Belgium Algorithm Contest

Belgium Algorithm Contest
Round 4 - 2017

Do not open before the start of the contest.

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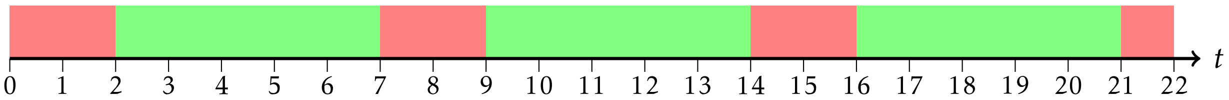
● Problem A
To run or not to run?
Time limit: 1s

Alice is late for school again. The road from her house to school is a straight road of length d. Right at the end of the road there is a red light that she needs to cross to reach school. The light is currently red. After r seconds it will become green for g seconds. Then it will be red again for r seconds and so on. For example, if $r = 2$ and $g = 5$ then the light will be red from time 0 to 2, then green from time 2 to 7 and so on, as shown in the following figure.



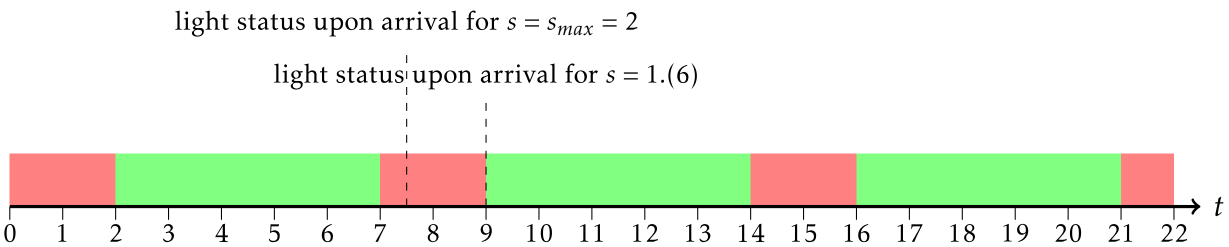
Alice can run at any speed s up to s_{max}. After traveling distance d, if the light is red then she will have to wait until it becomes green to reach school. Assume that crossing the road takes 0 time. If she arrives exactly when the light changes then she can cross at that time.

She would like to arrive as soon as possible but also to run as slow as possible. Can you help her compute the minimum constant speed at which she needs to run so that she reaches school as soon as possible?

Example:

Suppose that $r = 2$, $g = 5$, $d = 15$ and $s_{max} = 2$.

If she runs at speed $s = 2$, she will reach the light at time $t = 7.5$ and it will be red. Thus, she will still wait for 1.5 seconds making her arrive at school in a total of 9 seconds. However, if she runs at speed $s = 1.(6)$, then she will arrive at the red light at time $t = 9$ and she can cross immediately. So she manages to arrive at the same time but run at a lower speed.



Input

A single line with four integers r, g, d and s_{max} as described above.

Constraints

- $1 \le r, g, d, s_{max} \le 10^6$

Output

A single line with a number giving the minimum speed at which she needs to run in order to arrive as soon as possible.

The output must be accurate to an absolute or relative error of at most 10^{-4}

Input 1	Output 1
2 5 15 2	1.6666666666

Input 2	Output 2
3 3 5 1	1

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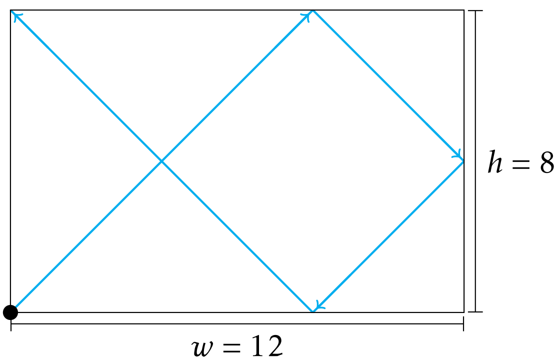
Problem B
Pool
Time limit: 1s

Alice and Bob are playing pool. After some games they reached a situation where the ball was in the bottom left corner. Alice hit it at an angle of 45 degrees as show in the following figure.



They found the trajectory of the ball very fascinating and they wondered what was the actual distance that the ball traveled before hitting a corner for the first time. In the figure the distance that the ball traveled was ≈ 33.941125497.

Given the dimensions of the table, what will be the total distance traveled by the ball?

