



ATTACKING ROBOTS

COURSE WORK #02

Author: prof. Yevhenii Borodavka

PROBLEM STATEMENT

You have a square board with a size of $R \times R$ cells ($5 \leq R \leq 1000$) and with N robots ($1 \leq N \leq 5000$) on board. Each robot is tiny, can occupy only one cell, and is located exactly in the cell center. The robot has a cannon that can shoot in any direction. When one robot is attacking, all others can be opened or covered. If several robots are located on the same line as the attacker then only the closest robot is considered as opened and all others are covered. You need to find the opened robot count for each attacking robot and return their sum.

Input. The first string contains two numbers R and N divided by spaces. The next N lines contain the coordinates of each robot divided by space.

Output. The sum of the opened robots for each attacking robot.

THE PROBLEM SOLVING

Example: **R**=9 **N**=8

Input

9 8

2 1

7 1

8 2

4 3

6 5

2 7

4 8

6 9

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

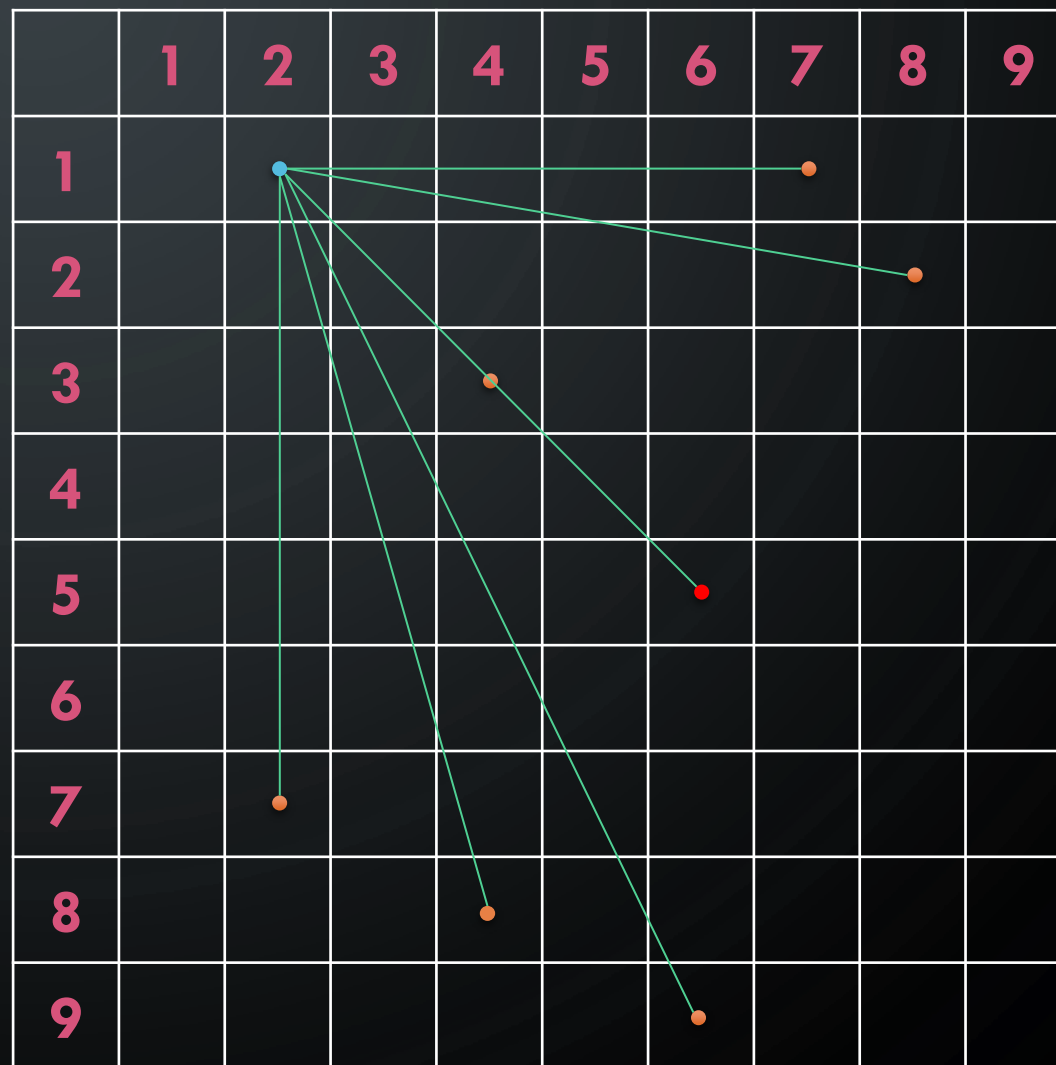
THE PROBLEM SOLVING

Let's consider the first robot (2,1) as an attacker and create all possible ways for shooting.

All other robots are opened except one robot (6,5) — his covered by the robot (4,3).

Thus, the sum of the opened robots for the robot (2,1) is 6.

The total sum of the opened robots is 6.



