

Operation Imaginary II

INFORMATION

Date	29 May 2022
Time	14:00 - 19:00 (5 hours)
Full Score	400

PROBLEMS

Problem		Limit		Score	
		Time	Memory	Subtasks	Total
TW2221	Typhoon Kompasu	1s	256MB	100	100
TW2222	DVD Logo	1s	256MB	7 + 23 + 15 + 11 + 27 + 17	100
TW2223	Colourful Highlighter	1s	256MB	5 + 13 + 23 + 12 + 30 + 17	100
TW2224	Blossom Tree	1s	256MB	8 + 12 + 30 + 33 + 17	100

REMINDERS

- All tasks are divided into subtasks, your program must pass all test cases in a subtask to get points.
- Unless otherwise specified, your output will be automatically fixed as follows:
 - Trailing spaces in each line will be removed.
 - An end-of-line character will be added to the end of the output if not present.
- 64-bit integers may be required in some problems, use `long long` in C++ if needed.

TW222I Typhoon Kompasu

Score	100
Time Limit	1s
Memory Limit	256MB

Remember the story of the judge team? Let us talk about it more. Shortly after forming the team in September, October had arrived! (Surprise surprise!) Approaching the end of the typhoon season, members in the judge team were hoping for a last typhoon holiday of the year as they were so tired of the heavy workload! “Emperor sky don’t lose person with heart (皇天不負有心人)”, a typhoon called Kompasu (圓規) was approaching Hong Kong! “Due to typhoon signal no. 8, the EDB has announced the suspension of schools.” Daniel was excited! So he decided to write a “simple” problem on the judge about Compass (圓規, the actual Kompasu)! Here it is!

Given two points with distance 1. Please use only compass and ruler to draw a line segment with length N .

IMPLEMENTATION

You have to call the below functions to perform various actions:

`line(point A, point B)`: draw a line that passes through both point A and point B . Return an integer: the ID of the line.

`circle(point A, point B)`: draw a circle with centre A that passes through point B . Return an integer: the ID of the circle.

`intersection(line/circle  $l_1$ , line/circle  $l_2$ )`: Return a vector of integer: the ID of ALL intersections of l_1 and l_2 , sort by x -coordinate first, then by y -coordinate, both in ascending order.

`answer(point A, point B)`: answer the N -unit long line segment AB . You should only call this function once.

Please note that the same ID system is used to refer to points, lines, and circles. (i.e. no points, lines, or circles have the same ID)

SCORING

For each test case, you will receive zero score if your program:

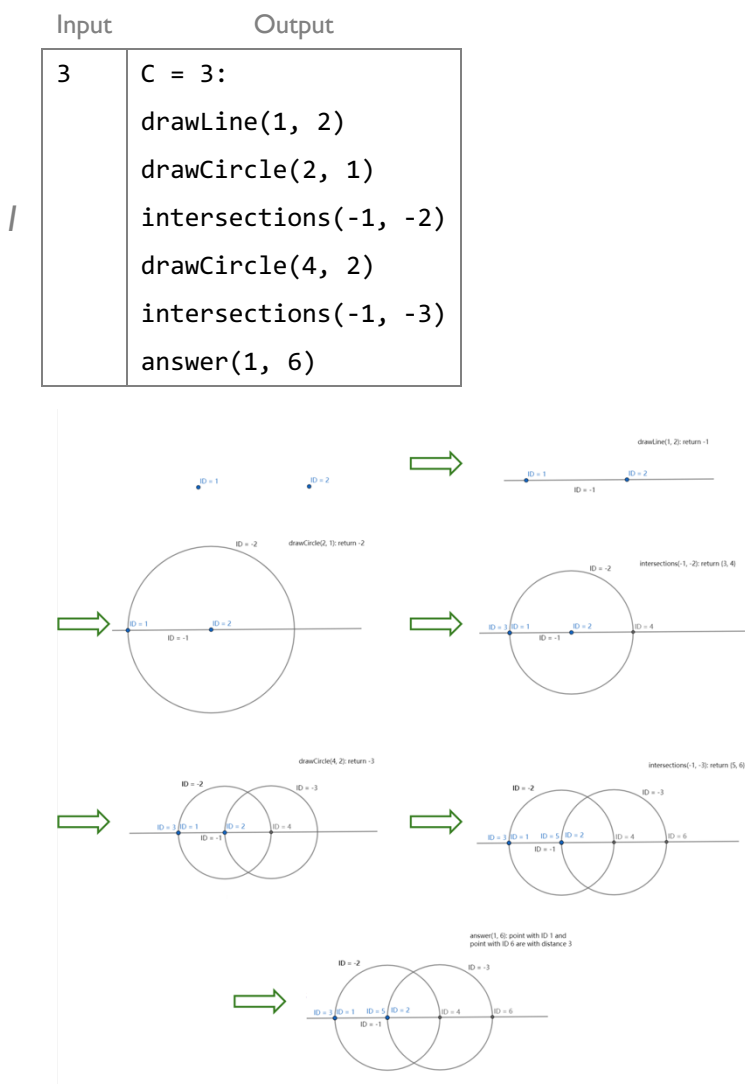
- does not exit correctly, or
- violates any rules mentioned in the section “Implementation”, or
- does not/wrongly find a N -length line segment.

