Digital Technologies @ School
Unplugged activities for students

This activity is for: Years 7-10

Spaceship Rescue

This activity teaches algorithms

We use algorithms to solve all sorts of problems around us. Algorithms are sequences of steps, or procedures, that lead us from a starting position to a goal. Some algorithms can be described easily (think about the recipe for making a cake), whilst others are harder to describe (think about a Sudoku puzzle).

The algorithm in this activity is somewhere between a cake recipe and a Sudoku puzzle. Two parts of it are purely procedural, whilst some other parts require trial and error, heuristics, or gut feeling. Rest assured, it is completely based on the laws and logic and can be described as a computer algorithm, just like a Sudoku puzzle can be solved by an algorithm. Students interested in taking this activity further can try to create a computer game that implements the ideas in this activity.

This activity will take up to **60 minutes**. If you are a teacher, read through page 7 for further information. Instructions for students are on pages 4 and 5.

You will need…

● Printouts of the spaceship grid on page 2 and the markers on page 3. (If you don't want to cut out markers, you can use a pencil to record where you think a spaceship may or may not be).

Getting started (read this with your child):

Attention Space Commanders! NASA has lost four spaceships in deep space. Probes have been deployed to gather data. A probe can see any number of spaceships along its line of sight. The maximum number it can see in this situation is four, since there are four spaceships. Your job is to triangulate the data to find the missing spaceships and save the astronauts. Are you up for the challenge?

Clarifying terms:

In trigonometry and geometry, **triangulation** is the process of determining the location of a point by forming triangles to it from known points.[1]

See a demonstration

cmp.ac/spaceshipvid

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[1] Wikipedia, Triangulation, https://en.wikipedia.org/wiki/Triangulation, last accessed: 31.3.2020

Spaceship Rescue

NASA has lost 4 spaceships in deep space ... Probes have been deployed to gather data … NASA needs your help to find the spaceships and save the astronauts.
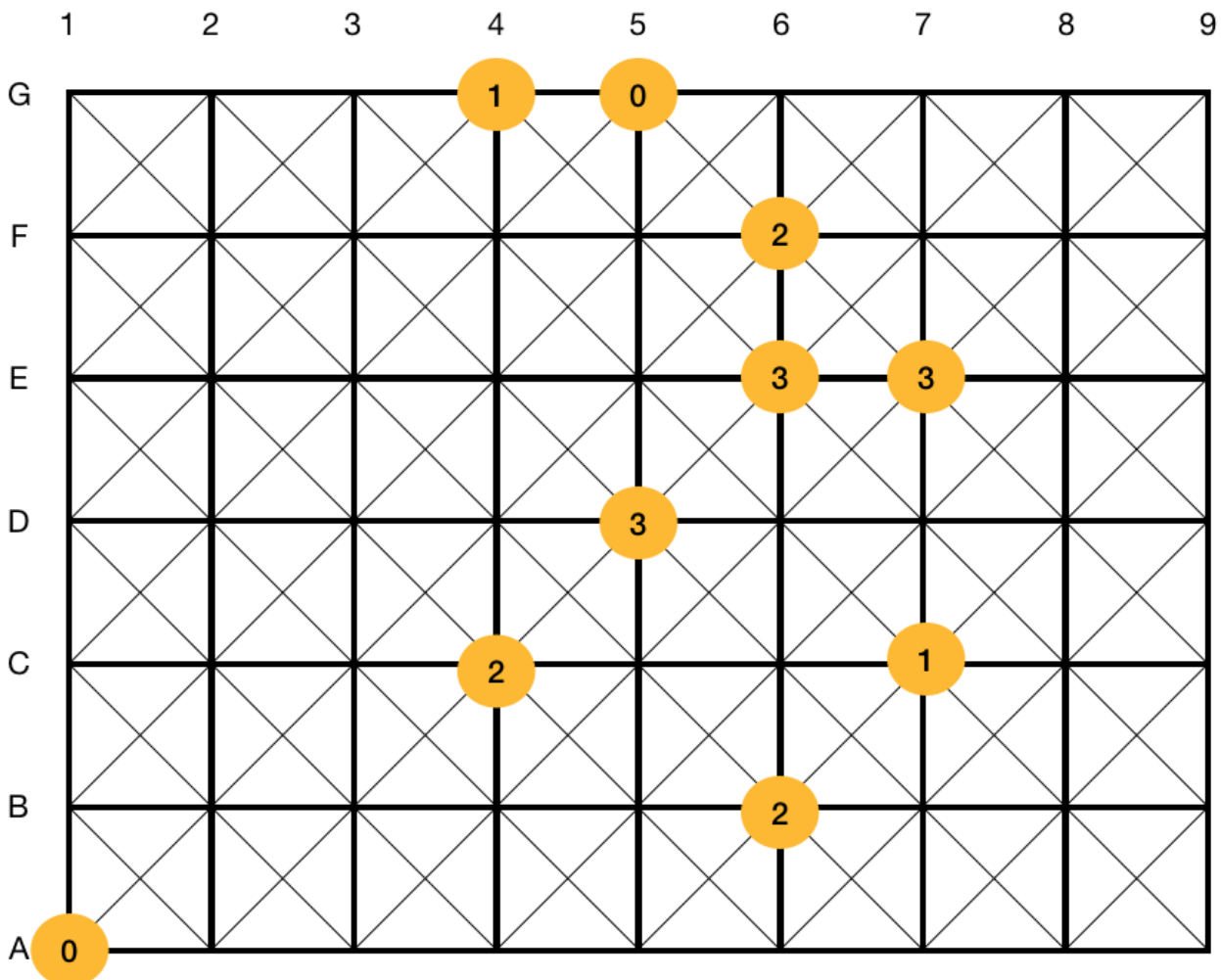