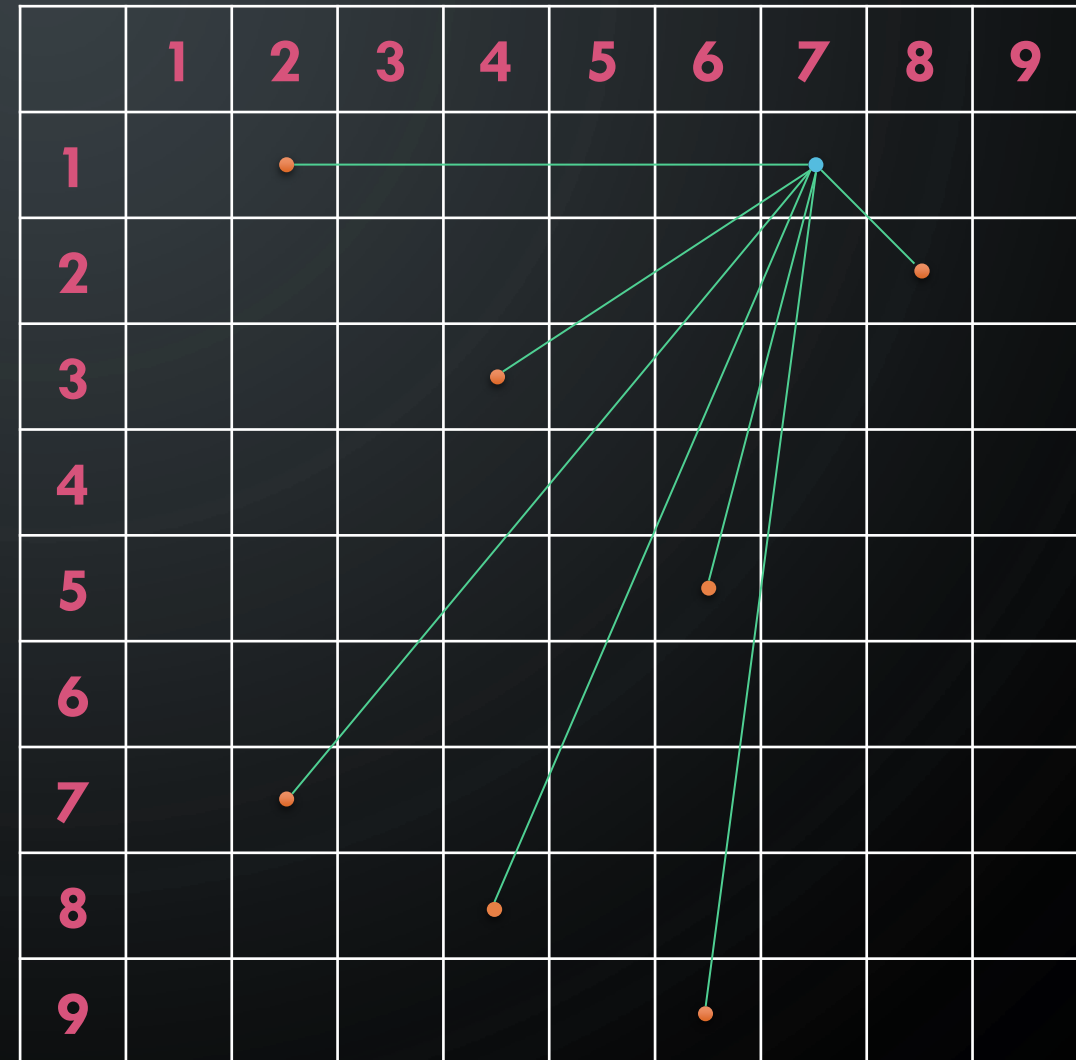
THE PROBLEM SOLVING

Let's consider the robot (7,1) as an attacker and create all possible ways for shooting.

All other robots are opened.

Thus, the sum of the opened robots for the robot (7,1) is **7**.

The total sum of the opened robots is **13**.



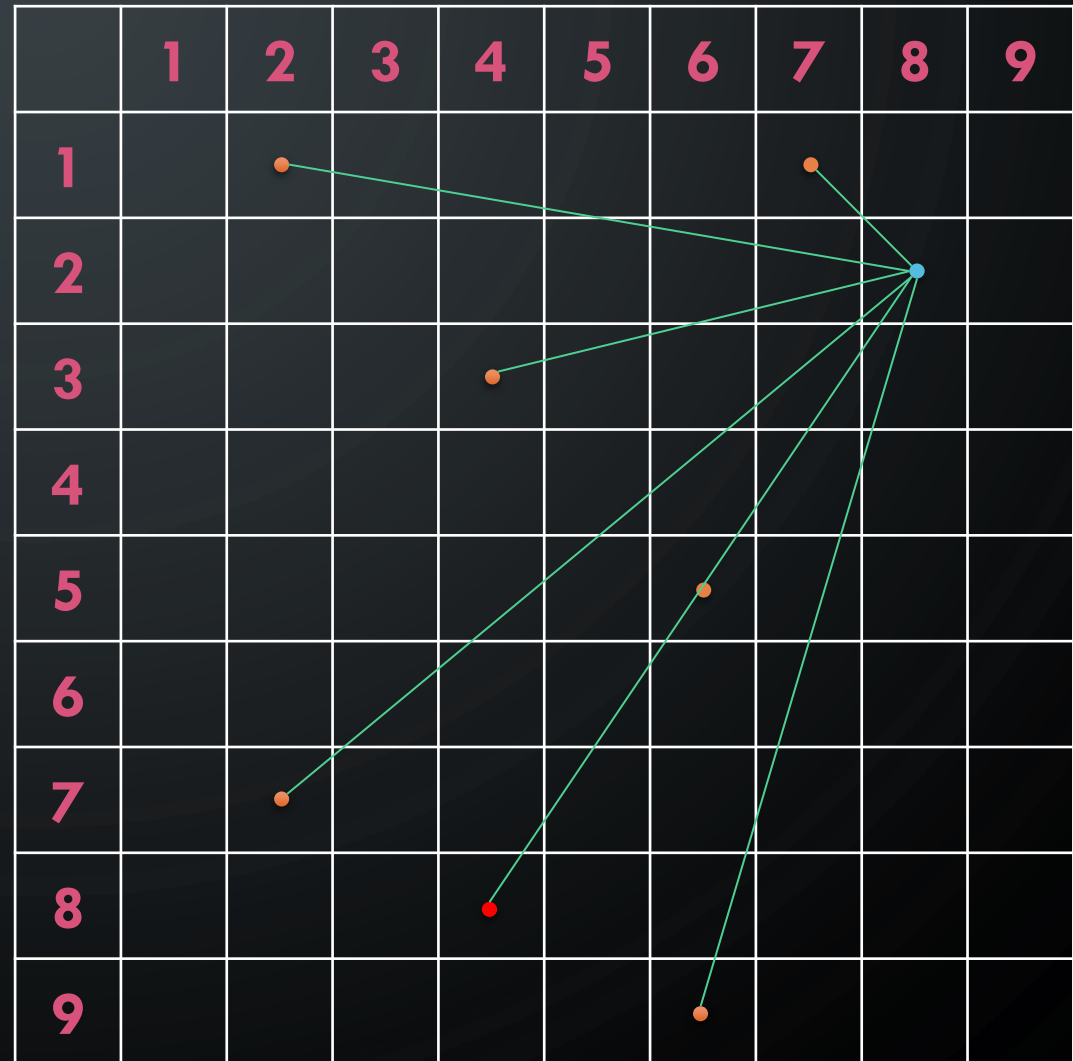
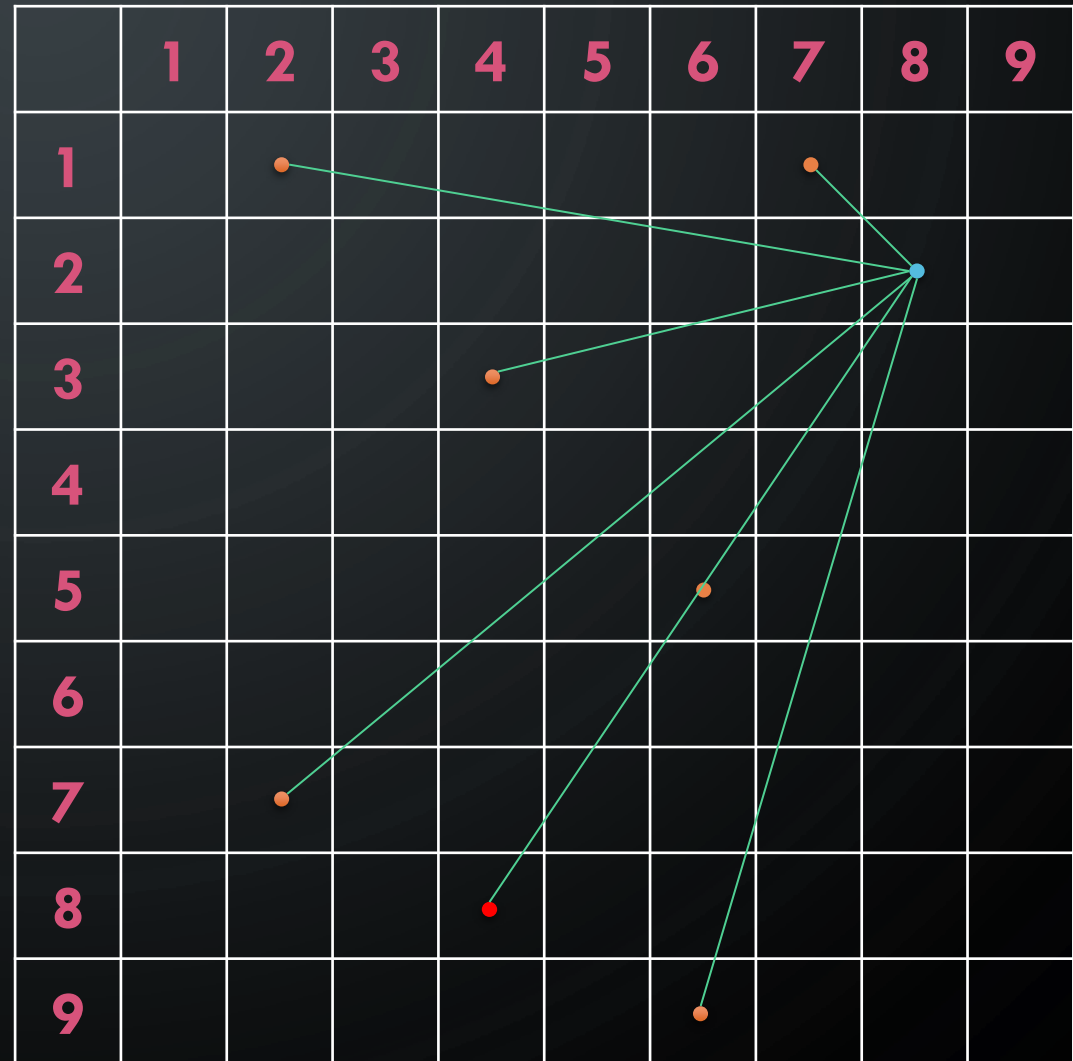
THE PROBLEM SOLVING

