000$). $V[\text{m/s}]$ is the ground speed of the bicycle. The $(i - 1)$ line segments $(X_i, Y_i) - (X_{i+1}, Y_{i+1})$ form the slopes on the ground, with the sky in the positive direction of the Y axis. Each coordinate value is measured in meters.

The start is at (X_1, Y_1) , and the goal is at (X_N, Y_N) . It is guaranteed that $X_i < X_{i+1}$ for $1 \leq i \leq N - 1$.

You may assume that the distance of x -coordinate between the falling point and any endpoint (except for the jumping point) is not less than 10^{-5}m .

► Output

Output the length you will run on the ground with the bicycle, in meters. The value may be printed with any number of digits after the decimal point, should have the absolute or relative error not greater than 10^{-8} .

► Sample Input and Output

Input #1:

5 10
0 0
10 10
20 0
30 10
40 0

Output #1:

22.22335598

Input #2:

2 10
0 0
10000 0

Output #2:

10000.00000000

Input #3:

4 10000
0 0
1 1
9999 0
10000 10000

Output #3:

11.21323169

Input #4:

4 50
0 10000
1 10000
2 0
10000 0

Output #4:

7741.23024274

Problem G

Fuel Problem

Practice Contest I, Tokyo
21 Feb 2009

Today, Mr. Fisher is going to a town from his hometown by car. As his schedule is not so tight, he is planning to trade fuel in towns on his way to gain some money.

At the beginning, the tank of the car is filled up. Mr. Fisher can buy or sell any amount of fuel at any town, including the hometown and the destination, but he needs one unit of fuel to drive one unit of distance. Also, he cannot hold fuel more than the capacity of the tank of his car. Even though he is not in a hurry, he would not like to buy or sell so many times, namely, more than Q times. The price of fuel varies in each town.

He would like to maximize the gain from the trade under these conditions. He calls you, an excellent programmer, for a help.

Your task is to calculate the maximum gain. Here, the gain means the increase in the amount of money at the end of the drive from the beginning. The amount of the fuel at the end is not taken into the account. You can assume that Mr. Fisher has enough money at the beginning; it is acceptable for him to lose some money on the way or even at the end. If he has to lose some money to reach the destination, minimize the loss.

► Input

The input is given in the following format:

```
 $N$   $M$   
 $S$   $T$   $F$   $Q$   
 $R_1$   $R_2$  ...  $R_N$   
 $A_1$   $B_1$   $D_1$   
 $A_2$   $B_2$   $D_2$   
...  
 $A_M$   $B_M$   $D_M$ 
```

The first line contains two integers N and M ($2 \leq N \leq 300$). N indicates the number of towns and M indicates the number of roads. The second line contains four integers S , T , F and Q ($1 \leq S, T \leq N$, $0 < F \leq 10000$, $0 < Q \leq 100$). S and T indicates the hometown and the destination town respectively; F indicates the capacity of the tank; and Q indicates the maximum number of times he is going to buy or sell the fuel. The third line contains N integers R_i ($0 \leq R_i \leq 1000$). R_i indicates the rate of fuel (the price for one unit of fuel) in the i -th town. The following M lines describe the roads between the towns. The j -th line contains three integers A_j , B_j and D_j ($1 \leq A_j, B_j \leq N$, $0 < D_j \leq 1000$), which denotes there is a bidirectional road between A_j -th and B_j -th towns and the distance is D_j .

► Output

Output a line containing the maximum gain. If he must lose money, output the minimum loss with a minus sign. In case he cannot arrive the destination in any way, output "impossible" instead.

► Sample Input and Output

Input #1:

5 5
1 5 5 5
0 4 2 3 10
1 2 5
2 3 1
2 4 5
3 4 2
4 5 3

Output #1:

0

Input #2:

2 1
1 2 20 10
0 10
1 2 5

Output #2:

550

Input #3:

3 3
1 2 10 3
0 0 5
1 2 5
2 3 4
1 3 3

Output #3:

35

Input #4:

3 2
1 3 10 1
5 5 5
1 2 10
2 3 10

Output #4:

-50

Problem H Magic Walls

Practice Contest I, Tokyo
21 Feb 2009

You are a magician and have a large farm to grow magical fruits.

One day, you saw a horde of monsters, approaching your farm. They would ruin your magical farm once they reached your farm. Unfortunately, you are not strong enough to fight against those monsters. To protect your farm against them, you decided to build magic walls around your land.

You have four magic orbs to build the walls, namely, the orbs of Aquamarine (A), Bloodstone (B), Citrine (C) and Diamond (D). When you place them correctly and then cast a spell, there will be magic walls between the orbs A and B, between B and C, between C and D, and between D and A. The walls are built on the line segments connecting two orbs, and form a quadrangle as a whole. As the monsters cannot cross the magic walls, the inside of the magic walls is protected.

Nonetheless, you can protect only a part of your land, since there are a couple of restrictions on building the magic walls. There are N hills in your farm, where the orbs can receive rich power of magic. Each orb should be set on the top of one of the hills. Also, to avoid interference between the orbs, you may not place two or more orbs at the same hill.

Now, you want to maximize the area protected by the magic walls. Please figure it out.

