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Problem A
Boss Battle
Time Limit: 2

You are stuck at a boss level of your favourite video game. The boss battle happens in a circular room with n indestructible pillars arranged evenly around the room. The boss hides behind an unknown pillar. Then the two of you proceed in turns.

- First, in your turn, you can throw a bomb past one of the pillars. The bomb will defeat the boss if it is behind that pillar, or either of the adjacent pillars.

- Next, if the boss was not defeated, it may either stay where it is, or use its turn to move to a pillar that is adjacent to its current position. With the smoke of the explosion you cannot see this movement.

The last time you tried to beat the boss you failed because you ran out of bombs. This time you want to gather enough bombs to make sure that whatever the boss does you will be able to beat it. What is the minimum number of bombs you need in order to defeat the boss in the worst case? See Figure A.1 for an example.

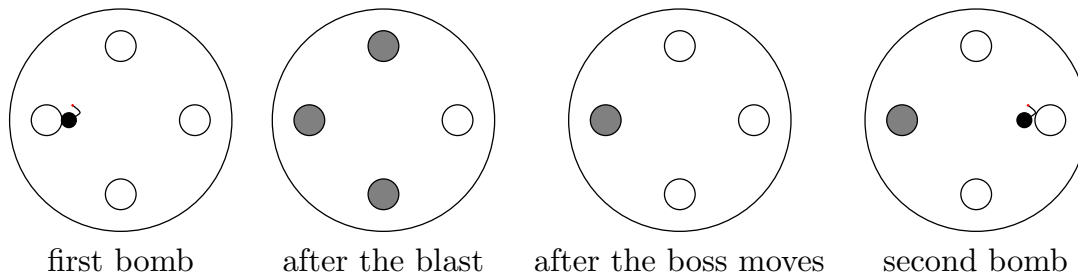first bomb   after the blast   after the boss moves   second bomb

Figure A.1: Example for $n = 4$. In this case 2 bombs are enough. Grey pillars represent pillars where the boss cannot be hiding. The bomb is represented in black.

Input

The input consists of:

- One line with a single integer n ($1 \le n \le 100$), the number of pillars in the room.

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Output

Output the minimum number of bombs needed to defeat the boss in the worst case.

Sample Input 1	Sample Output 1
4	2

Sample Input 2	Sample Output 2
7	5

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Problem B
Candle Box
Time Limit: 1

Rita loves her Birthday parties. She is really happy when blowing the candles at the *Happy Birthday*'s clap melody. Every year since the age of four she adds her birthday candles (one for every year of age) to a candle box. Her younger daydreaming brother Theo started doing the same at the age of three. Rita's and Theo's boxes look the same, and so do the candles.

One day Rita decided to count how many candles she had in her box:

– *No, no, no! I'm younger than that!*

She just realized Theo had thrown some of his birthday candles in her box all these years. Can you help Rita fix the number of candles in her candle box?

Task

Given the difference between the ages of Rita and Theo, the number of candles in Rita's box, and the number of candles in Theo's box, find out how many candles Rita needs to remove from her box such that it contains the right number of candles.

Input

The first line of the input has one integer D, corresponding to the difference between the ages of Rita and Theo.

The second line has one integer R, corresponding to the number of candles in Rita's box.

The third line has one integer T, corresponding to the number of candles in Theo's box.

Constraints

$1 \leq D \leq 20$ Difference between the ages of Rita and Theo

$4 \leq R < 1{,}000$ Number of candles in Rita's box

$0 \leq T < 1{,}000$ Number of candles in Theo's box

Output

An integer representing the number of candles Rita must remove from her box such that it contains the right number of candles.

Sample Input 1	Sample Output 1
2 2 6 8	4

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Problem C
Careful Ascent
Time Limit: 1

That went well! As police sirens rang out around the palace, Mal Reynolds had already reached his lifting device outside of the city.

No spaceship can escape Planet Zarzos without permission from the High Priest. However, Mal's spaceship, Firefly, is in geostationary orbit well above the controlled zone and his small lifting device can avoid being recognised as an intruder if its vertical velocity is exactly 1 km/min.

