

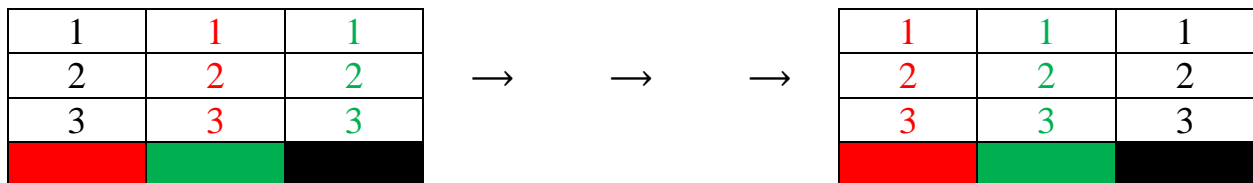
STEM Project from Dr. Wei-Kai Lai

Project Introduction

In this project we will study a variation of a popular mathematical puzzle, Towers of Hanoi. The regular version consists of three towers and a set of disks in different sizes. In the starting position, all disks are placed in one tower with the size in decreasing order from the bottom to the top. The player needs to move the whole set of disks to another tower following these two rules:

1. Only one disk can be moved each time.
2. A bigger disk cannot be placed above a smaller disk.

In this project we will focus on a variation of this puzzle: Tricolored Towers of Hanoi. We still have three towers, but with three complete sets of disks in different sizes like the regular version. The three towers are painted with three different collars: red, green and black. These three sets of disks are also painted with different colors: red, green and black. In the starting position, all three sets of disks are placed at wrong colored towers. The player will need to move all disks back to the tower with the matching color, following the original two rules. Our goal is to analyze the pattern of moves, find a recursive formula to describe the moves, create an algorithm, and to find the smallest number of moves needed, especially when the number of disks increases.



*In the figure above, a smaller number indicates a disk with a smaller size. We only show a puzzle with disks of three sizes due to space limit.

Expectation for Students

To build a foundation, students will first study the existing documents of the regular version of Towers of Hanoi. They then will learn how to observe patterns and find recursive and explicit formulas. Students will also learn basic techniques of proofs, and apply them to prove the formulas we created. A public presentation is required for students working on this project, either in Discover USC or a Math

conference. By preparing a presentation, students will also learn how to organize the results we find, and explain it to others systematically.

Requirement for Applicants

Students who are interested in Math or Computer Science are encouraged to apply. However, students must have at least one Math course foundation after MATH 111 to work on this project.