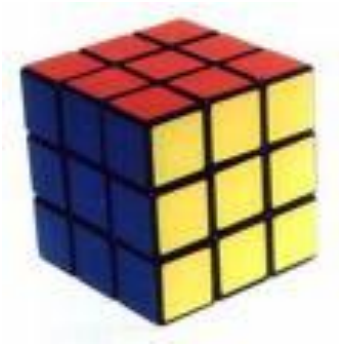# Solving the Rubik's Cube with Eight Algorithms

By Ben Martin

Introduction

This is a step by step guide on solving the classic Rubik's Cube, invented by Enrno Rubik. Although it may look almost impossible to solve, with its many faces and multiple combinations possible, it can be done. Before attempting to solve it, it is best to familiarize oneself with the arrangement, colors, and the different turning combinations. From then, understanding the eight algorithms or the combinations of turns, and their purposes are extremely important in getting to the final solution. The following guide, if followed properly, will help you accomplish the puzzle. The step by step procedures will be accompanied by diagrams to help you stay on track. Finally, remember that solving the Rubik's Cube takes practice as well as persistence. The final result will be worth the time. It may be necessary to start by practicing the eight algorithms several times to get used to the patterns. Good luck and enjoy!
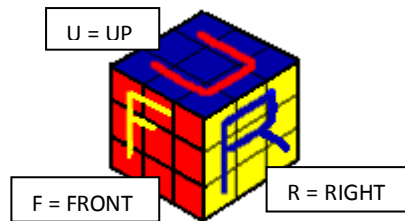
Terminology

The algorithms are dependent on rotating the different cube faces. So in order to understand what the algorithms mean, it is important to know how to turn the cube. Please take a few minutes rotating the cube for each motion, as well as understanding the different abbreviations mean. For the following table, CCW stands for counterclockwise.

a)	F:	Front Clockwise		Fi:	Front Inverse (CCW)	
b)	U:	Up Clockwise		Ui:	Up Inverse (CCW)	
c)	R:	Right Clockwise		Ri:	Right Inverse (CCW)	
d)	L:	Left Clockwise		Li:	Left Inverse (CCW)	

Table One: Rotating the Cube symbols. Parts a through d from the above table shows the eight basic movements.

Algorithms

The algorithms are step combinations that move a certain block to a preferred spot. It is important that the algorithms are performed with the correct front face. For details on how to hold the cube during an algorithm, look at each individual section under *Solving the Cube*. Here is a list of the eight algorithms for reference.

LIST OF ALGORITHMS
1) Fi U Li Ui
2) Ri Di R D
3) U R Ui Ri Ui Fi U F
4) Ui Li U L U F Ui Fi
5) F R U Ri Ui Fi
6) R U Ri U R U U Ri
7) U R Ui Li U Ri Ui L
8) Ri Di R D

Table Two: This table shows the eight algorithms needed to solve the cube. Some may only be used once, and others may require several repeats to achieve desired alignment.

## Solving the Cube

The Plus Sign

To start solving the cube, make a plus sign on any surface. There is no specific algorithm dedicated to this first step, just close observations of how colors are patterned. I have chosen the color yellow.
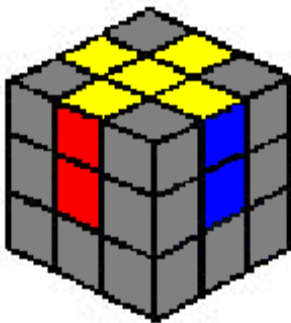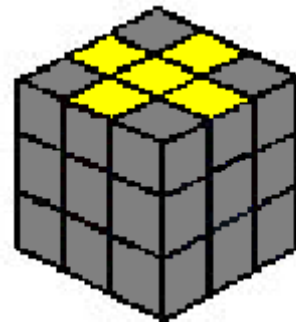
Now you must align the middle center pieces to match with the middle edge pieces like the two reds and two blues in the diagram. Try not to move the parts of the plus sign that you have already solved.

If the following Yellow-Red position occurs, then perform algorithm 1 to fix the alignment.

1) Fi U Li Ui
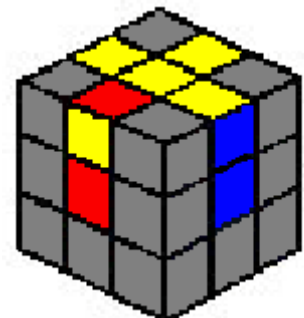
The Corners

Place the Corner Piece below the correct corner and perform algorithm 2 as many times as necessary. Notice that the corner piece shown corresponds to the spot two spaces above it. It does not matter how it is currently aligned, just that it is the right piece. It may require multiple repetitions of the algorithm to get it in the right position. Remember to keep the same face during each repetition.

