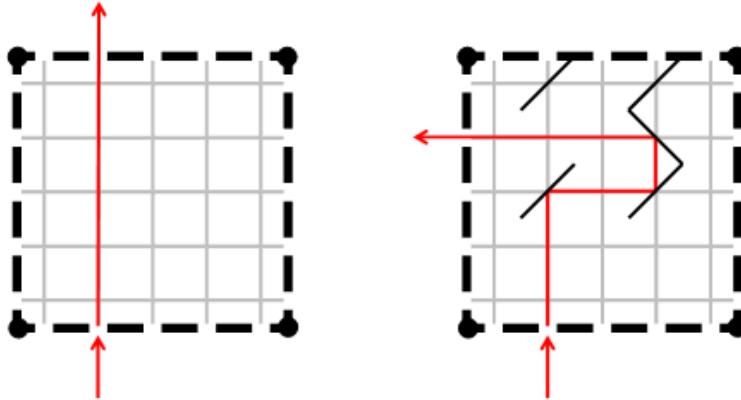


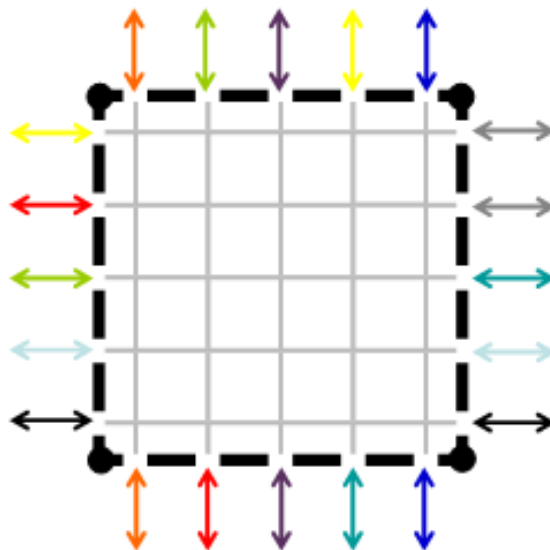
Mirror, Mirror in the Box

Merlin the magician has a magic box which plays tricks with light. He places mirrors in the box so that when a light beam enters, it bounces around before exiting:



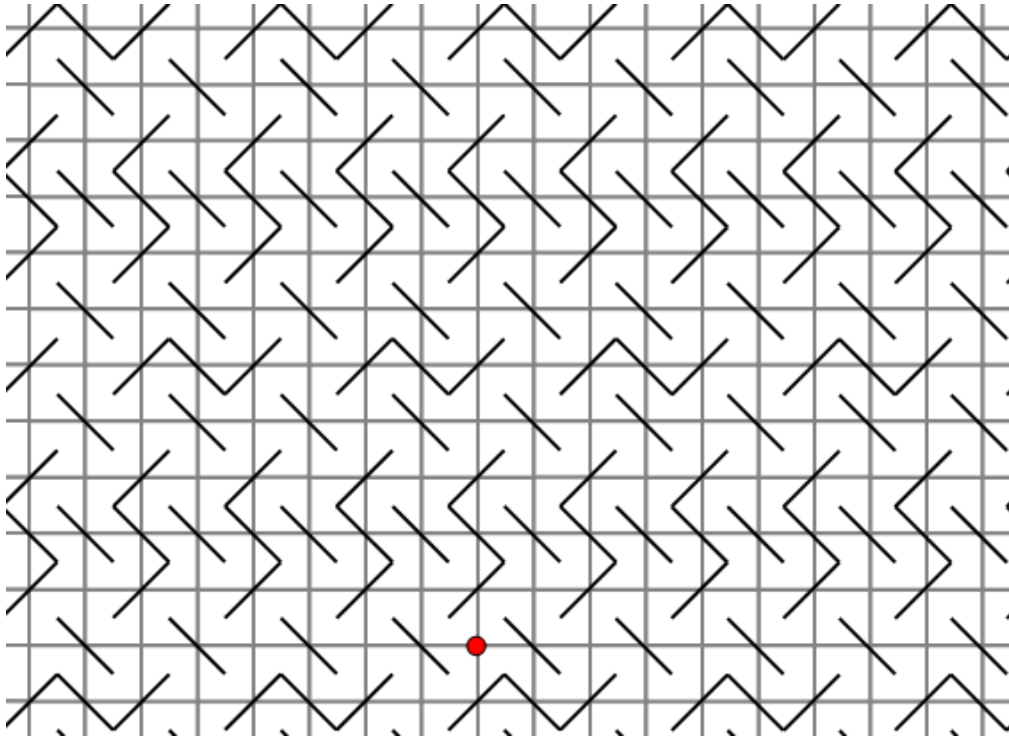
He shows you the box, and lets you fire light beams into it, but he does not let you see how the mirrors are set up. Is it always possible for you to figure out where all the mirrors are inside the box?