There are still two problems. First, Mal will not be able to control the vehicle from his space suit, so he must set up the autopilot while on the ground. The vertical velocity must be exactly 1 km/min and the horizontal velocity must be set in such a way that Mal will hit the Firefly on the resulting trajectory. Second, the energy shields of the planet disturb the autopilot: They will decrease or increase the horizontal velocity by a given factor. The original horizontal velocity is restored as soon as there is no interference. For this problem we consider Firefly to be a single point – the shape shown in Figure C.1 is merely for decorative purposes.
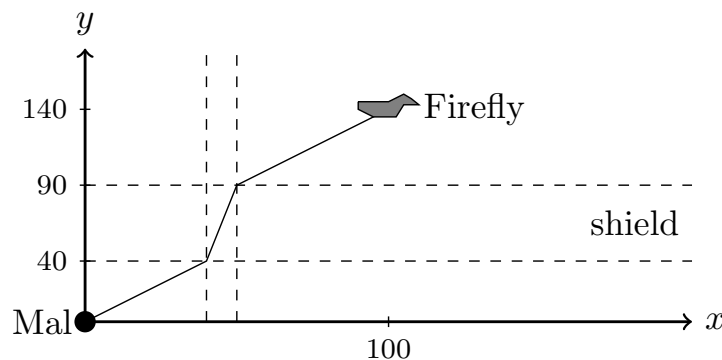

Figure C.1: Illustration of Sample Input 1.

Luckily, Mal recorded the positions of the shields and their influence on the autopilot during his descent. What he needs now is a program telling him the right horizontal velocity setting.

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Input

The input consists of:

- one line with two integers x, y ($-10^7 \le x \le 10^7$, $|x| \le y \le 10^8$ and $1 \le y$), Firefly's coordinates relatively to Mal's current position (in kilometres).

- one line with an integer n ($0 \le n \le 100$), the number of shields.

- n lines describing the n shields, the ith line containing three numbers:

    - an integer l_i ($0 \le l_i < y$), the lower boundary of shield i (in kilometres).
    - an integer u_i ($l_i < u_i \le y$), the upper boundary of shield i (in kilometres).
    - a real value f_i ($0.1 \le f_i \le 10.0$), the factor with which the horizontal velocity is multiplied during the traversal of shield i.

It is guaranteed that shield ranges do not intersect, i.e., for every pair of shields $i \ne j$ either $u_i \le l_j$ or $u_j \le l_i$ must hold.

All real numbers will have at most 10 digits after the decimal point.

Output

Output the horizontal velocity in km/min which Mal must choose in order to reach Firefly. The output must be accurate to an absolute or relative error of at most 10^{-6}.

Sample Input 1	Sample Output 1
100 140 1 40 90 0.2000000000	1.0

Sample Input 2	Sample Output 2
100 100 3 0 20 2.0000000000 50 100 0.1000000000 20 50 0.2000000000	1.96078431373

Problem D
Completing the Square
Time Limit: 1

In the heart of your home city, there is an old square, close to the train station, appropriately called *Station Square*. It used to look like a perfect square: four sides of equal length joined by right angles. However, it hasn't looked like this for decades, as one of the four corners was destroyed by bombings in the Second World War. After the war, the square was rebuilt as a quarter circle, and it has looked like that ever since. (In other words, it looks like an isosceles right triangle, except that the hypothenuse is not a straight line but a circular arc.) This is illustrated in the figure below, which corresponds with Sample Input 1.

(a) The old square, in the shape of an actual square.