Otherwise, your score will depend on C , the number of times `line()` and `circle()` is called.

$$score = \begin{cases} 100 & \text{if } C \leq 12 \\ 75 + 1.5 \times (26 - C) & \text{if } 12 < C \leq 26 \\ 48 + 27 \times \frac{130 - C}{130 - 26} & \text{if } 26 < C \leq 130 \\ 20 + 25 \div (1 + e^{\frac{C-700}{100}}) & \text{if } 130 < C \leq 2022 \\ 0 & \text{if } C > 2022 \end{cases}$$

Your score on this task is the lowest score you get among all test cases.

SAMPLE TESTS



CONSTRAINTS

$$1 \leq N \leq 2000$$

TEMPLATE

```
#include "kompasu.h"

#include <utility>

// TODO: global variables can be declared here

void kompasu(int N) {
    // TODO: implementation
}
```

SAMPLE GRADER

The sample grader reads the input in the following format:

line 1:

If your solution is correct, the output will be in the following format:

line 1:

line 2:

If your solution is wrong, the output will be in the following format depending on the reason:

line 1:

line 2: Simple description of the reason for the wrong answer

TW2222 DVD Logo

Score	100
Time Limit	1s
Memory Limit	256MB

“What a relaxing day!” Daniel said. He was certainly enjoying the typhoon holiday, he decided to take out his DVD machine and to play some DVD movies. (What an old-schooled guy!) Turning on the machine, he noticed that there was a (fashion) DVD logo bouncing everywhere. He wondered whether the DVD logo will hit a corner at some time. If yes, he wanted to find out how long did it take for the logo to touch the first corner.

The monitor of the TV has the height N pixels $\times$ width M pixels. Where the coordinate of the top-left corner is $(0, 0)$, while the bottom-right is (N, M) . Assume the DVD logo size is negligible. Initially (at the zeroth second), the DVD logo is at (x, y) , and it will move horizontally v_x pixels and vertically v_y pixels every second.

Each time the DVD logo hits the edge of the TV (not guaranteed to be at integer second), it bounces off.

- If it hits the top or bottom edge, the vertical velocity is inverted.
(New vertical velocity $v_y' = -v_y$)
- Similarly, if it hits the left or right edge, the horizontal velocity is inverted.
(New horizontal velocity $v_x' = -v_x$)

INPUT

The only line of the input contains six integers, each separated by a space: N, M, x, y, v_x, v_y .

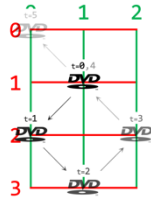
OUTPUT

If the DVD logo never hits any of the corners, output **NO** on the first and only line.

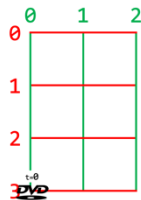
Otherwise, output **YES** on the first line. On the second line, output the time (in seconds) needed for the first collision with any corner. Your output will be accepted if your absolute or relative error is less than 10^{-6} .