2) Ri Di R D

Proceed with the other corners performing algorithm 2 for each. Remember to hold the cube with the missed aligned piece in the lower right corner of the top face. If correctly done, you should now have the upper face and the first layer completely solved, as shown below:
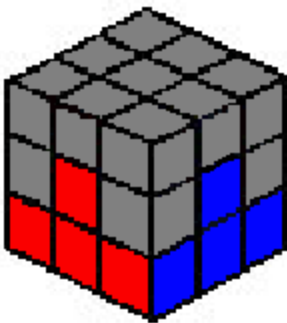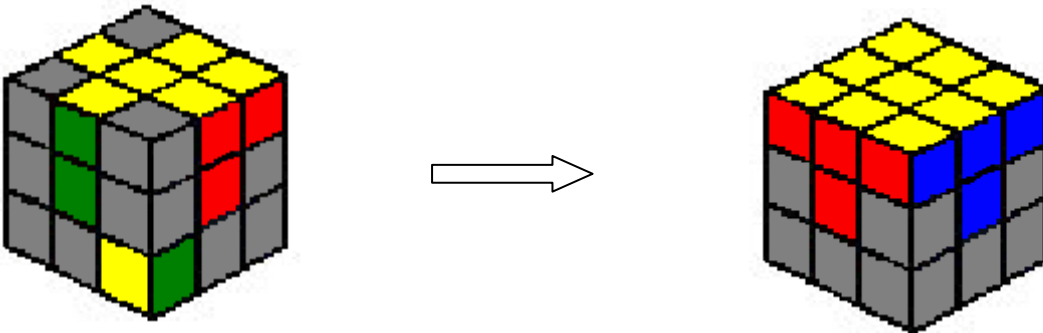

Flip the Cube such that the Yellow Top is now on the Bottom. Now you're ready to start solving the middle layer.

Middle Layer Edges

There is a possibility of 4 unsolved edge pieces in the middle layer. To start solving the middle layer, turn the top face until the colors match and the top color matches with the left face or right face. There are two different moves that are important, moving the top edge piece to the right or to the left. The example covers both moves. The 3rd algorithm will be used to move right while the 4th algorithm will be used to move left.
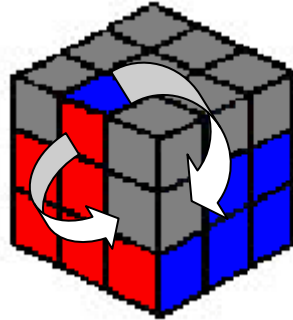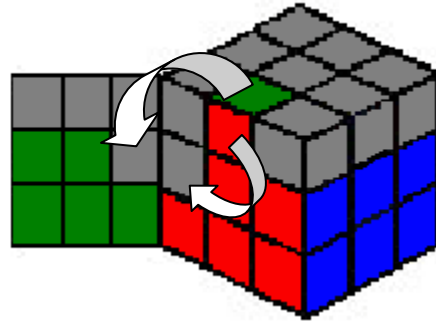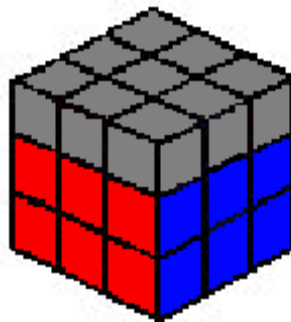
3) U R Ui Ri Ui Fi U F   **4) Ui Li U L U F Ui Fi**

Continue solving each middle edge piece until you have solved them all. Remember to hold the cube with the front face that has the middle edge piece to move.

The Plus Sign

Turn the top face until one of the following patterns is seen. Determine your face from the figure and perform algorithm 5. You may be on any stage and you will progress through the stages as you perform algorithm 5. You shouldn't have to perform algorithm 5 more than three times to make a plus sign.

Stage 1   Stage 2   Stage 3   Stage 4
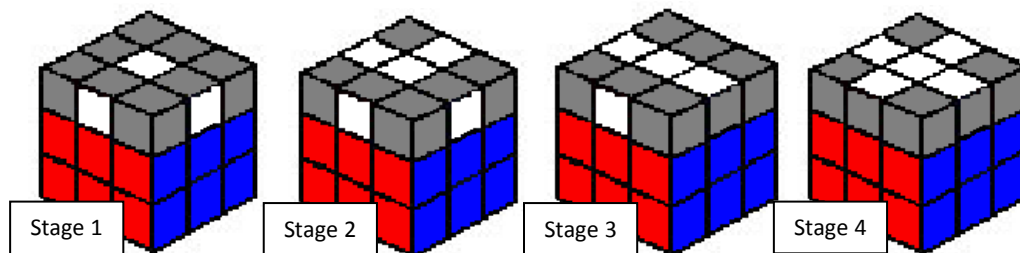
5) F R U Ri Ui Fi

Middle Center

Now you must turn the top until two of the center edge pieces align. You will have two options; hold the cube in your hand with the correct front facing you like in the diagrams. In order to perform algorithm 6 correctly, the cube needs to have the diagrams front face. All 4 center edge pieces should be aligned correctly. This algorithm shouldn't be performed more than twice.