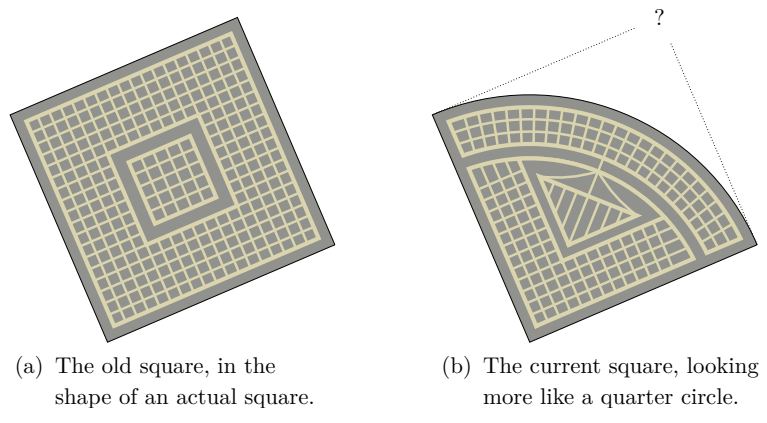(b) The current square, looking more like a quarter circle.

Figure D.1: Illustration of the first example input.

Recently, the city council voted to completely remodel the train station and its surroundings, which includes restoring Station Square to its original state. Therefore they need to determine the exact location of the fourth corner. This task is too complicated for ordinary aldermen, so the city decided to hire a top scientist. That would be you! Please help the city complete the square, and you will be greatly rewarded!

Input

There are three lines of input. Each line contains two integers denoting the x and y coordinates of one of the corners of the current square ($-10^4 \le x, y \le 10^4$).

Output

Output one line with two space-separated integers denoting the x and y coordinates of the long-lost fourth corner.

Sample Input 1

```
2 -5
-8 -1
-5 -8
```

Sample Output 1

```
-1 2
```

Sample Input 2

```
0 0
1 0
1 1
```

Sample Output 2

```
0 1
```

Sample Input 3

```
2 -1
-2 3
2 7
```

Sample Output 3

```
6 3
```

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Problem E
European Trip
Time Limit: 1

After winning Vietlott, a woman decided to go on a trip to Europe! Let's refer to her as *Ms. Mask*.

Like other women, *Ms. Mask* really loves shopping and guess where her first stop is? Of course, it is London, a dream land for shopaholics. She has already discovered three greatest shopping centers in London: Westfield Stratford City, Piccadily Arcade and Fortnum & Mason. On the Cartesian plane, these three shopping centers can be depicted by three points.

Ms. Mask wants to rent a house to stay during the whole trip, so that the total distance from her house to those shopping centers are as small as possible. Help her find an optimal position for her house, assuming that she can put her house everywhere, even in Green Park or on Thames River!

Input

The input consists of three lines, each line contains two integers x and y (between 0 and 10^3, inclusive) representing the coordinates of three shopping centers.

It is guaranteed that those three points are not collinear.

Output

Write in one line two real numbers x and y representing the place where *Ms. Mask* should hire a house and stay.

Let P be the total distance from your point to three points given in the input, and J be the total distance from jury's point. Your answer is considered correct iff P differs from J at most 10^{-4} in term of either absolute or relative value.

Sample Input 1

```
0 0
1 0
0 1
```

Sample Output 1

```
0.211324865 0.211324865
```

Sample Input 2

```
174 711
980 989
976 384
```

Sample Output 2

```
803.563974893 697.742533711
```

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Problem F
Final Exam
Time Limit: 1

The Vietnamese High School graduation exam is in progress! For most Vietnamese high school students, this is their most important exam, as its result not only decides whether they can graduate from high school, but is also used for their university applications.

Today, Hanh finished his final exam, Math, which is Hanh's strongest subject. In this exam, there are n questions, numbered from 1 to n. Each one is a multiple choice question, with 4 answers, A, B, C, and D. The students have to write the answers on an answer sheet with n lines, the i-th line should contain the answer for the i-th question. Each question has only one correct answer, and the student will receive one point if their answer matches the correct one.

Multiple Choice Test.

Hanh started checking his results with his friends confidently. After few minutes, Hanh's confidence turned into fright: Most of Hanh's answers are different from his friends'.