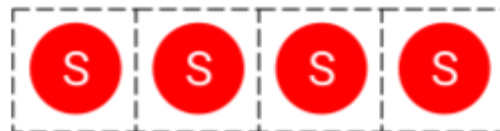Image: Credit Grok Academy Limited (formerly the Australian Computing Academy, the University of Sydney

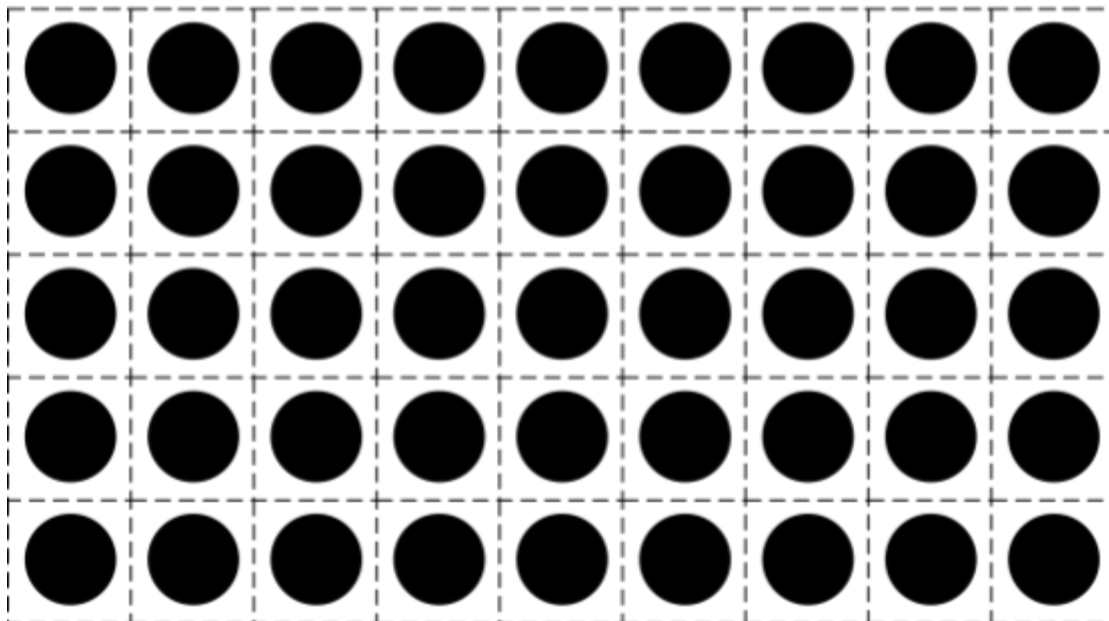**Preparation:**
Cut out the red and black markers