► Input

The input begins with an integer N ($4 \leq N \leq 1500$), the number of the hills. Then N line follow. Each of them has two integers x ($0 \leq x \leq 50000$) and y ($0 \leq y \leq 50000$), the x - and y -coordinates of the location of a hill.

It is guaranteed that no two hills have the same location and that no three hills lie on a single line.

► Output

Output the maximum area you can protect. The output value should be printed with one digit after the decimal point, and should be exact.

► Sample Input and Output

Input #1:

5
2 0
0 1
1 3
4 2
3 4

Output #1:

7.5

Input #2:

4
0 0
0 3
1 1
3 0

Output #2:

3.0

Problem I

Sort by Hand

Practice Contest I, Tokyo
21 Feb 2009

It's time to arrange the books on your bookshelf. There are n books in the shelf and each book has a unique number; you want to sort the books according to the numbers. You know that the quick sort and the merge sort are fast sorting methods, but it is too hard for you to simulate them by hand — they are efficient for computers, but not for humans. Thus, you decided to sort the books by inserting the book with the number i into the i -th position. How many insertions are required to complete this task?

► Input

The first line of the input is n ($1 \leq n \leq 20$), which is the number of books. The second line contains n integers v_1, \dots, v_n ($1 \leq v_i \leq n$), where v_i indicates the number of the book at the i -th position before the sorting. All v_i 's are distinct.

► Output

Print the minimum number of insertions in a line. If it is impossible for him to complete the sort, print "impossible" (without quotes).

► Sample Input and Output

Input #1: 3 1 2 3	Output #1: 0
Input #2: 3 2 1 3	Output #2: 1
Input #3: 3 3 2 1	Output #3: 2
Input #4: 20 4 14 11 13 17 10 1 12 2 6 16 15 8 7 19 18 3 5 9 20	Output #4: 14

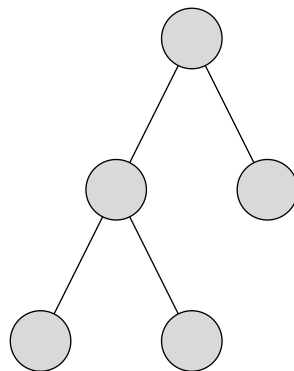
Problem J Substring Expression

Practice Contest I, Tokyo
21 Feb 2009

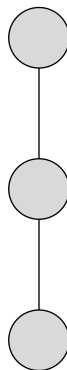
Trees are sometimes represented in the form of strings. Here is one of the most popular ways to represent unlabeled trees:

- Leaves are represented by “()”.
- Other nodes (i.e. internal nodes) are represented by “($S_1 S_2 \dots S_n$)”, where S_i is the string representing the i -th subnode.

For example, the tree depicted in the figure below is represented by a string “((()) ())”.



A strange boy Norward is playing with such strings. He has found that a string sometimes remains valid as the representation of a tree even after one successive portion is removed from it. For example, removing the underlined portion from the string “((())) ()” results in “((())”, which represents the tree depicted below.



However, he has no way to know how many ways of such removal there are. Your task is to write a program for it, so that his curiosity is fulfilled.

► Input

The input contains a string that represents some unlabeled tree. The string consists of up to 100,000 characters.

► Output

Print the number of portions of the given string such that removing them results in strings that represent other valid trees.

► Sample Input and Output

Input #1:
((()())())

Output #1:
10

Problem K

Up Above the World So High

Practice Contest I, Tokyo
21 Feb 2009

One of the questions children often ask is “How many stars are there in the sky?” Under ideal conditions, even with the naked eye, nearly eight thousands are observable in the northern hemisphere. With a decent telescope, you may find many more, but, as the sight field will be limited, you may find much less at a time.

Children may ask the same questions to their parents in a spaceship billions of light-years away from the Earth. Their telescopes are similar to ours with circular sight field. It can be rotated freely, that is, the sight vector can take an arbitrary value.

Given a set of positions of stars and the spec of a telescope, your task is to determine the maximum number of stars that can be seen through the telescope at a time.

► Input

The first line of a test case contains a positive integer N not exceeding 100, meaning the number of stars. Each of the N lines following it contains three integers, s_x , s_y and s_z . They give the position (s_x, s_y, s_z) of the star described in Euclidean coordinates. You may assume that $-1000 \leq s_x \leq 1000$, $-1000 \leq s_y \leq 1000$, $-1000 \leq s_z \leq 1000$ and $(s_x, s_y, s_z) \neq (0, 0, 0)$.

Then comes a line containing a positive integer ψ ($0 < \psi < 90$), which represents the angular radius, in degrees, of the sight field of the telescope. The telescope is at the origin of the coordinate system $(0, 0, 0)$.

You may assume that change of the angular radius ψ by less than 0.01 degrees does not affect the answer, and that $\angle POQ$ is greater than 0.01 degrees for any pair of distinct stars P and Q and the origin O.

► Output

One line containing an integer meaning the maximum number of stars observable through the telescope should be output. No other characters should be contained in the output.

► Sample Input and Output

Input #1:	Output #1:
2	1
1 0 0	
0 1 0	
40	
Input #2:	Output #2:
2	2
1 0 0	
0 1 0	
50	

► Note

This problem statement is taken from “How I Wonder What You Are!” in ACM-ICPC Asia Regional Contest 2006, Yokohoma, with small but substantial changes.