Hanh quickly realized that he made a terrible mistake: Hanh wrote the answer for the 2nd question on the 1st line of the answer sheet, the answer for the 3rd question on the 2nd line, the answer for the 4th question on the 3rd line, and so on. Hanh left the n-th line of the answer sheet empty, and did not write the answer for the 1st question anywhere!

Please help Hanh check what will be his final score. Given that Hanh is a great Math student, his answers for all n questions would be correct if they were on the correct line of the answer sheet.

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Input

- The first line of the input contains a single integer n $(1 \leq n \leq 1{,}000)$ — the number of questions.

- n lines follow, the i-th line contains a single character, A, B, C, or D — the correct answer for the i-th question.

Output

Print a single integer — Hanh's final score.

Explanation of the first sample input

Fortunately for Hanh, all 4 questions have A as correct answer. So Hanh wrote A on the first three lines, and left the 4-th line empty. Hanh's final score is 3.

Sample Input 1	Sample Output 1
4 A A A A	3

Sample Input 2	Sample Output 2
6 A D B B C A	1

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Problem G
ICPC Awards
Time Limit: 1

The ACM International Collegiate Programming Contest has been held in Vietnam for more than 10 years. The contest is a great chance for the students to meet new friends, broaden their knowledge and of course, win prizes.

Every years, universities can send one or multiple teams to the contest and all universities hope to win prizes. The organizers want to define a rule to award the excellent contestants.

The contest director decided to follow the World Finals policy by having 4 first prizes, 4 second prizes and 4 third prizes. 12 winners out of more than a hundred teams is also a good proportion to recognize the best students.

Since universities can send multiple teams, we don't want one university to swept all the awards. Thus, only the top team from a university can be awarded. It seems harsh for the second best team from one university but do not worry, they will still receive relevant certificates.

The table below is the result of top 10 of Nha Trang Regional Contest 2016. The 4-th (team WINDOWS) and 8-th place (team UBUNTU) did not receive prizes because they were not the top team from University of Engineering and Technology - VNU. Team Metis and team BK.DeepMind are in the same situation.

Place	Institution	Team	Prize
1	Seoul National University	ACGTeam	First Prize
2	University of Engineering and Technology - VNU	LINUX	First Prize
3	Shanghai Jiao Tong University	Mjolnir	First Prize
4	University of Engineering and Technology - VNU	WINDOWS	
5	National Taiwan University	PECaveros	First Prize
6	Hanoi University of Science and Technology	BK.Juniors	Second Prize
7	Ho Chi Minh City University of Science	HCMUS-Serendipity	Second Prize
8	University of Engineering and Technology - VNU	UBUNTU	
9	Shanghai Jiao Tong University	Metis	
10	Hanoi University of Science and Technology	BK.DeepMind	

Given the final scoreboard of the contest, your task is to determine which 12 teams should be awarded prizes.

Input

- The input starts with the number of teams N ($12 \leq N \leq 200$).

- The i-th line of the next N lines contains information about the team that ranks i: the university name and the team name separated by a single space. Both names consists of digits, lowercase and uppercase English alphabet letters only. Both names does not exceed 20 letters in length.

- It is guaranteed that there are at least 12 different universities.

Output

The output should contain 12 lines describing 12 winners. In each line, you should print the university name and the team name separated by a single space. The winners should be listed in the same order as the input.

Sample Input 1

```
30
Seoul ACGTeam
VNU LINUX
SJTU Mjolnir
VNU WINDOWS
NTU PECaveros
HUST BKJuniors
HCMUS HCMUSSerendipity
VNU UBUNTU
SJTU Metis
HUST BKDeepMind
HUST BKTornado
HCMUS HCMUSLattis
NUS Tourism
VNU DOS
HCMUS HCMUSTheCows
VNU ANDROID
HCMUS HCMUSPacman
HCMUS HCMUSGeomecry
UIndonesia DioramaBintang
VNU SOLARIS
UIndonesia UIChan
FPT ACceptable
HUST BKIT
PTIT Miners
PSA PSA
DaNangUT BDTTNeverGiveUp
VNU UNIXBSD
CanTho CTUA2LTT
Soongsil Team10deung
Soongsil BezzerBeater
```

