Math 304 • Mathematical Journeys IV • Spring 2021

Permutation Puzzles: A Mathematical Perspective

Want to play with puzzles and get credit for it?

In this course we will play around with Rubik's cube, TopSpin, and other fun, but challenging puzzles to develop an understanding of, and intuition for *group theory*. You'll even learn some computing.

Group theory is a very powerful and exciting branch of mathematics. It is often described as the algebra of symmetry and transformations. Physicists, chemists, biologists, computer scientists, and mathematicians all use these concepts. Now is your chance to take a fun, hands-on approach to this subject!

Don't know how to solve Rubik's cube? Never heard of TopSpin? Don't let that stop you! Our primary goal in this course is to understand these puzzles using mathematics. You'll learn how to solve them while we investigate questions like:

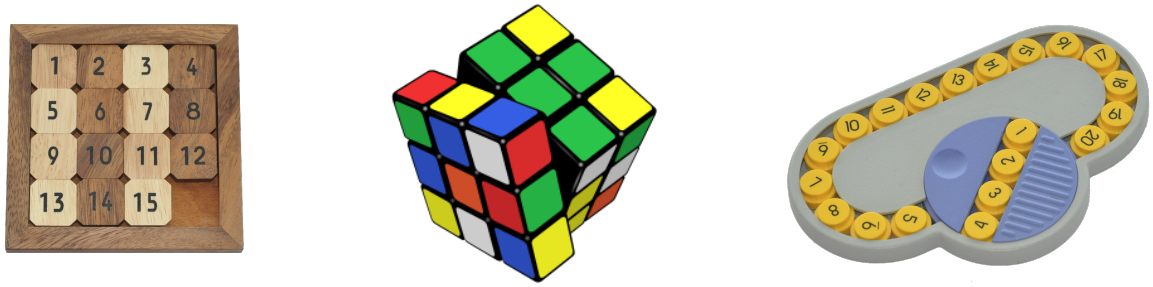
- How many different configurations are there of Rubik's cube?
- If you disassemble, then reassemble, Rubik's cube what is the probability it is still solvable?
- Why do we know there exist legal configurations of Rubik's cube that no cube has ever been twisted into?
- Why is it impossible to flip only one edge sub-cube of Rubik's cube?
- ... and many, many more.

You will learn how to use the mathematical software package *SageMath* to model these puzzles. You'll experience how computation can give insight into these puzzles and help answer questions like those listed above.

Instructor: Dr. Jamie Mulholland

Course prerequisites: Calculus (Math 152 or 155 or 158), Linear Algebra (Math 232 or 240), and a willingness to "play" with mathematics. Previous computing experience is not required, but can be helpful.

Further information: http://www.sfu.ca/~jtmulhol/permutationpuzzles/



The 15-puzzle, Rubik's Cube and TopSpin are some puzzles which embody the principles of permutation theory.