1 The Lion, the Llama and the Lettuce

A farmer needs to get a lion, a llama and a lettuce across a river in order to sell them all at market. He has a small boat that will hold him and one of the three things he's taking to market. The problem is, he can't leave the llama and the lettuce alone together on a bank of the river, or the llama will eat the lettuce, and he can't leave the lion and the llama alone, or the lion will eat the llama. As long as he is with the animals and the lettuce, though, the animals will behave.

How can the farmer get the lion, the llama and the lettuce across the river?

2 Enter the Leviathan

The farmer has a bad day, and doesn't manage to sell any of the lion, the llama or the lettuce. However, he does buy a Leviathan, and now he has to get all four back across the river. Just as before, the llama will eat the lettuce if left alone with it, and the lion will eat the llama. Further, the leviathan will eat the lion if the farmer isn't there, but only if the lettuce isn't there as well–leviathans are scared of lettuce, and unable to move in the presence of it.

How can the farmer get the leviathan, the lion, the llama and the lettuce across the river?

3 The Towers of Hanoi

The Towers of Hanoi are three pegs arranged in a row (hereafter referred to as the left, middle and right pegs) with three circular discs of different diameters on the left peg, stacked largest to smallest. You can move the discs one at a time by removing the top disc from a peg and putting it on another peg. However, you cannot put a larger disc on top of a smaller disc. The goal is to move all three discs to the right peg.

How can you get all three discs from the left peg to the right peg without violating the rules? How many moves does it take you?

4 More Towers of Hanoi

The game we just played is sometimes called 3-Hanoi, because there are three discs. We can ask the same question with 4 discs, or 2 discs, or 10 discs, and that game is called 4-Hanoi, or 2-Hanoi or 10-Hanoi. If there are n discs, where n is a positive integer, we call it n-Hanoi.

How many moves are needed to solve n-Hanoi? A good way to think about this is to find the shortest solution to 1-Hanoi, 2-Hanoi and 4-Hanoi, and look for a pattern.