Let's consider the robot (8,2) as an attacker and create all possible ways for shooting.

All other robots are opened
except one robot (4,8) — his
covered by the robot (6,5).

Thus, the sum of the opened robots for the robot (8,2) is 6.

The total sum of the opened robots is **19**.



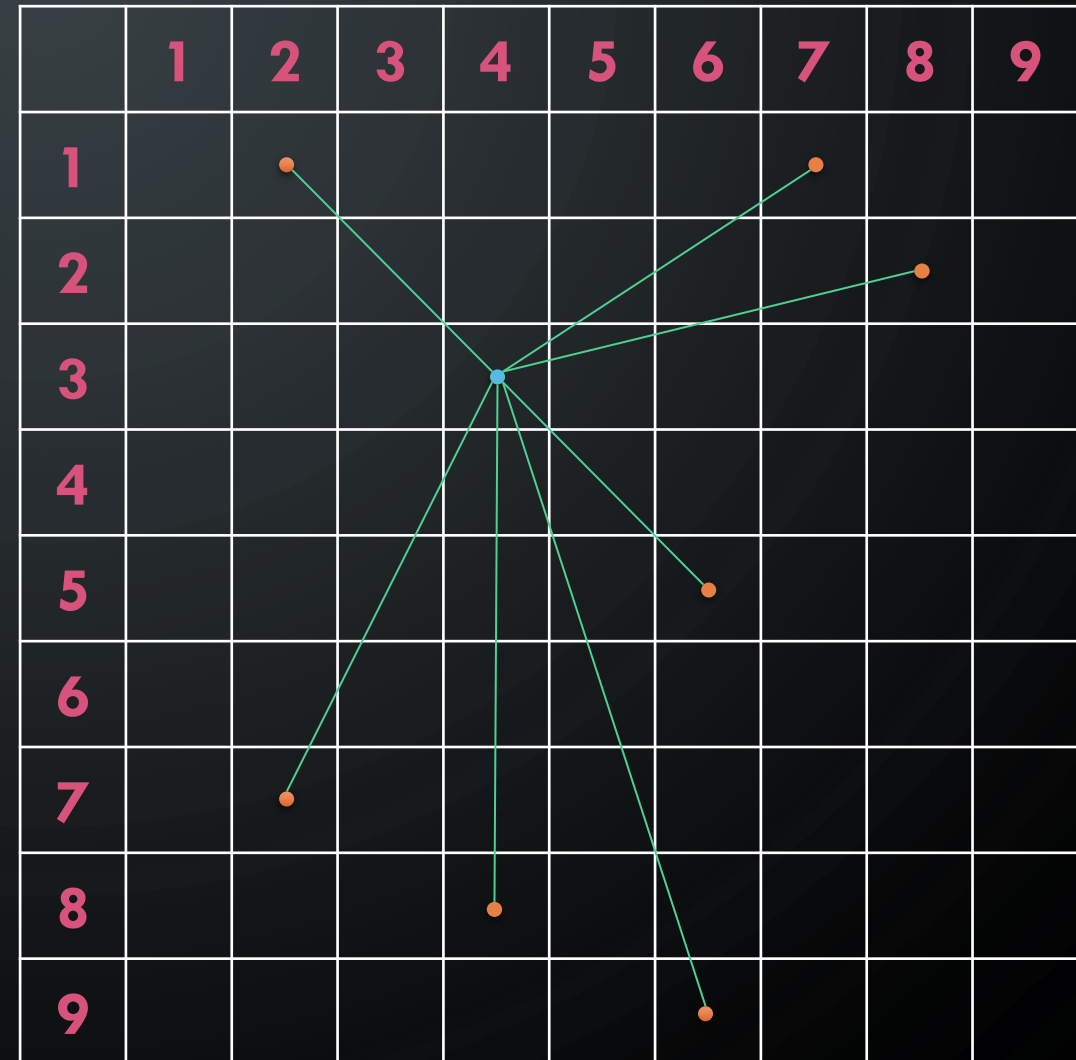
THE PROBLEM SOLVING

Let's consider the robot (4,3) as an attacker and create all possible ways for shooting.

All other robots are opened.

Thus, the sum of the opened robots for the robot (4,3) is **7**.

The total sum of the opened robots is **26**.