Option 1

Option 2
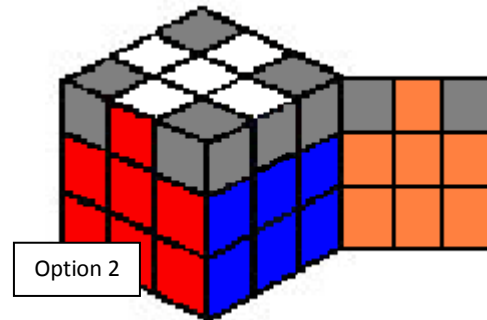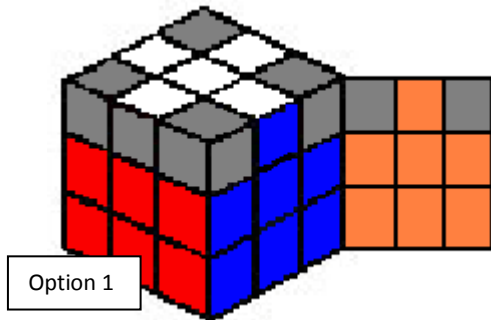
6) R U Ri U R U U Ri
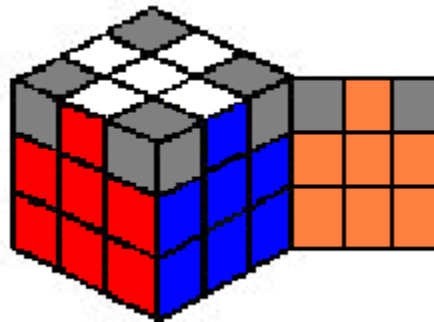
The Corners

There should be at least one corner piece in the correct place, but not necessarily aligned correctly. Hold the cube with this piece in the lower right corner of the top face. Now it's time to perform algorithm 7. This will place all the corner pieces in the correct spot but not aligned correctly. This may be performed up to three times. If there is no pieces in the correct place, then perform algorithm 7 with any face as the front except for the top or bottom faces. Now there should be one that is in the correct corner. Find it and place it in the lower right corner of the top face.
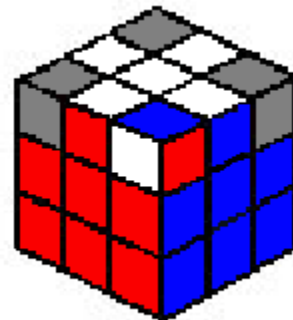
7) U R Ui Li U Ri Ui L

One of the following will occur, hold the cube with the unaligned piece in the lower right corner of the top face. Perform algorithm 8 two to four times. Watch for the piece to match, at that moment you will need to rotate the top face once CCW and perform algorithm again. Remember to keep the same front face throughout the rotations. You will have to repeat this for as many times as you had unsolved corner pieces.

8) Ri Di R D

Possibility 1
Possibility 2
Possibility 3
Possibility 4
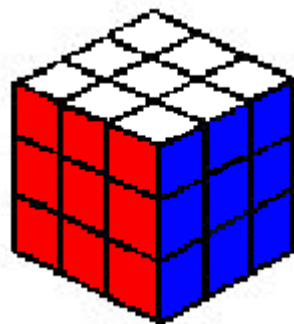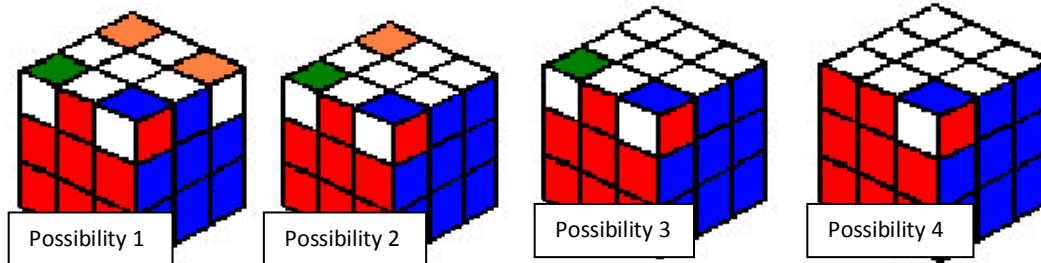
Finally the Rubik's Cube is solved.