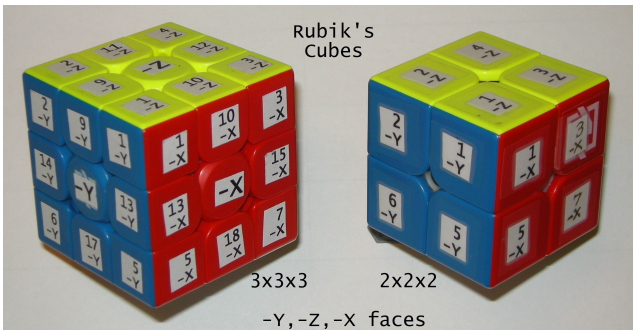
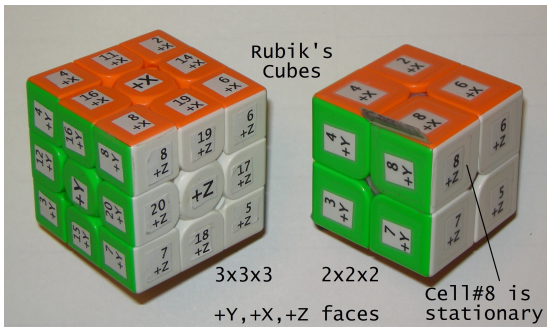
Rubik Math

For the last 18 months I've been exploring the huge problem of "realizing World Peace" by studying a familiar puzzle wherein complete harmony of all the moving parts is the solution: the Rubik's Cube ('RC')





Many people already know and teach canned move recipes for solving scrambled 3x3x3 RC's. Solving RC's in minimum time is a vibrant sport on YouTube, with win times between four and six seconds. My objectives differ:

> To guide novices to computer-aided solutions of scrambled RC's using the fewest number of moves.
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> To inspire interest in minimum move, totally cooperative game theory by reporting how the RC example became solved.
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> To let the RC solution inform my quest for World Peace.

1. Perhaps the definition of wisdom could become:
   > "Wisdom": achieving totally harmonious results with the fewest number of functional moves and, when faced with dysfunction, the fewest number of dysfunctional correcting moves.

   In more familiar phraseology:
   > Wisdom may be able to take 'less than an eye for an eye', and 'less than a tooth for a tooth' while efficiently converging to harmony.

   For everyday life's breakdowns: experts discern & fix problems with no wasted effort.

2. I've restricted "dysfunctional moves" to the act of rotating single RC cells in place. A cube that has been blown up by a stick of dynamite (destruction) or when there are two-or-more cells with identical color patterns (identity theft) are examples of dysfunctions that are not modeled here.

3. A software model of RC mechanical behavior (an 'emulator') is at the core of the computations. For a 2x2x2 RC there are 9 unique functional choices: (-90°, +90°, or 180°) rotation of one of three faces of the cube, (-X,-Y, or -Z, shown in the left image above)). The

8th cell is held stationary to create a geometric frame of reference. I identified the minimum needed number of such moves to reach all the valid scrambles by systematically deconstructing a solved cube to all of the reachable scrambles and saving the move count in a lookup table as the 'discord' at the address of the particular scramble. 11 or fewer functional moves reach the total of 3,674,160 scrambles (= 21*18*15*12*9*6), including "solved". (My fastest customized algorithm generated and saved the lookup table in 16.5 seconds during which time the computer consumed about 1/3rd of the energy in an AAA battery.)

Notes:
> The corners of a 3x3x3 RC have 24 times more valid scrambles, & twice as many faces rotate because the 8th corner cell must be moveable. None-the-less, to my surprise, the 3x3x3 corners alone still solve in 11 moves or less.
> My hunch is that the 12 edge cells of a 3x3x3 have 9.8099e11 scrambles (= 24*22*20*18*16*14*12*10*8*6*4). The product of these total corner & edge scrambles may be the total 3x3x3 functional scrambles. If so, the 3x3x3 has about 23.5 trillion times more functional scrambles than the 2x2x2.
> Since 23.5 trillion times 16.5 seconds is about 12.3 million years, the need for improved algorithms for assessing the discord of 3x3x3 scrambles is apparent.

4. The 'discord' value reveals 'how close to solved' a scramble is, and counts down to solved. For 2x2x2 RCs exactly two-thirds of the scramble addresses have no discord value because the mechanical geometry of the RC prevents reaching these scrambles in a functional way. But no matter how many dysfunctional moves have occurred - any dysfunctional scramble is only one dysfunctional move away from being functional and hence efficiently solvable! (Revealing the 'less-than-an eye for an eye' idea.)

5. Discords embody wisdom's guidance for solving RCs. The discord of any functional scramble is known. The 9 move choices result in 9 other functional scrambles, each with a discord value. Other than at solved, one or more of the move choices will have a lower discord – wisdom's wise path(s). This demonstrates wisdom enlightening 'freedom-of-choice'.

6. In step #3, the discord lookup table could be generated because both complete harmony and the functional moves were known for RC's. The first task in figuring out World Peace could be to clarify a uniform baseline of humanity's earthly expectations of 'solved'. Then to use a world emulator to study how this 'solved' world reaches particular scrambles, revealing choices which, when emulated functionally, may then be deployed wisely. A choice analogy is deciding which piano keys to play, and when to play them, to create a beautiful song.

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