

CATALYSTS  
CODING  
CONTEST

# Level 4

The background of the entire image is a dark, deep blue space filled with numerous small, distant stars. In the center, a pair of human hands is shown from the wrists up, cupping a glowing, semi-transparent globe of the Earth. The globe is illuminated from the right, showing the Americas and parts of Europe and Africa in a warm, golden-brown light. The hands are positioned symmetrically, with fingers slightly curled to support the globe from below and the sides.

GladOS:

- Robin.

- Robin, who?

- Oh, and by the looks of your code, you're all going to die.

- I mean **we** are! **We**'re all going to die. Sorry, memory leak, tee-hee!

Since light is a big part of how solar panels work, your next task will be to analyze light rays and trace their path.

Given a 2D grid, an origin with integer coordinates and a direction vector with integer components, determine all the cells that are touched by light.

If a light ray is tangent to a cell it means light is touching that cell.

A cell has its center on integer coordinates. **That means that the  $(0, 0)$  cell spans from  $(-0.5, -0.5)$  to  $(0.5, 0.5)$  inclusively.**

The list of cells should be written in the order that light touches them.

In case the ray enters multiple cells at the same time, pick the one that is on the dominant direction first, then the one on the other direction and finally the one on the composed direction.

A direction is called dominant if the absolute value of its component is greater than the absolute value of the component of the other direction. In case of equality, the horizontal direction is considered dominant.

The OX-axis is horizontal and the OY-axis is vertical. When coordinates are given as a pair, it will be in the format  $(x, y)$  - meaning the  $x$ -th column and  $y$ -th row

Examples:

- ›  $D = (-3, -1) \Rightarrow$  OX is dominant
- ›  $D = (-3, 4) \Rightarrow$  OY is dominant
- ›  $D = (-3, -3) \Rightarrow$  OX is dominant
- ›  $D = (0, 0) \Rightarrow$  This case won't be present in the testcases

## Input

rows cols

n

$o_{0x}$   $o_{0y}$   $d_{0x}$   $d_{0y}$

$o_{1x}$   $o_{1y}$   $d_{1x}$   $d_{1y}$

$\dots$   
 $o_{n-1x}$   $o_{n-1y}$   $d_{n-1x}$   $d_{n-1y}$

cols - number of columns

rows - number of rows

n - number of queries

$o_{ix}$   $o_{iy}$  - origin of the i-th ray (integers)

$d_{ix}$   $d_{iy}$  - direction of the i-th ray  
(integers)

## Output

$X_{00}$   $Y_{00}$   $X_{01}$   $Y_{01}$   $X_{02}$   $Y_{02}$   $X_{03}$   $Y_{03}$   $\dots$

$X_{10}$   $Y_{10}$   $X_{11}$   $Y_{11}$   $X_{12}$   $Y_{12}$   $X_{13}$   $Y_{13}$   $\dots$