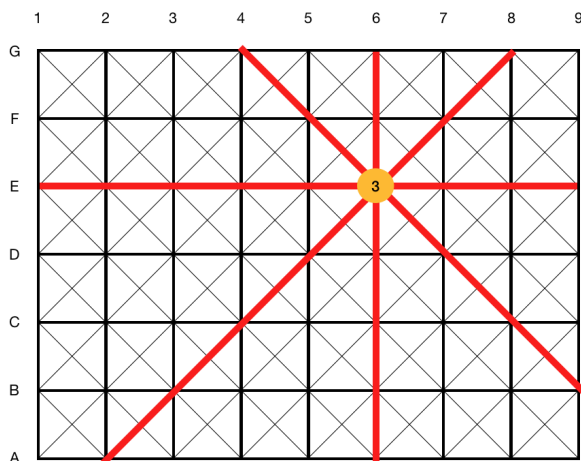Spaceship Markers

No Spaceship Markers

Step 1

The yellow circles represent the space probes. Each one has a number that shows how many spaceships the probe sees horizontally, vertically and diagonally. So if the number is 3, then the probe sees exactly three spaceships along the lines that go in any direction from the probe to the end of the grid.

Here is an example. The probe on E6 sees three spaceships. The spaceships are somewhere on the thick red lines.

Step 2

If a space probe displays a zero, then it doesn't see any spaceship along its connected lines. Mark the places that are definitely free of spaceships with the black markers. This step can significantly reduce the search space, as shown in the figure below.
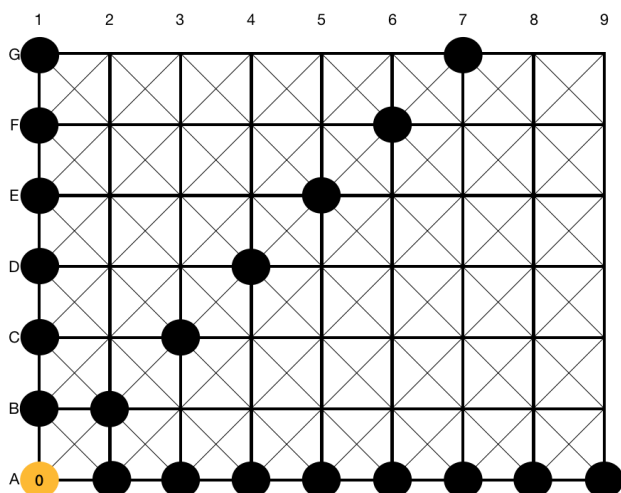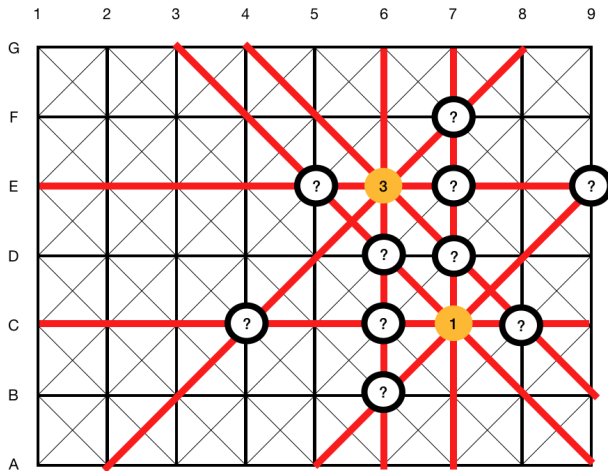
Students

Step 3

The intersections of lines from multiple probes on the main grid are places where the spaceships could be.

Here is an example of potential spaceship locations using data from two probes. You can see that there are ten possible locations, marked with a '?' where one spaceship might be hiding. Why just one spaceship? That's because the probe at C7 sees only one spaceship. Remember each probe can only see 4 positions in any direction.

You need to follow the lines from multiple probes and determine if an intersection point is a sure location of a spaceship. Remember, each probe shows the total number of spaceships it can see, not more or less. Mark the location with a red spaceship marker.