Sample Output 1

```
Seoul ACGTeam
VNU LINUX
SJTU Mjolnir
NTU PECaveros
HUST BKJuniors
HCMUS HCMUSSerendipity
NUS Tourism
UIndonesia DioramaBintang
FPT ACceptable
PTIT Miners
PSA PSA
DaNangUT BDTTNeverGiveUp
```

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Problem H
Janitor Troubles
Time Limit: 1

While working a night shift at the university as a janitor, you absentmindedly erase a blackboard covered with equations, only to realize afterwards that these were no ordinary equations! They were the notes of the venerable *Professor E. I. N. Stein* who earlier in the day solved the elusive *maximum quadrilateral problem*! Quick, you have to redo his work so no one noticed what happened.
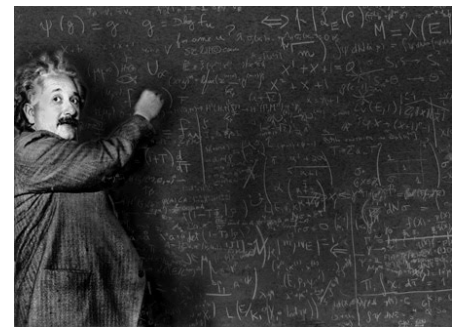
The *maximum quadrilateral problem* is quite easy to state: given four side lengths s_1, s_2, s_3 and s_4, find the maximum area of any quadrilateral that can be constructed using these lengths. A quadrilateral is a polygon with four vertices.

Input

The input consists of a single line with four positive integers, the four side lengths s_1, s_2, s_3, and s_4.

It is guaranteed that $2s_i < \sum_{j=1}^{4} s_j$, for all i, and that $1 \leq s_i \leq 1{,}000$.

Output

Output a single real number, the maximal area as described above. Your answer must be accurate to an absolute or relative error of at most 10^{-6}.

Sample Input 1	Sample Output 1
3 3 3 3	9

Sample Input 2	Sample Output 2
1 2 1 1	1.299038105676658

Sample Input 3	Sample Output 3
2 2 1 4	3.307189138830738

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Problem I
Millionaire Madness
Time Limit: 5

A close friend of yours, a duck with financial problems, has requested your help with a matter that will help him pay off his debts. He is the nephew of an extremely wealthy duck, who has a large vault, filled with mountains of coins. This wealthy duck has a certain coin in his possession which has a lot of sentimental value to him. Usually, it is kept under a protective glass dome on a velvet cushion.

However, during a recent relocating of the coins in the vault, the special coin was accidentally moved into the vault, leading to an extremely stressful situation for your friend's uncle. Luckily, the coin has recently been located. Unfortunately, it is completely opposite to the entrance to the vault, and due to the mountains of coins inside the vault, actually reaching the coin is no simple task.

He is therefore willing to pay your friend to retrieve this coin, provided that he brings his own equipment to scale the mountains of coins. Your friend has decided he will bring a ladder, but he is still uncertain about its length. While a longer ladder means that he can scale higher cliffs, it also costs more money. He therefore wants to buy the shortest ladder such that he can reach the special coin, so that he has the largest amount of money left to pay off his debts.

The vault can be represented as a rectangular grid of stacks of coins of various heights (in meters), with the entrance at the north west corner (the first height in the input, the entrance to the vault is at this height as well) and the special coin at the south east corner (the last height in the input). Your avian companion has figured out the height of the coins in each of these squares. From a stack of coins he can attempt to climb up or jump down to the stack immediately north, west, south or east of it. Because your friend cannot jump or fly (he is a very special kind of duck that even wears clothes), successfully performing a climb of n meters will require him to bring a ladder of at least n meters. He does not mind jumping down, no matter the height; he just lets gravity do all the work.

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Input

The first line contains two integers: the length M, and the width N of the vault, satisfying $1 \leq M, N \leq 1000$.