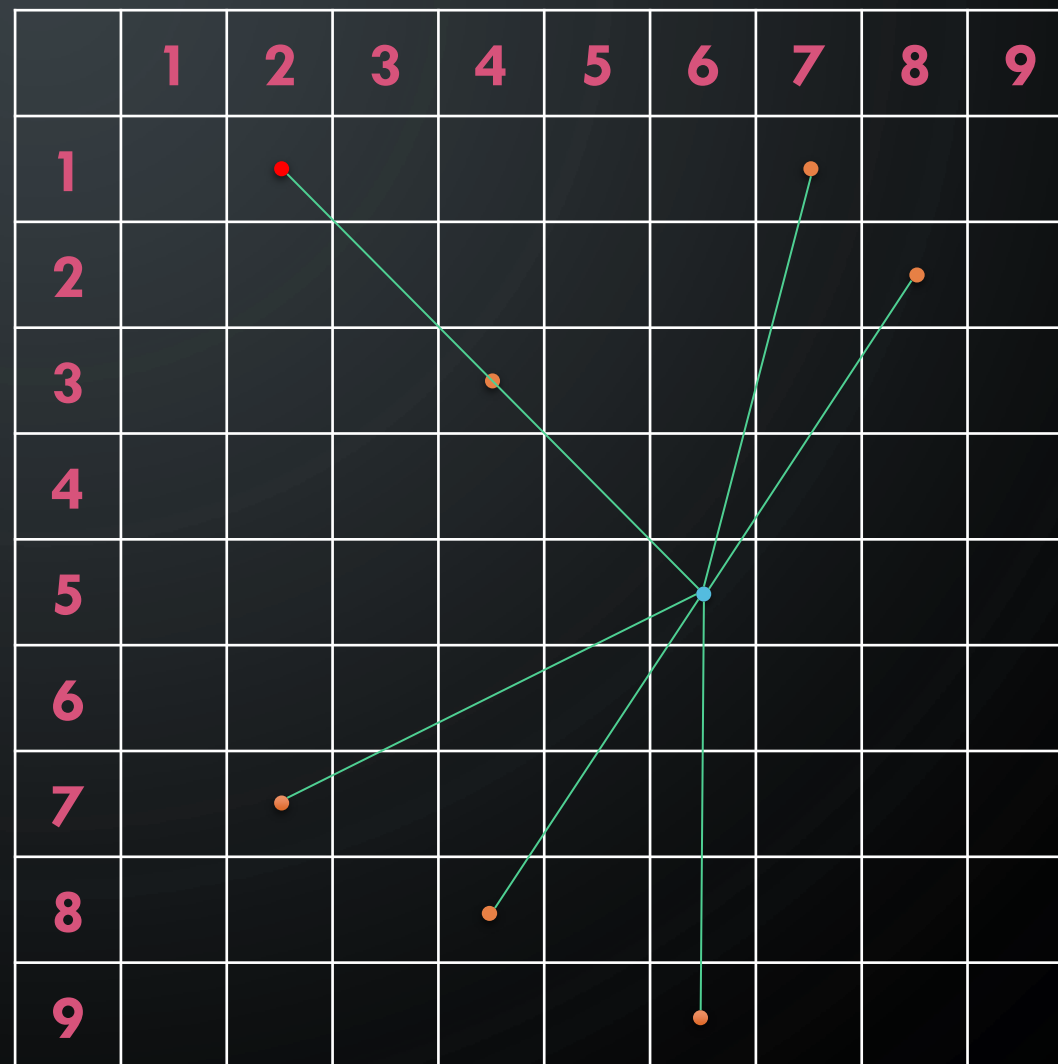
THE PROBLEM SOLVING

Let's consider the robot (6,5) as an attacker and create all possible ways for shooting.

All other robots are opened except one robot (2,1) — his covered by the robot (4,3).

Thus, the sum of the opened robots for the robot (6,5) is **6**.

The total sum of the opened robots is **32**.



THE PROBLEM SOLVING

Let's consider the robot (2,7) as an attacker and create all possible ways for shooting.

All other robots are opened except one robot (6,9) — his covered by the robot (4,8).

Thus, the sum of the opened robots for the robot (2,7) is 6.

The total sum of the opened robots is 38.