Assume that there are no obstacles, the ball is a dot with no dimension and that there is no friction.

Input

The input contains a single line with two integers w and l giving the width and the height of the pool table, respectively.

Constraints

- $1 \leq w, l < 2^{31}$

Output

The total distance traveled by the ball until it reaches a corner.

The output must be accurate to an absolute or relative error of at most 10^{-4}.

Input 3	Output 3
12 8	33.941125497

Input 4	Output 4
1 1	1.41421356237

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● Problem C
Greedy Bridge
Time limit: 2s

In Strangeland there is a very peculiar bridge of length L. The bridge can hold at most one car at a time or it will collapse. People can apply for a bridge traversal on the day before by specifying:

- the exact time at which they will enter the bridge, t;
- the speed of their car, s;
- the amount of money they are willing to pay to traverse the bridge, m.

Cars in Strangeland always travel at constant speed. So if a car was built with speed s, it will always travel at speed s.

Every night, the greedy government of Strangeland has to decide which of the cars that applied will be allowed to cross the bridge. As they are greedy, they want to maximize their profit. Hence they will select cars so that the total money paid is maximum. However they have to make sure that the bridge will not collapse so only one car should be on the bridge at any given time. Can you help them?

Note that a car can enter at the exact same time as another car exits the bridge. Customers are only interested in traversing the bridge at the exact time they specify in their application.

Input

The first line of the input contains two integers separated by single spaces n and L giving the number of cars and the length of the bridge, respectively.

Then follow n lines each with three integers t, s, m giving the entry time, speed and amount paid by each of the cars.

Constraints

- $1 \leq L < 2^{31}$
- $1 \leq n \leq 2 \cdot 10^5$

- $0 \leq t < 2^{31}$
- $1 \leq s < 2^{31}$
- $1 \leq m \leq 1000$

Output

A single line with the maximum profit the government can make for the given cars.

Input 5

```
4 10
5 2 2
3 1 3
7 10 5
1 5 1
```

Output 5

```
6
```

Input 6

```
3 10
0 1 3
0 2 2
5 2 2
```

Output 6

```
4
```

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Problem D
Homework
Time limit: 20s

Bob and Craig just came back from school with n exercises for their homework. To finish their homework faster they decide to split the n exercises between them. For that, each of them will read all the exercises and tell how much time he needs in order to solve each of the exercises. However, some exercises depend on other exercises. Thus if they are not solved by the same person, at the end, they will have to spend some time to put their solutions together. This also takes some time that depends on the two exercises.

Given the time each of them needs to do each of the exercises and the merging times (which is 0 for independent exercises), can you help them figure out what is the minimum time they need to finish their homework?

Input

The first line of the input contains a single integer n, giving the number of exercises in the homework.

Then follow two lines, each with n integers. The first will contain $b_1, \ldots, b_n$, giving the time Bob needs to solve each of the exercises. The second will contain $c_1, \ldots, c_n$, giving Craig's times.

Finally n lines follow each with n integers. The j-th integer of the i-th line gives the time t_{ij} needed to merge the solutions of exercises i and j if one of the is solved by Bob and the other by Craig.

If i and j are independent then $t_{ij} = 0$.

Constraints

- $1 \leq n \leq 300$
- $1 \leq b_i, c_i \leq 1000$
- $0 \leq t_{ij} \leq 1000$
- $t_{ii} = 0$
- $t_{ij} = t_{ji}$

Output

The output consists of two lines.

The first line contains a single integer with the minimum time required to finish the homework.

The second line contains a string s of n character such that $s_i = \texttt{B}$ if the i-th exercise should be done by Bob and $s_i = \texttt{C}$ otherwise.

If there are multiple answers that yield the minimum time to finish the homework, any such solution will be accepted.