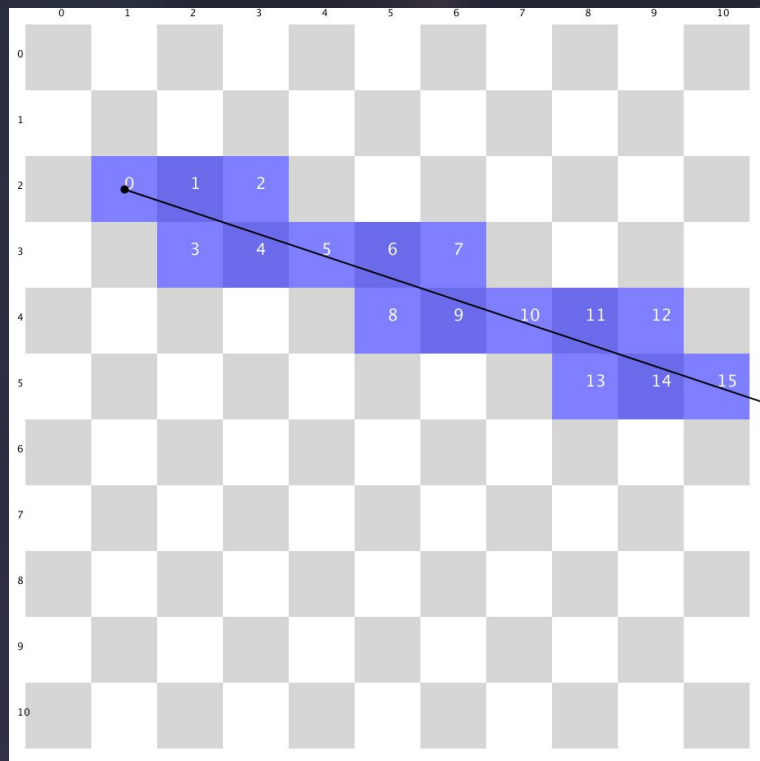
$\ddots$   
 $X_{n-1\ 0}$   $Y_{n-1\ 0}$   $X_{n-1\ 1}$   $Y_{n-1\ 1}$   $X_{n-1\ 2}$   $Y_{n-1\ 2}$   $X_{n-1\ 3}$   $Y_{n-1\ 3}$   
 $\dots$