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



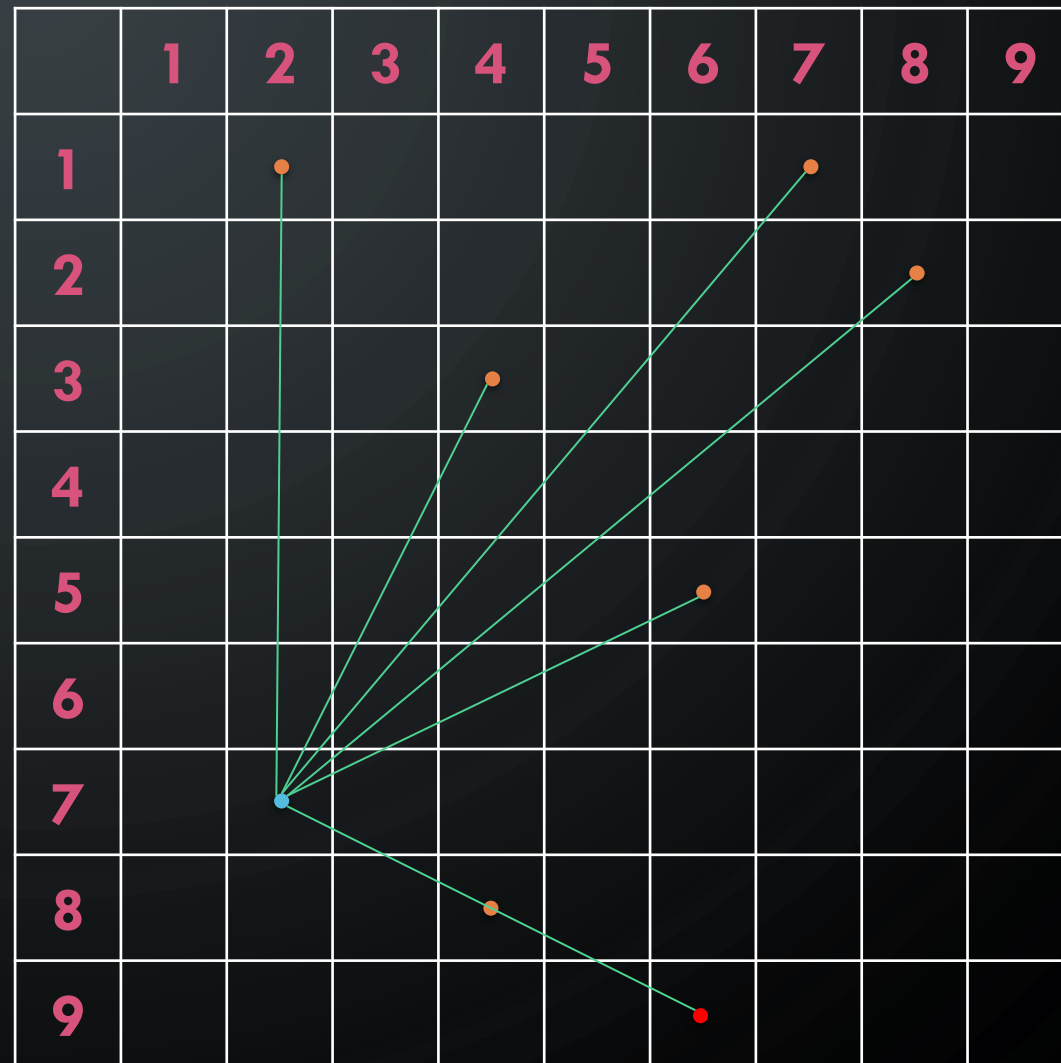
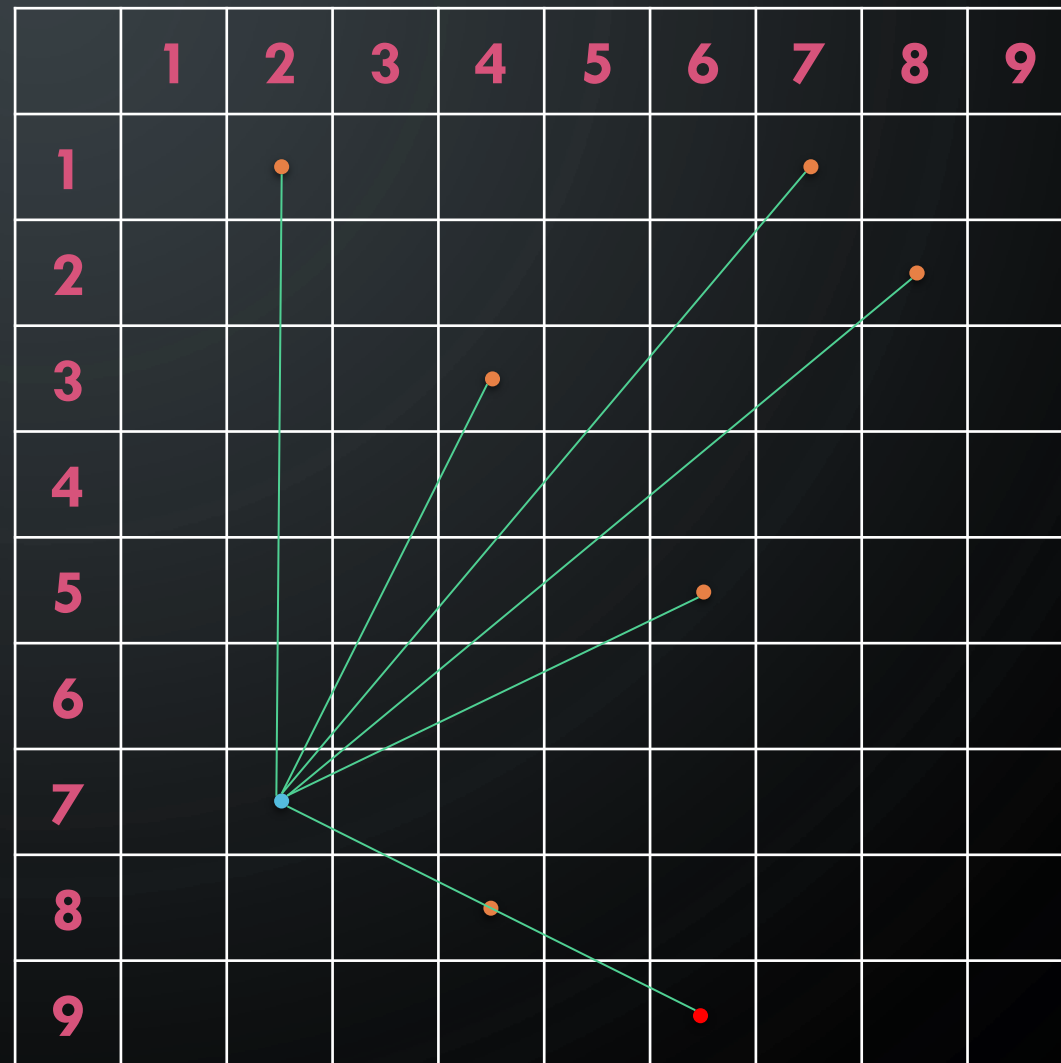
THE PROBLEM SOLVING

Let's consider the robot (2,7) as an attacker and create all possible ways for shooting.

All other robots are opened
except one robot (6,9) — his
covered by the robot (4,8).

Thus, the sum of the opened robots for the robot (2,7) is 6.

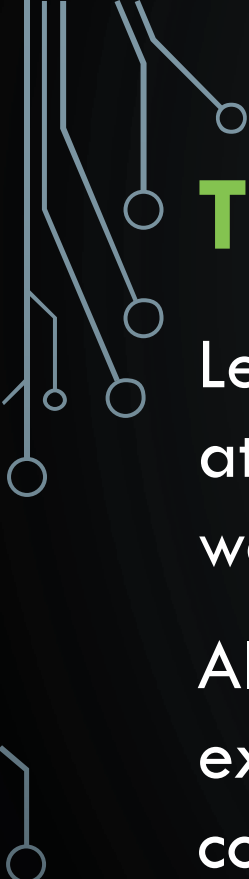
The total sum of the opened robots is **38**.



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THE PROBLEM SOLVING

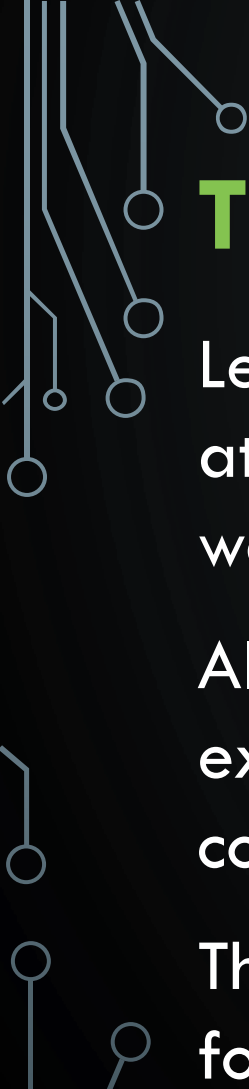
Let's consider the robot (4,8) as an attacker and create all possible ways for shooting.



THE PROBLEM SOLVING

Let's consider the robot (4,8) as an attacker and create all possible ways for shooting.

All other robots are opened except one robot (8,2) — his covered by the robot (6,5).