Input 7

```
4
6 5 10 4
4 10 3 8
0 5 0 0
5 0 6 2
0 6 0 1
0 2 1 0
```

Output 7

```
24
CCCB
```

Input 8

```
4
1 2 1 2
2 1 2 1
0 3 0 0
3 0 0 0
0 0 0 3
0 0 3 0
```

Output 8

```
6
BBBB
```

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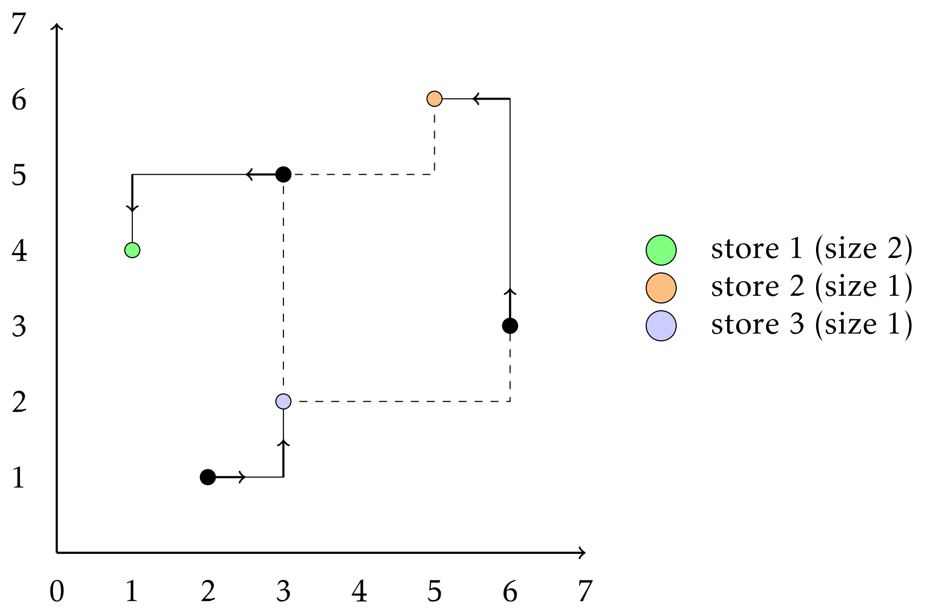
Problem E
ACM near you
Time limit: 3s

Authentic Market Chain (ACM) is a new supermarket chain that is growing fast in Gridcity. They want to build a new app to help their customers to easily be able to find the closest shop from a given the customer location. In Gridcity the distance between locations (i_1, j_1) and (i_2, j_2) is $|i_1 - i_2| + |j_1 - j_2|$. They will provide you with the location and sizes of all theirs stores and your task is to, for a given customer location, compute the store that is closer to the customer. In case several stores are at the same distance, the largest store should be given. Further ties should be broken by store id.

Note that the stores and the clients should be considered as points on the plane with no dimension. The size of a store does not influence the distance between the store and a customer.

For example, suppose that there are 3 stores. Store 1 is located at $(1, 4)$ and has size 2, store 2 is located at $(5, 6)$ and has size 1. Store 3 is located at $(3, 2)$ and also has size 1. A customer at position $(3, 5)$ is at distance 3 from the three stores. Therefore, since store 1 is the largest, he will be directed to store 1. A customer at $(6, 3)$ is at distance 4 from stores 2 and 3. Both stores have the same size so the customer will be directed to store 2 as it has a lower index. A customer at position $(2, 1)$ will be directed to store 3 as this is the closest store.



You will be given q queries each of them being a position (x, y) of a customer. For each of them, output the closest store breaking ties as described above.

Input

The first line contains a single integer k giving the number of stores.

The follow k lines each with three integers x, y and s representing the positions and sizes of the k stores.

The id of each store is equal to its position on the input (the first store as id 1, the second has id 2 and so on).

The next line contains a single integer q, giving the number of queries.

Finally, follow q lines each with two integers q_x and q_y representing the position of the customer.

Constraints

Let x_{min} and x_{max} (y_{min} and y_{max}) denote the maximum and minimum x (y) coordinates of the stores. Write $dx = |x_{min} - x_{max}|$ and $dy = |y_{min} - y_{max}|$.

- $1 \leq dx \cdot dy \leq 10^6$
- $1 \leq q \leq 10^5$
- $1 \leq k \leq 10^5$
- $-2^{31} \leq x, y, q_x, q_y < 2^{31}$
- $1 \leq s < 2^{31}$
- no two stores are at the same location

Output

One line of each of the q queries giving the id of the closest store. Ties should be broken by store size first and then by store id.

Input 9

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

Output 9

```
1
2
3
```

Input 10

```
12
301 622 933
42 806 792
302 621 108
303 622 51
302 623 498
42 938 735
41 807 511
41 937 186
43 807 364
42 936 661
43 937 811
42 808 262
3
696 49
278 485
903 92
```

Output 10

```
3
1
3
```

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