The following M lines each contain N integers. Each integer specifies the height of the pile of coins in the vault at the corresponding position. (The first line describes the north-most stacks from west to east; the last line describes the south-most stacks from west to east). The heights are given in meters and all heights are at least 0 and at most 10^9 (yes, your friend's uncle is very rich).

Output

Output a single line containing a single integer: the length in meters of the shortest ladder that allows you to get from the north west corner to the south east corner.

Sample Input 1

```
3 3
1 2 3
6 5 4
7 8 9
```

Sample Output 1

```
1
```

Sample Input 2

```
1 4
4 3 2 1
```

Sample Output 2

```
0
```

Sample Input 3

```
7 5
10 11 12 13 14
11 20 16 17 16
12 10 18 21 24
14 10 14 14 22
16 18 20 20 25
25 24 22 10 25
26 27 28 21 25
```

Sample Output 3

```
3
```

ICPC NA Division Championships 2021 Practice Problem I: Millionaire Madness 20

Problem J
Reversed Binary Numbers
Time Limit: 1

Yi has moved to Sweden and now goes to school here. The first years of schooling she got in China, and the curricula do not match completely in the two countries. Yi likes mathematics, but now... The teacher explains the algorithm for subtraction on the board, and Yi is bored. Maybe it is possible to perform the same calculations on the numbers corresponding to the reversed binary representations of the numbers on the board? Yi dreams away and starts constructing a program that reverses the binary representation, in her mind. As soon as the lecture ends, she will go home and write it on her computer.

Task

Your task will be to write a program for reversing numbers in binary. For instance, the binary representation of 13 is 1101, and reversing it gives 1011, which corresponds to number 11.

Input

The input contains a single line with an integer N, $1 \leq N \leq 1\,000\,000\,000$.

Output

Output one line with one integer, the number we get by reversing the binary representation of N.

Sample Input 1	Sample Output 1
13	11

Sample Input 2	Sample Output 2
47	61

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Problem K
Shattered Cake
Time Limit: 6

A rectangular cake is transported via a truck to a restaurant. On the way to the destination, the truck hits a pothole, which shatters the cake into N perfectly rectangular pieces of width w_i and length l_i, for $1 \leq i \leq N$.

At the destination, the damage is assessed, and the customer decides to order a replacement cake of the same dimensions. Unfortunately, the original order form was incompletely filled and only the width W of the cake is known. The restaurant asks for your help to find out the length L of the cake. Fortunately, all pieces of the shattered cake have been kept.

Input

The input consists of the following integers:

- on the first line, the width W of the cake;
- on the second line, the number N of shattered pieces;
- on each of the next N lines, the width w_i and length l_i of each piece.

Limits

- $1 \leq N \leq 5,000,000$;
- $1 \leq W, L \leq 10,000$;
- for each $1 \leq i \leq N$, $1 \leq w_i, l_i \leq 10,000$.

Output

The output should be the integer L.

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Sample Input 1	Sample Output 1
4 7 2 3 1 4 1 2 1 2 2 2 2 2 2 1	6

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Problem L
Soda Slurper
Time Limit: 1

Tim is an absolutely obsessive soda drinker, he simply cannot get enough. Most annoyingly though, he almost never has any money, so his only obvious legal way to obtain more soda is to take the money he gets when he recycles empty soda bottles to buy new ones. In addition to the empty bottles resulting from his own consumption he sometimes find empty bottles in the street. One day he was extra thirsty, so he actually drank sodas until he couldn't afford a new one.

Input

Three non-negative integers e, f, c, where $e < 1{,}000$ equals the number of empty soda bottles in Tim's possession at the start of the day, $f < 1{,}000$ the number of empty soda bottles found during the day, and $2 \le c < 2{,}000$ the number of empty bottles required to buy a new soda.

Output

How many sodas did Tim drink on his extra thirsty day?

Sample Input 1	Sample Output 1
9 0 3	4

Sample Input 2	Sample Output 2
5 5 2	9

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