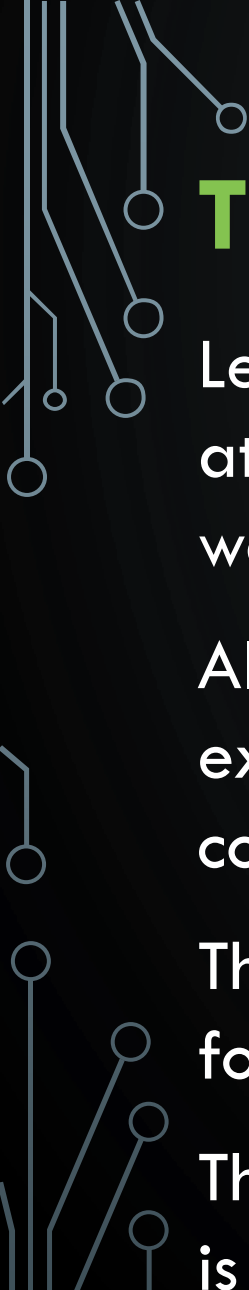


THE PROBLEM SOLVING

Let's consider the robot (4,8) as an attacker and create all possible ways for shooting.

All other robots are opened except one robot (8,2) — his covered by the robot (6,5).

Thus, the sum of the opened robots for the robot (4,8) is 6.



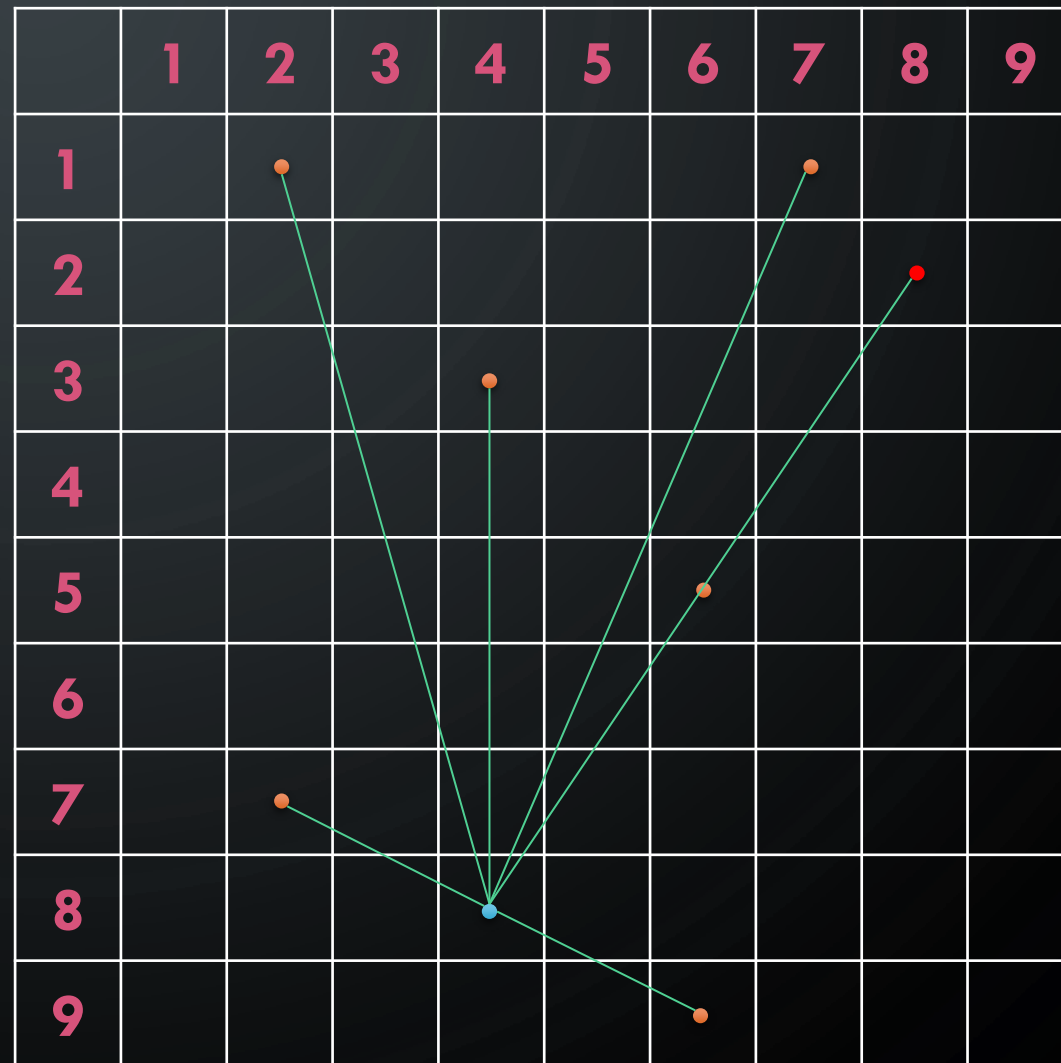
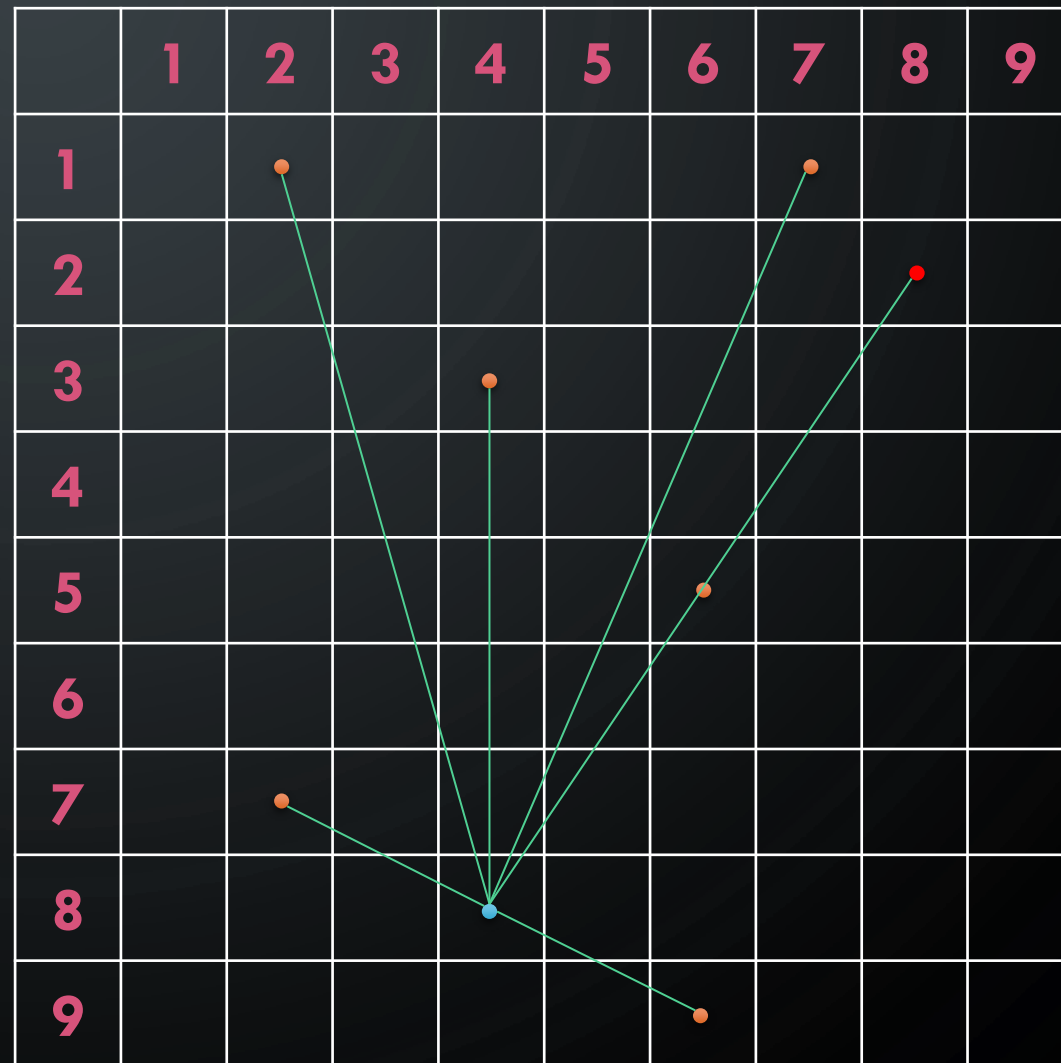
THE PROBLEM SOLVING

