Rubik's Cube Virtual Data Model

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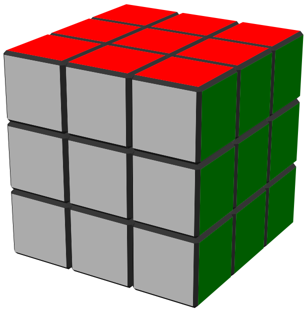
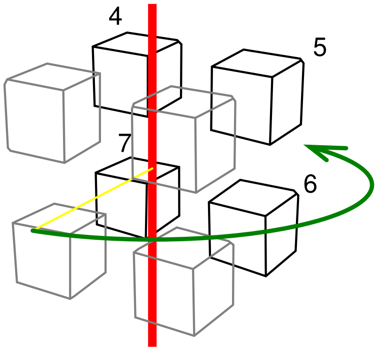
Since a Rubik's Cube is a 3D object that can be looked at from several different perspectives, there are also several different ways that a Rubik's Cube model can be represented in the computer. Therefore, the purpose of this document is to clarify the representation that is used within this Rubik's Cube program.

First of all, we should start with which side will be regarded as the front one. Take a Rubik's Cube and rotate it so that the white side faces you and the red side is up. The green side should face right, the blue side should face left, orange down, and yellow should be the back side.



A Rubik's Cube is composed of eight corner pieces, twelve edge pieces, and six face pieces. When the Rubik's Cube is rotated, the corner and edge pieces glide across the Rubik's Cube into their proper slots, but the face pieces just rotate in place. Each corner piece can be rotated to three different orientations in the same slot, and each edge piece can be rotated to two different orientations in the same slot.

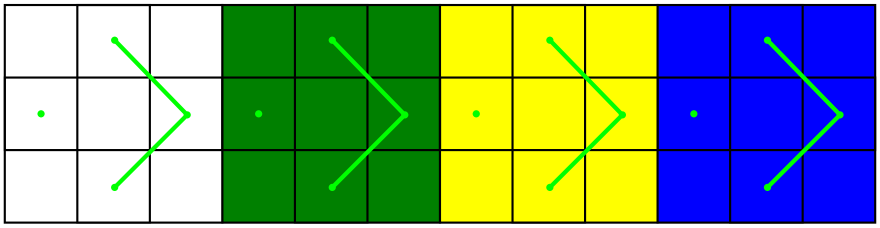
Lets start with the front face of the virtual model. When touching all of the pieces on the front face, a fourth of the edges are touched and half of the corners are touched. The first corner (index 0) will be regarded as the top-right corner on the front face, and the next corners will proceed counterclockwise. Then the numbering order for the second set of corners is obtained by rotating the Rubik's Cube 180 degrees to look at the back as if it were the front, and continue numbering in the same way.



In fact, the way the program renders the back corners is by rotating the local rendering space around the z-axis as is shown in the figure (the program uses the GL y-axis for the spatial z-axis), and then proceeding according to which corner pieces are in which slots.

The corner rotations are a measure of how the corner colors would look if you looked at the corner straight-on. The corner rotation states have three possible values: 0, 1, or 2. The corner rotation state is a measure of counterclockwise color rotation, zero being no rotation.

Now lets look at how the edges are represented. Cut out a strip of paper that is as tall as the height of the Rubik's Cube and four times as wide as a face on the Rubik's Cube. Then wrap this strip of paper around the white, green, yellow, and blue sides of the Rubik's Cube. When the paper is wrapped around the Rubik's Cube, draw a dot on the center of each edge piece that the paper covers. Unwrap the paper from the Rubik's Cube and lay it flat. For each face, draw a line that connects the bottom dot to the right dot, and another line that connects the right dot to the top dot.



Think of how the edges of faces are shared in the edge pieces. When looking at the dots touched by the lines in this diagram, you can tell that all twelve edge pieces are touched only once by such a dot. Also, when you look down at the Rubik's Cube from the red face, you can see that this ordering of faces proceeds counterclockwise.

Each edge piece in the Rubik's Cube program is formed by starting with the bottom edge of a face, and filling then rotating counterclockwise to the top edge of the face. Then the local coordinate space is rotated to the next face to continue the process.

This document's central purpose was to introduce you to the data model that is used within the Rubik's Cube program. As an introduction, it told you summarized qualities of the data model that would otherwise be difficult to obtain had you only been able to look at the source code. Now that you know the general aspects of the data model used to represent the Rubik's Cube in this program, you should understand that the next steps are to look at the specifics contained within the source code.