Step 4

When you have placed all 4 spaceship markers, double-check that the numbers on the connected probes match with the number of spaceships a probe can see from its position. If you have made a mistake, place the spaceship marker somewhere better. When you think you have found all the spaceships, check your answer against the answer key (which your teacher or carer has.)
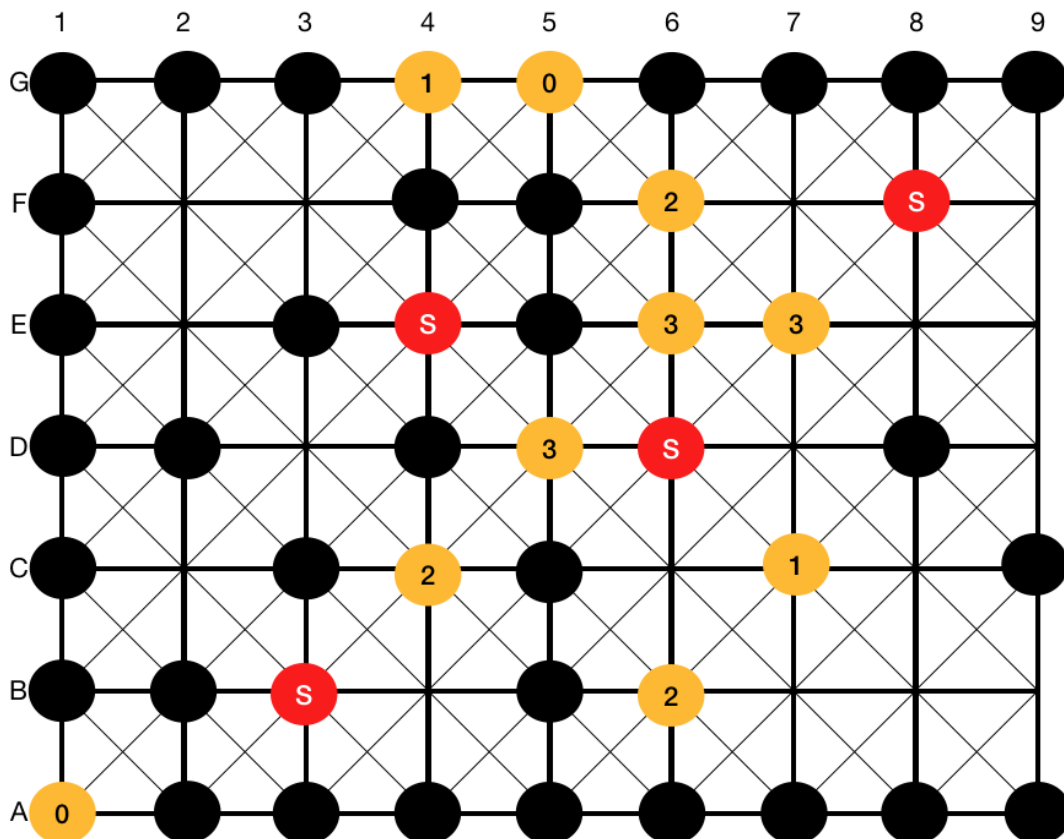
Answer key

This is a possible solution. It is entirely possible that your student may have found another valid solution!

More information for teachers

Here are some further activities, online resources, assessment ideas and curriculum references.

Adapting this activity

Once students understand how to complete this activity, ask them to prepare their own levels and share them with other students to solve them.

In a variation of the game rules, space probes cannot see spaceships that are hiding in the radio shadow of another spaceship. This makes the challenge more difficult to solve.

Keep the conversation going

- The activity is suitable for implementation as a computer game
- Students can work on designing an algorithm that randomly places four spaceships on a 9x7 grid.
- Another algorithm can inform the user about the number of spaceships that are visible from any user-selected grid position.
- Yet another algorithm can find the spaceships without user intervention.
- In a final step, students can design a game in which two human players play against each other or one human player against the computer.

Keep learning

For High School students interested in learning more about programming there are many courses to choose from at aca.edu.au/resources: you might like to try the space invaders game: cmp.ac/javaspaceinvaders

For teachers creating a portfolio of learning or considering this task for assessment

Ask students to describe the algorithm they followed to find the spaceships.

Linking it back to the Australian Curriculum: Digital Technologies

Algorithms
The precise sequence of steps and decisions needed to solve a problem. They often involve iterative (repeated) processes. (ACTDIP029 / ACTDIP040 - see cmp.ac/algorithms).

Refer to aca.edu.au/curriculum for more curriculum information.