Let's consider the robot (4,8) as an attacker and create all possible ways for shooting.

All other robots are opened except one robot (8,2) — his covered by the robot (6,5).

Thus, the sum of the opened robots for the robot (4,8) is 6.

The total sum of the opened robots is 44.



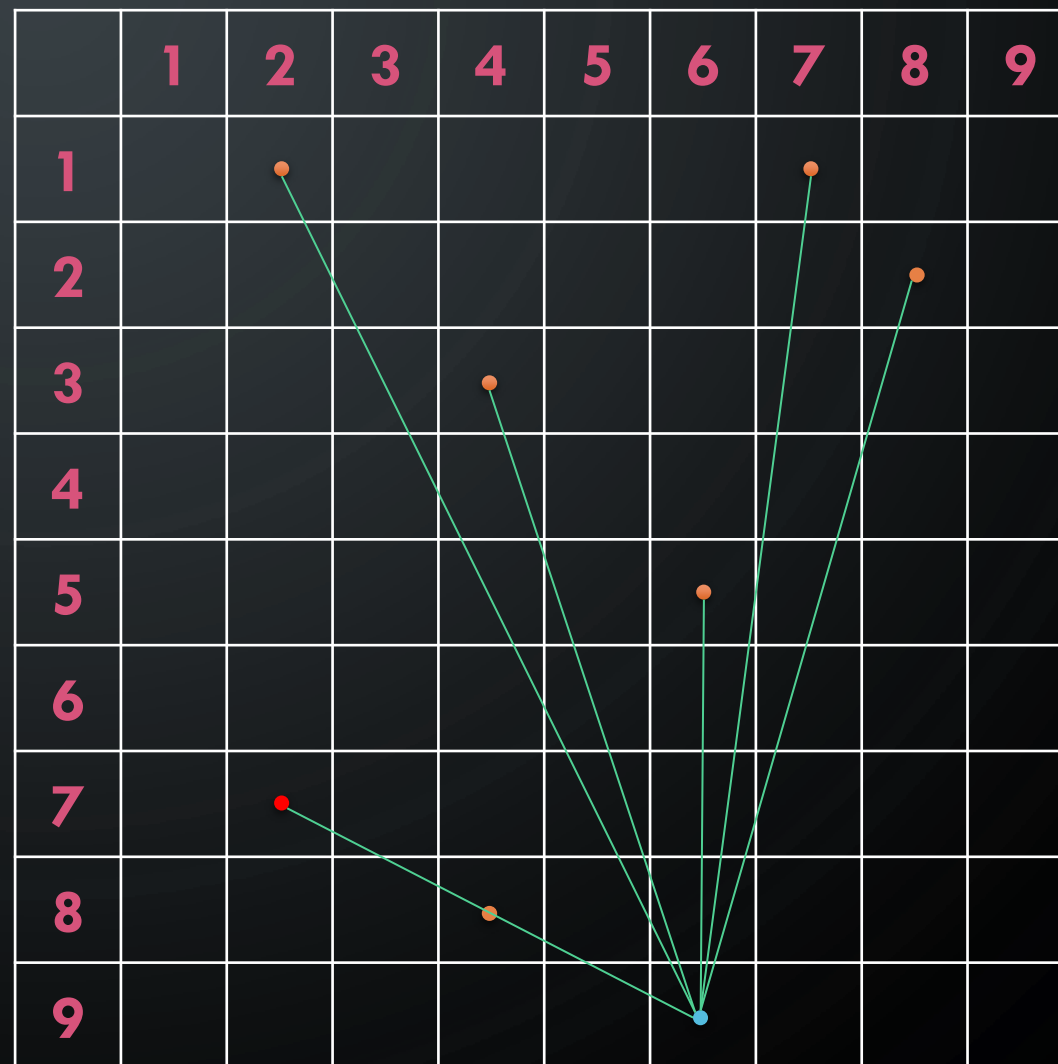
THE PROBLEM SOLVING

Let's consider the robot (6,9) as an attacker and create all possible ways for shooting.

All other robots are opened except one robot (2,7) — his covered by the robot (4,8).

Thus, the sum of the opened robots for the robot (6,9) is **6**.

The total sum of the opened robots is **50**, and that is the answer!