Extensions:

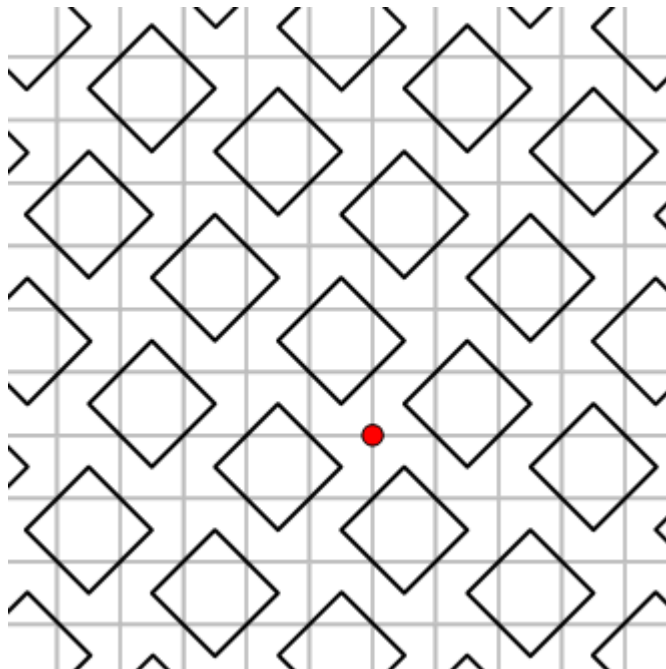


- If you were to randomly position the pairs of coloured arrows above, is it always possible for a set of mirrors to be placed so that a light beam starting at a specific colour emerges from the box at the same colour?
- Is it possible to place at least one mirror so that all light beams pass straight through the box as if there were no mirrors inside?

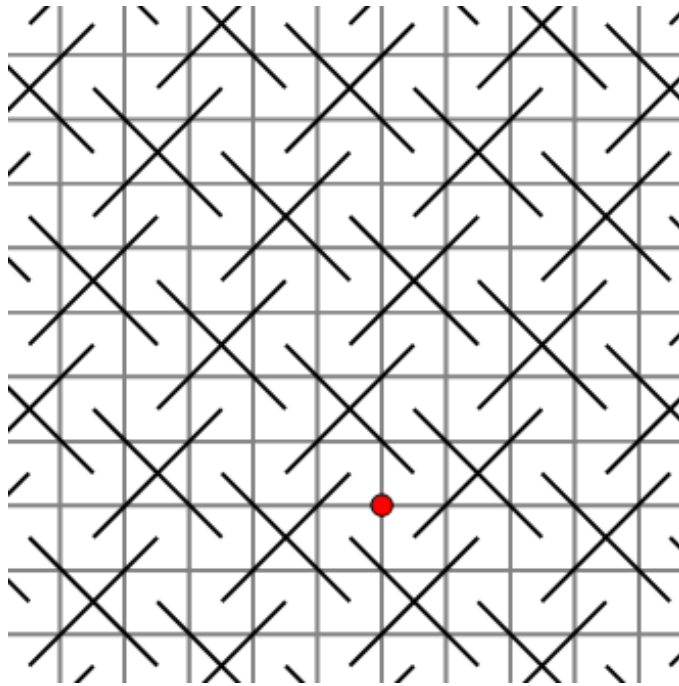
- Imagine an infinitely large box with the following pattern of mirrors:



- How many different shapes can a light beam trace in this infinite box? The red dot is one position where a light beam could start. You can place dots of different colours to help you.
- A light beam starts on the red intersection. After a millisecond it is discovered that a light beam is 5 units higher. How many units left or right may it be?



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The Math in This Problem:

This math puzzle challenges students to work with light beams reflected off mirrors within various boxes. To simplify the notion of reflection, which is a fundamental notion of mathematics, this brainteaser introduces it using 90 degree angles.