SAMPLE TESTS

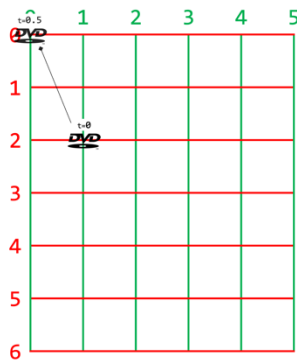
	Input	Output
1	2 3 1 1 -1 1	YES 5.000000



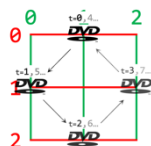
2	2 3 0 3 1 1	YES 0.000000
---	-------------	-----------------



3	5 6 1 2 -2 -4	YES 0.500000
---	---------------	-----------------



4	2 2 0 1 -1 1	NO
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CONSTRAINTS

$$1 \leq N, M \leq 10^6$$

$$0 \leq x \leq N$$

$$0 \leq y \leq M$$

$$-N \leq v_x \leq N$$

$$-M \leq v_y \leq M$$

v_x and v_y will not be 0 at the same time

SUBTASKS

	Points	Constraints
1	7	$v_x = 0$ $1 \leq N, M \leq 1000$
2	23	$v_x = v_y = 1$ $1 \leq N, M \leq 1000$
3	15	N and x is divisible by v_x M and y is divisible by v_y (note that v_x and v_y can be negative)
4	11	The DVD logo will eventually hit the corner $1 \leq N, M \leq 1000$
5	27	$1 \leq N, M \leq 1000$
6	17	No additional constraints

SCORING

For all subtasks except subtask 4, you score 40% of that subtask if the first line of your output is correct in all test cases within the subtask.

TW2223 Colourful Highlighter

Score	100
Time Limit	1s
Memory Limit	256MB

Being bored watching DVD, Daniel decided to do some homework (which he don't do that normally)! He decided to tackle his favourite subject — Chemistry first! His Chemistry teacher, Miss Chan, always uses various colourful highlighters to indicate main points in the beautiful notes. Being a huge fan of Miss Chan, Daniel took out N highlighters with possibly different colours and wanted to follow his favourite teacher using highlighters to indicating main points while he was doing the homework. But Daniel quickly noticed something weird. "Why my highlighters arrangement looks worse than Miss Chan's?" By some careful observations, he discovered that Miss Chan's highlighters are sorted in colour (i.e. rainbow colour, from red to purple)! Having a lot of time to spare, he decided to ask you to do that. (What an irresponsible person!)

Now, there are N highlighters, the i^{th} ($0 \leq i \leq N - 1$) highlighter has the colour index c_i (which multiple highlighters may have the same colour index). Initially, the highlighters are arranged in ascending order of ID from left to right (i.e. leftmost: highlighter 0; rightmost: highlighter $N - 1$). You are allowed to perform 2 types of operation to move the highlighters:

- $\boxed{L} \ i$: moves the highlighter with the ID of i to leftmost.
- $\boxed{R} \ i$: moves the highlighter with the ID of i to rightmost.

Note that the ID of highlighters does NOT change after moving.

To sort the highlighters, you have to be arranged in left to right, ascending order of the colour index c_i (i.e. $c_i \leq c_j$ for all $i \leq j$). As you have limited time (unlike irresponsible Daniel, having a lot of spare time), you have to sort the highlighters using the least number of operations.

INPUT

There are 2 lines of input.

The first line of input contains an integer N .

The second line contains N positive integers $c_0, c_1, \dots, c_{N-1}$, which the i^{th} ($0 \leq i \leq N - 1$) integer indicates the colour index of the i^{th} highlighter.

OUTPUT

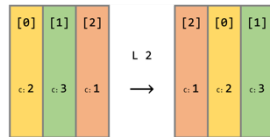
On the first line, output an integer, K , the minimum number of operations needed to sort the highlighters.

Then output K lines, each line consists of an operation performed to the highlighters, which contains a character either $\boxed{L}$ or $\boxed{R}$, then an integer i , separated by a space.

Note that you should output the operations in order of performing them.