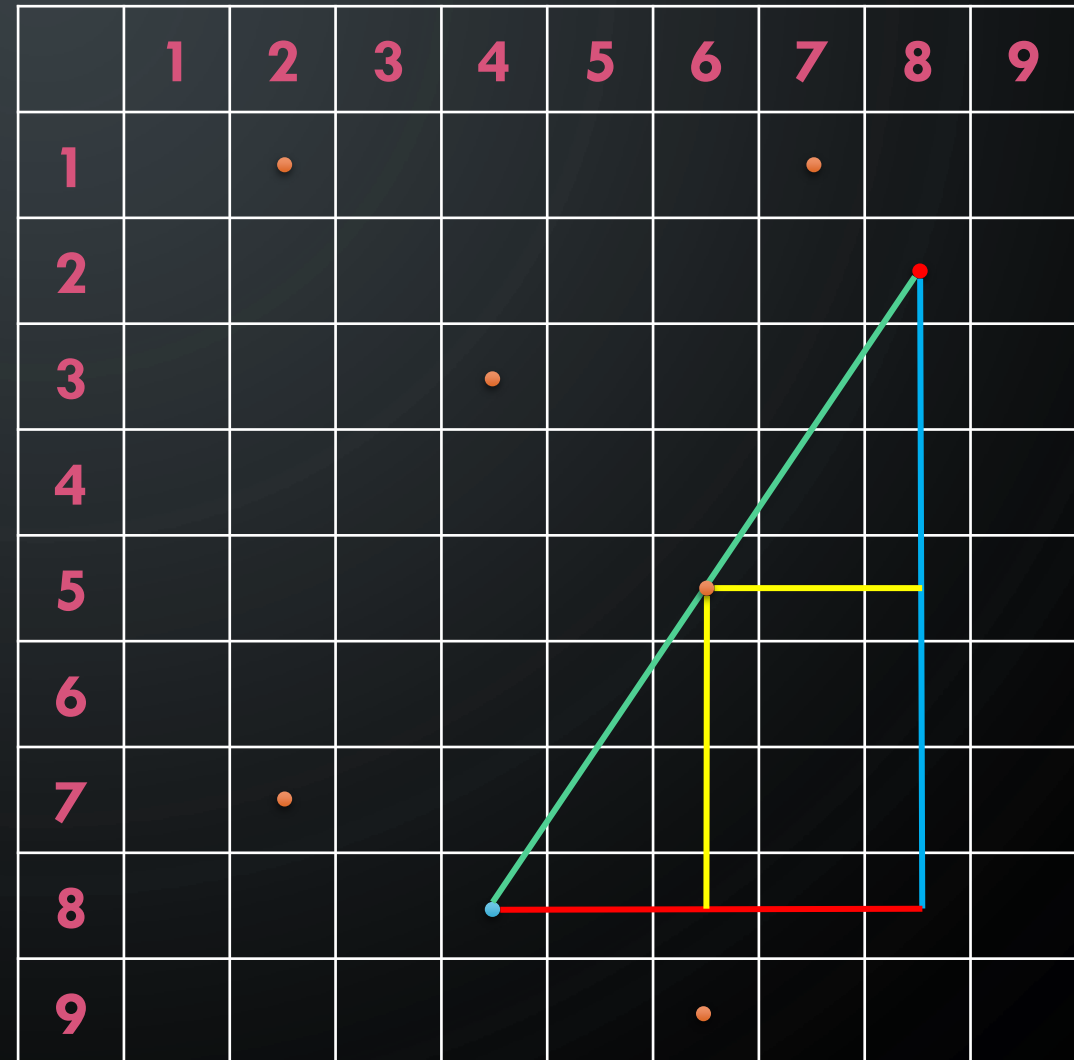


THE PROBLEM SOLVING

Now let's consider how to find robots on the same line.

The brute force method is to calculate a line equation through two points and try to substitute the coordinates of all other points in the equation. But this way is too slow.

The fastest way is to find steps in **X** and **Y** directions to check each cell center on the line.



THE PROBLEM SOLVING

The distances between points (4,8) and (8,2) are:

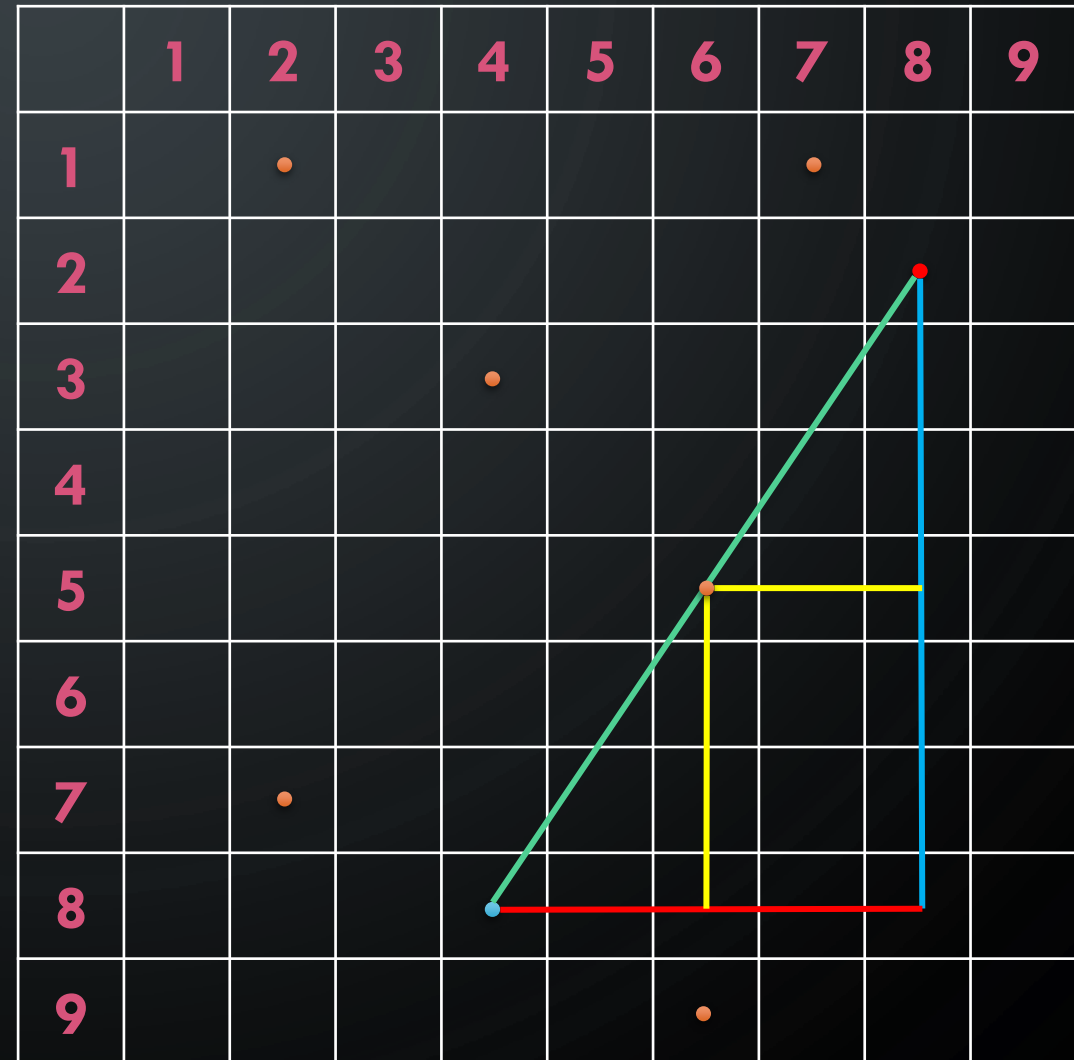
$$dX = (8-4) = 4$$

$$dY = (8-2) = 6$$

But we can see that minimum distances are $dX = 2$ and $dY = 3$.

How can we find it?

Think wisely about how to do it.



THE PROBLEM SOLVING

The algorithm to solve this problem.

1. Create a 1D array with robot coordinates.
2. Create a 2D array with cells and mark the occupied cells.
3. Pick up the first robot and compare its coordinates with each other.
4. Find the steps **dX** and **dY** to check the covered robots and exclude them from accumulation.
5. To find steps use a simple algorithm (you must figure it out).

The image features a dark gray background with a subtle pattern of concentric circles. In the four corners, there are white, stylized circuit board traces with small circles at the end of the lines, resembling electronic components or data paths.

**THANK
YOU!**