$X_{ij}$  - X-coordinate(column) of the j-th  
cell in the path of the i-th ray

$Y_{ij}$  - Y-coordinate(row) of the j-th cell  
in the path of the i-th ray



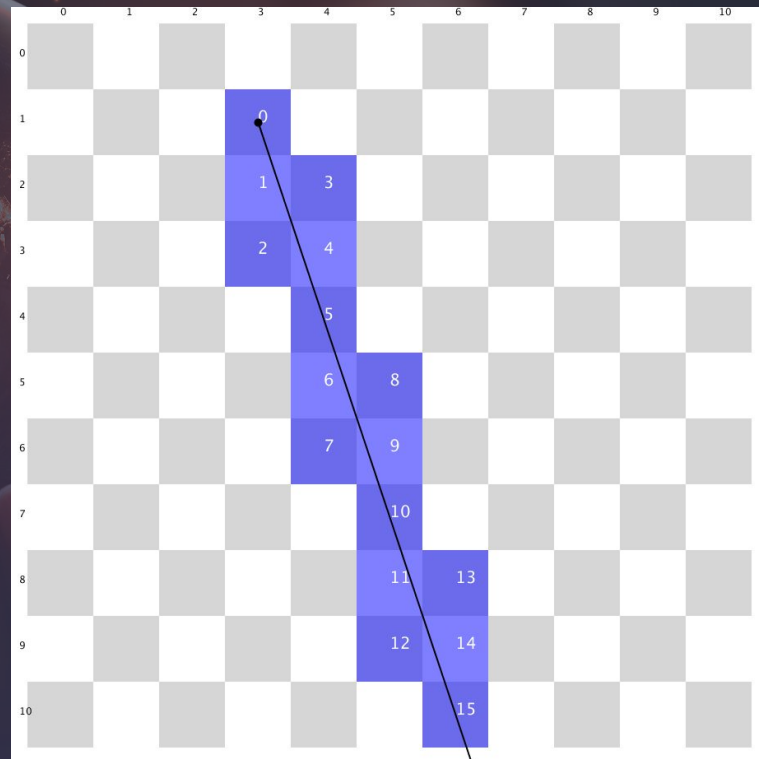
# CATALYSTS CODING CONTEST



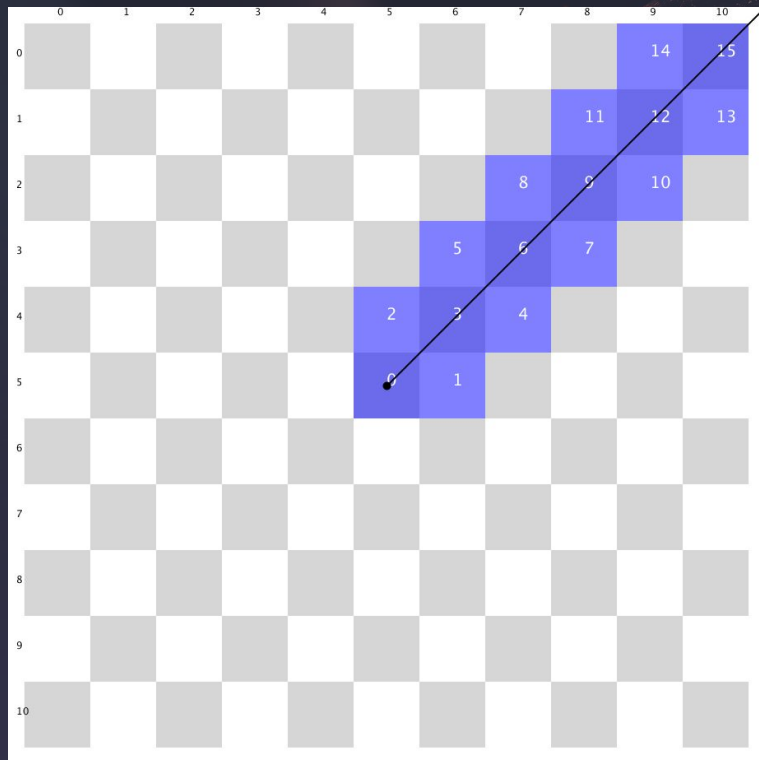
$o=(1,2)$   $d=(3,1)$   
 $3 > 1 \Rightarrow$  Horizontal is dominant

Pay attention  
 to the order  
 of the  
 6,7,8,9 and  
 11,12,13,14  
 cells

## Level 4

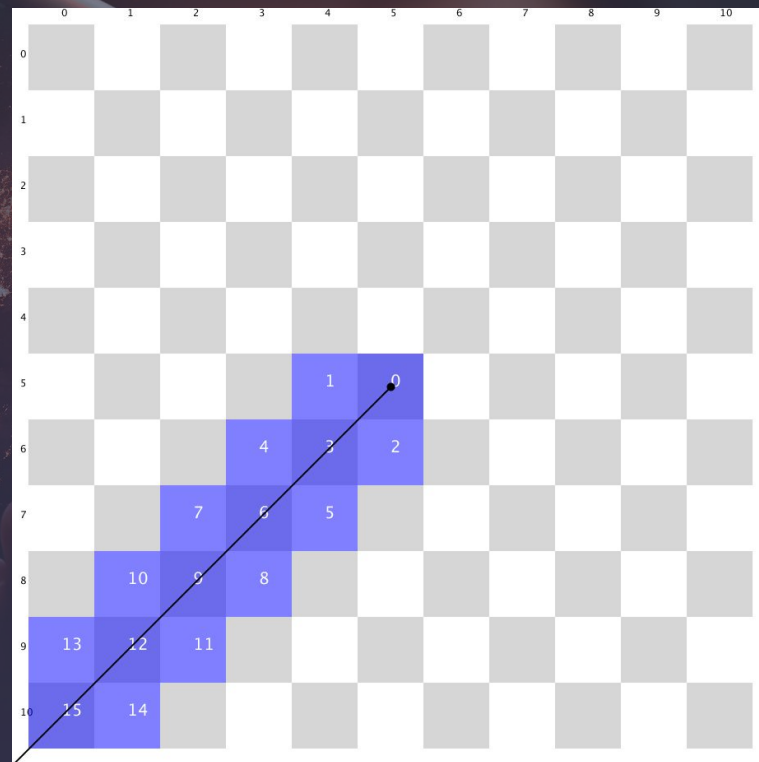


$o=(3,1)$   $d=(2,6)$   
 $6 > 2 \Rightarrow$  Vertical is dominant




$o=(5,5)$   $d=(1,-1)$

Axis are tied for dominance.  
Horizontal is considered dominant



$o=(5,5)$   $d=(-1,1)$

Axis are tied for dominance.  
Horizontal is considered dominant



The previous 4 examples are  
present in the archive.