SAMPLE TESTS

Input	Output
3	1
2 3 1	L 2



6	2
1 3 2 1 1 2	R 2
	R 1



CONSTRAINTS

$$1 \leq N \leq 2 \times 10^5$$

$$1 \leq c_i \leq N$$

SUBTASKS

Points	Constraints
1	5 $N = 3$ All c_i are distinct
2	13 $N \geq 3$ All c_i are equal except at most two
3	23 $N \leq 500$ All c_i are distinct
4	12 $N \leq 5000$
5	30 $1 \leq c_i \leq 2$
6	17 No additional constraints

TW2224 Blossom Tree

Score	100
Time Limit	1s
Memory Limit	256MB

After Daniel finished his Chemistry homework, the night has begun! Watching the wind blowing strongly and raining outside the window, Daniel quickly fell asleep on the table. (Doing homework is certainly an energy-consuming job!) Suddenly, Daniel found himself in an “old colour old hong (古色古香)” world! The night was still dark, wind was still blowing, it was still raining, but all things around him were changed to a very traditional style.

A man slowly came by, he said to Daniel, “The country is going to end, but as you can see, during this Lantern Festival (元宵節, 元夕), people are celebrating. How dare they!” Daniel was shocked, “Wait... Emm... So... Where am I? What do you mean by “the country is going to end”? And... who are you?” The man slowly and calmly responded “How come you didn’t know our country? We’re in Song dynasty (宋朝)! And I forgot to introduce myself, my full name is 辛棄疾, you may call me Mr. 辛, nice to meet you.” “What? 辛棄疾?” Daniel remembered the author of the poem 《青玉案·元夕》, which he learnt in school, is 辛棄疾, who is in front of him now! He quickly asked, “Ehh... Mr. 辛, have you written a poem called 《青玉案·元夕》?” 辛棄疾 responded, “What do mean? I am a poet, but I haven’t written a poem called this name before. But it may be a good topic to write on! Let me think and write it now! Thank you for the idea!”

An hour later, he came to Daniel again. “I’ve finished the poem! Let me read it...”

東風夜放花千樹。更吹落、星如雨。
寶馬雕車香滿路。鳳簫聲動，玉壺光轉，一夜魚龍舞。
蛾兒雪柳黃金縷。笑語盈盈暗香去。
衆裏尋他千百度。驀然回首，那人卻在，燈火闌珊處。
—— 辛棄疾 《青玉案·元夕》

Suddenly, Daniel opened his eyes. “Where is 辛棄疾?” Seeing his phone pushed a notification about typhoon, the bouncing DVD logo on the TV, and piles of homework on his desk. He realised that it was a dream. “I should called 辛棄疾 to try DSE problems! What a waste of a dream!” Feeling pity, he decided to write a program to find the 燈火闌珊處 in his dream, hoping he will back to the dream with 辛棄疾 one day and tell him to try DSE problems.

There are N trees (lights) located in $[-P, P]$ (the location of the trees (lights) are between $-P$ and P (inclusive)). The position and the lightness of the i^{th} tree (light) is x_i and l_i respectively. Suppose the light level l at position x is defined to be the sum of $\max(0, l_i - |x_i - x|)$ over all trees, find the minimum lightness and the dimmest position in the range of $[-P, P]$. If there is multiple dimmest position, find the eastmost (rightmost) one (東風, you know).

INPUT

The first line contains two positive integers, N and P .

The next N lines each contains two integers: x_i and l_i , the position and the lightness of the i^{th} tree (light).

OUTPUT

On the first and only line, output the eastmost (rightmost) dimmest position x and its light level l .

SAMPLE TESTS

	Input	Output
1	2 10 -2 3 1 2	10 0

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

3	4 4 -4 2 -2 2 2 2 4 2	0 0
---	--	----------------

CONSTRAINTS

$$1 \leq N \leq 10^5$$

$$1 \leq P \leq 10^9$$

$$-P \leq x_1 < x_2 < \dots < x_N \leq P$$

$$1 \leq l_i \leq 10^9$$

SUBTASKS

	Points	Constraints
1	8	$1 \leq N \leq 2$
2	12	$1 \leq N, P \leq 1000$ $1 \leq l_i \leq 1000$
3	30	$1 \leq N \leq 1000$ All l_i are equal
4	33	$1 \leq N, P \leq 10^5$
5	17	No additional constraints

HINT

As the answer might exceed the 32-bit limit of `int`, you are reminded to use the 64-bit `long long` in C++.