

Rubik's Cube Solution for Beginners

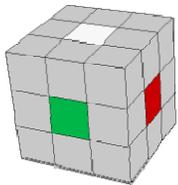
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Introduction

Ever wonder how to solve a Rubik's Cube? Well, this guide will teach you how with a simple solution that anyone can understand! Here are some facts you should know before you begin.

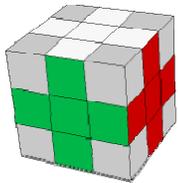
Pieces

There are three different kinds of pieces:



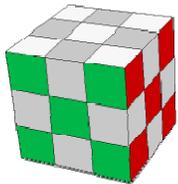
Center pieces

These pieces may rotate but never move with respect with each other. The color of each face is determined by the center color.



Edge pieces

These pieces have two stickers each and belong at the edges where two faces meet. The stickers on each side should match the centers' when solved.



Corner pieces

These pieces have three stickers each and belong at the corners where three faces meet. The stickers on each side should match the centers' when solved.

In this guide, some pieces are grayed out to help you ignore parts of the cube that are irrelevant to the task at hand. In addition, X's may be used in order to highlight certain areas.

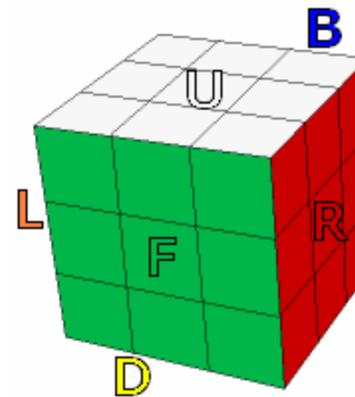
It is a common misconception to think that the Rubik's cube is composed of 54 "stickers" that need to be put in the right places to become solved. In fact, it is composed of only 20 "pieces" (8 corner pieces and 12 edge pieces) that need to be solved.

Notation

It is important to understand the notation in order to follow the algorithms in this solution!

There are six faces on the cube – Front, back, up, down, left, and right.

They will be referred to as follows – *F, B, U, D, L, and R.*



- A letter by itself means turn that face *clockwise*.
- If followed by an apostrophe then turn that face *counterclockwise*.
- If followed by the number 2 then turn that face *180 degrees*.
- Parentheses are used to group moves together in order to make learning longer algorithms easier.

Quick notes on the solution algorithm

This solution is a layer-by-layer solution and can be broken down into three steps: solving the first layer, the second layer, and the last layer. Each layer gets progressively harder and more complicated because the previous layers need to be preserved.

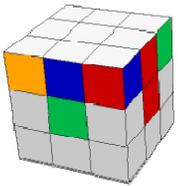
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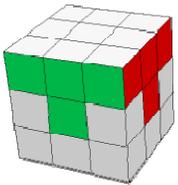
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The First Layer

Solving the first layer is a two-step process: solve the edges (*the cross*) and then solve the corners. Remember that edge and corner pieces have multiple stickers, and belong in a specific position!



Although all the stickers on top are white in this situation, the first layer is NOT SOLVED. Note how only the white-red edge is in the right location, while all the other pieces are not.

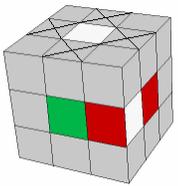


Here, the first layer is solved correctly. This is the most intuitive layer. See if you can solve it on your own before continuing!

Solving the cross

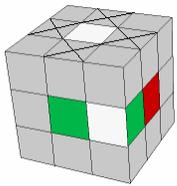
The very first thing you need to do is find a cross piece you want to solve. That would be any EDGE PIECE with a white sticker on it. There are only four of these pieces and these can be found in either the first, second, or last layer.

If the EDGE PIECE is in the second layer



CASE 1

or



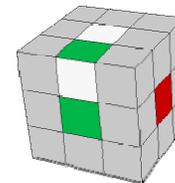
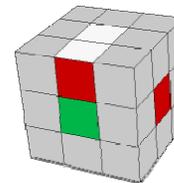
CASE 2

First, figure out how to bring the white sticker to the top face. For CASE 1, an F' move would put the white sticker to the front X, while for CASE 2, an R move would put the white sticker to the right X. Whichever X the white sticker will end up in is the TARGET POSITION. (Refer to the notation section in the introduction for an explanation of notation.)

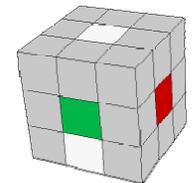
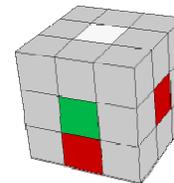
Second, figure out which X you need to bring the EDGE PIECE to. Determine this by observing the other sticker of the edge piece. For CASE 1, the other sticker is red and the piece belongs in the right X because that is above the red center. For CASE 2, the other sticker is green and belongs in the front X because that is above the green center. Whichever X your EDGE PIECE needs to go to is the GOAL.

Next, bring the GOAL into the TARGET POSITION by using either a U , U' , or $U2$ move. Then, bring the EDGE PIECE into the TARGET X POSITION the way you figured out in the first part. Finally, put your EDGE PIECE back where the GOAL started by undoing the U , U' , or $U2$ move you made before. For CASE 1, the set of moves would be $(U F' U')$. For CASE 2, the set of moves would be $(U' R U)$.

If the EDGE PIECE is in the first or last layer



or

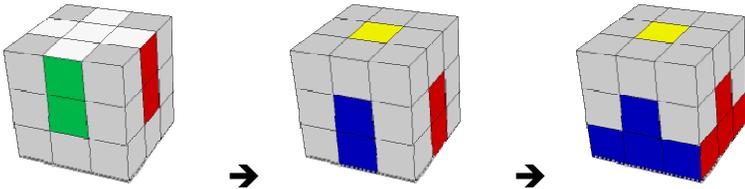


Perform an F or F' move to bring the EDGE PIECE into the middle layer. Now you may solve this piece using the technique for when the EDGE PIECE is in the second layer, described above.

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Solving the corners



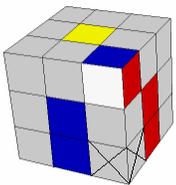
For the remainder of this solution, you will hold the cross on the bottom face. The reason for this is to improve visibility of all the remaining pieces.

Again, the very first thing you need to do is find a piece you want to solve. That would be any CORNER PIECE with a white sticker on it. There are only four of these pieces and these can be found in either the first or last layer.

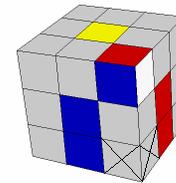
If the CORNER PIECE is in the last layer (top)

Look at the two non-white colors of your CORNER PIECE. Figure out which of the four corners in the first layer it belongs to by checking with the center colors. This is your GOAL. Then, bring the CORNER PIECE directly above the GOAL by using either a U , U' , or $U2$ move. In the following images, the CORNER PIECE has blue and red stickers, and was brought to the blue and red centers.

If the CORNER PIECE has a white sticker on the side

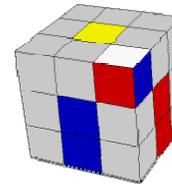


Algorithm: $(U R U' R')$
First, move the CORNER PIECE away from the right face (U). Then, bring the GOAL to the top (R). Finally, move the CORNER PIECE into the GOAL and bring it back to the first layer ($U' R'$).



Algorithm: $(U' F' U F)$
First, move the CORNER PIECE away from the front face (U'). Then, bring the GOAL to the top (F'). Finally, move the CORNER PIECE into the GOAL and bring it back to the first layer ($U F$).

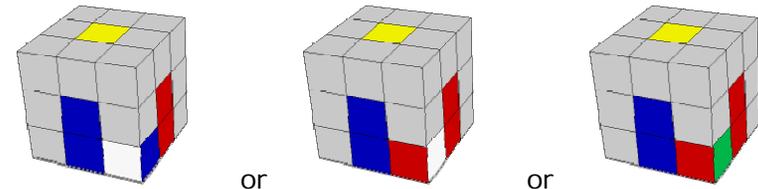
If the CORNER PIECE has a white sticker on top



Algorithm: $(R U' R' U2)$
First, get the white sticker to be on its side (R). Then move the CORNER PIECE away from the right face (U'). Finally, undo your first move and reposition the piece ($R' U2$). Now you may solve this piece using the previous technique for when it has a white sticker on the side.

If the CORNER PIECE is stuck in the first layer (bottom)

Algorithm: $(R U R' U')$



First, move the CORNER PIECE into the last layer (R). Then, move it away from the right face (U). Finally, undo your first move and reposition the piece ($R' U'$). You will find the piece is now directly above where it came from. Now you may solve this piece using the previous technique for when it is in the last layer (top).

Solve all four CORNER PIECES in this manner.

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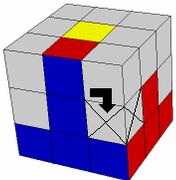
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The Second Layer

These algorithms are a little more complicated because there is less freedom now that the first layer is completed. The second layer consists of four edge pieces that need to be put in the right positions. First look for an EDGE PIECE to solve. These are pieces that do not have a yellow sticker on them, and can be found in either the second or last layer.

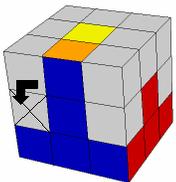
If the EDGE PIECE is in the last layer

First, move the EDGE PIECE so the front sticker matches the center by using either a U , U' , or $U2$ move. In the following images, the EDGE PIECE has a blue sticker in front, and was brought directly above the blue center. Then, depending on whether you want the piece to go into the right or left block, you use one of the following algorithms:



Algorithm: $U (R U' R') (U' F' U F)$

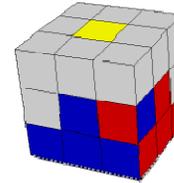
First, move the EDGE PIECE away from its GOAL (U). Then, break the first layer corner away from the first layer and connect it to the EDGE PIECE ($R U' R'$). Now solve the corner edge pair with the same algorithm you used before to solve the first layer corner ($U' F' U F$).



Algorithm: $U' (L' U L) (U F U' F')$

First, move the EDGE PIECE away from its GOAL (U'). Then, break the first layer corner away from the first layer and connect it to the EDGE PIECE ($L' U L$). Now solve the corner edge pair with the same algorithm you used before to solve the first layer corner ($U F U' F'$).

If the EDGE PIECE is stuck in the second layer



You will need to knock out that piece with another edge piece in the last layer by using one of the previous algorithms. After this is done, the piece in question will be on the last layer, and can be solved correctly like in the previous cases.

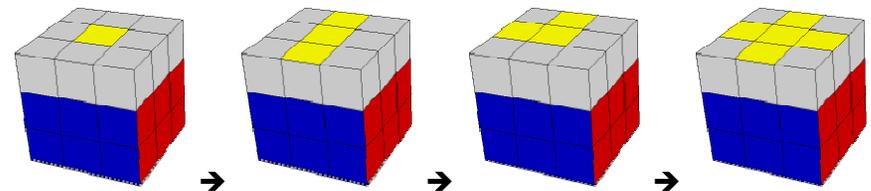
The Last Layer

The solution to the last layer is the most complicated and can be divided into four steps: orienting the edges, orienting the corners, positioning the corners, and positioning the edges. Four algorithms will be used.

Orienting the edges

The goal for this step is to have all the edges show their yellow stickers on top. There are three possible orientations presented below, and executing this 6 move algorithm will cycle through these following situations in order:

Algorithm: $(R' U' F') (U F R)$



What this algorithm does is it takes you from a dot to a line to the letter J and finally to a cross.

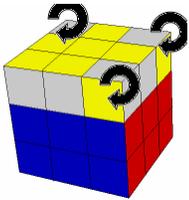
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To help you memorize this algorithm, just remember that it is three counterclockwise moves followed by three clockwise moves. Saying "Roof You Fur" will help you remember which order to move them in (although it may sound a little silly!).

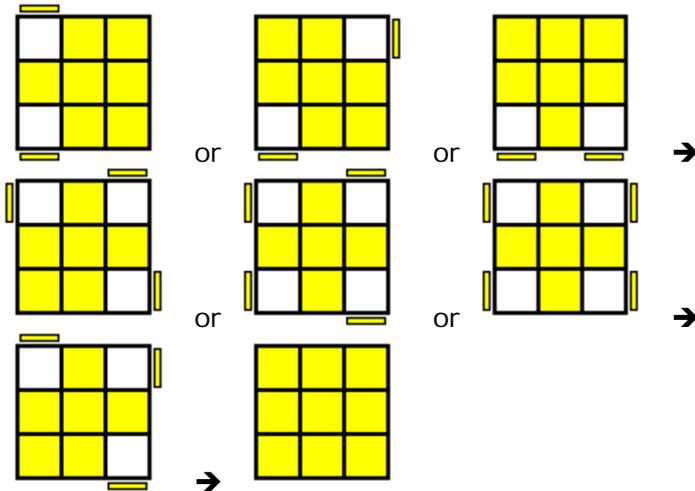
Orienting the corners

The goal for this step is to have all the corners show their yellow stickers on top. There are seven possible orientations presented below, and a combination of this 8 move algorithm will solve any case:



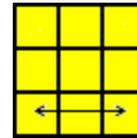
Algorithm: $(R U) (R' U) (R U2) (R' U2)$
 This 8 move algorithm will rotate the stickers on these three corners clockwise.

Although following diagrams give you are top-down view of the state, you must execute these moves holding the yellow side on top.



Positioning the corners

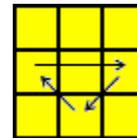
The goal for this step is to position the corners correctly. The following 16 move algorithm, executed with yellow on top, will swap two corners as shown, and can be used any number of times in order to position all four corners correctly:



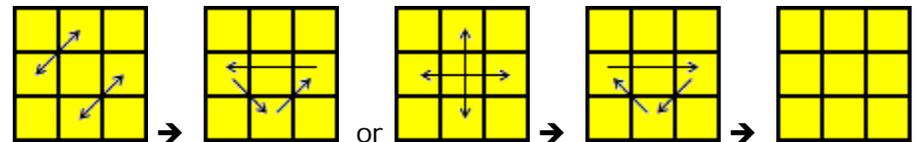
Algorithm:
 $(R' D2 R) U2 (R' D2 R) U' (R' D2 R) U' (R' D2 R) U'$
 This 16 move algorithm will swap the front two corners.

Positioning the edges

This is the final step in solving the cube. You will need to position the edges in the correct locations by cycling sets of three. There are four possible permutations of the edges, and with this 9 move algorithm, you will be able to solve them all!



Algorithm: $F2 U (L R') F2 (R L') U F2$
 This 9 move algorithm cycles the three edges closest to you in the clockwise direction.



Congratulations! Now you can solve the cube!

Acknowledgements

Thanks to Tyson Mao for the idea of writing down a beginner's solution and thanks to Lars Vandenberg for his cube images.