Rubik's Revenge Solution Page

Do you have one of those Rubik's Revenge (RR from now on) cubes? You know, the 4 x 4 x 4 ones. Is it an insurmountable challenge? Could you use some help?

I've managed to piece together a fairly complete solution to the RR. Steps 1 and 2 are still less than rigorous, but it should be doable. I've included the steps in my personal notation, however, when I have some serious free time, I'll rewrite it all (like right around never!)

For the following solution, I'll assume you know how to do the Rubik's cube, or are at least familiar with it. If you don't have any experience with the Rubik's cube, this may not be a good way to get introduced to cubes.

This page is kind of static. It hasn't been significantly revised since 1998. I just cleaned up some of the HTML and fixed some of the links to make it a little more useful (January 2002). I am mostly leaving the page up in the hopes that it may help you out a little.

Step 0 -- Notation

The RR requires some different notation than the regular cube. I haven't read any books on RR notation, so I'll take the liberty to make up my own. If there's a standard notation that I don't know about, please email me and I'll get my act together! We'll use the R face as an example (there are the same 6 faces as for the regular cube, U, D, F, B, R and L. Check my Rubik's Cube page if this is unclear).

- R = turn one slice (ie a flat group of 16 cubies, or the right-hand quarter of the cube) 90 degrees clockwise (all turns are from the perspective that you are looking down at the face)
- R' = turn one slice (as above) 90 degrees counter-clockwise
- R2 = turn one slice (still as above) 180 degrees in either direction
- 2R = turn two slices (ie the right half of the cube) 90 degrees clockwise (note this is the same as 2L)
- 2R' = turn two slices (as above) 90 degrees clockwise
- 2R2 = turn two slices (") 180 degrees in either direction

Hopefully this notation isn't too counter-intuitive. It seems to make sense to me, but then again, I came up with it!

The other challenge is to identify each of the pieces.

- Corner pieces are denoted by the three sides to which they belong. Examples include the UFR or UBL pieces.
- Edge pieces are denoted by the two sides to which they belong. Examples include the UL pieces (note that there are two of them) and the FD pieces. [Quick point: it may at first appear that these two edge pieces with exactly the same colours are interchangeable, however this is not the case.] If a distinction needs to be made between the two identically coloured pieces, the first two letters denote the faces, and the third letter will denote the side to which the piece is closer. For example, the FRU edge piece

would be the upper of the two FR edge pieces.
- Centre pieces are denoted by the side, followed by two letters indicating their location. For example, the UBR centre refers to the centre piece on the U face, which is in the closest to both the B and R faces

Since there is a certain amount of ambiguity with these references, I'll be sure to include the type of piece (corner, edge, or centre).

Step 1 -- Do Two Opposite Centres

The first thing to do is to get all 24 centre pieces in the right places, relative to one another. Examine the corner pieces, and figure out which sides go opposite each other. Choose two colours that will be opposite each other (i.e. there is no corner piece with both these colours). On my RR I use white and blue, so I'll use those for this step. Note that the locations of the centres are not fixed, like they are in the Rubik's Cube.

This step is sort of hard to put into words. Basically, try to get the white and blue (ie, opposite) centre pieces in pairs (for example, in the UFR and UFL centre positions -- note these are **not** diagonally adjacent), so that they are easier to manipulate. Then, get a white pair on the U face, a white pair on the F face, and blue pairs on the D and B faces. Rotate the faces individually (ie U, F, D and B moves) so that the UBL and UFL centres are white, then the FUR and FDR centres are white, and so forth, so that when you apply 2R, all the white centre pieces are on the U face and all the blue pieces are on the D face.

Step 2 -- Do the remaining centres

Try to line up the remaining centre pieces (now all in the middle two layers of the cube). Twist the side faces (F, B, R, L) and apply 2D until they are all in pairs. Just concentrate on making pairs of centre pieces. When they are all paired up, check their desired relative position by the corner pieces, then start by placing one pair in the upper half of each centre of each side face, so that these are in the correct order. Then, apply 2D. If you're lucky, they will all line up, and all the centres will be correct, however, they probably won't. Play around a bit, using side face squared and 2D moves, and hopefully it will all work out and the centres will be completed. If two of the side face centers are completely correct, and the other two have two pairs of the same colours (say the F face has an orange pair towards the top, and a green pair towards the bottom, and the R face has a green pair towards the top, and an orange pair towards the bottom), then apply F2 2D' F2 2D and the cube's centres will be correct. Sorry there aren't any more concrete moves for this step!

All the centre pieces should now be correct and in their correct relative locations.

Step 3 -- Match up edge pieces to their long-lost twins

The following is a move that cycles the following three edge pieces: UFL, UBL, FRU. I guess I could also write

- UFL := FRU

- UBL := UFL
- FRU := UBL

Here's the move: 2L' L U R U' 2L L' U R' U'. Now, at this stage, it doesn't matter about altering the other pieces, so this can be simplified to 2L' U R U' 2R. The way to use this move is to choose an edge piece, say yellow-red. Hold the cube so it's in the UFR position. Now, find the other yellow-red piece, and place it in the FRU position. Note that each of the sides of these two pieces on the F face are forced to be the same colour. Now, search for the twin of the piece in the FRD position. Place it in the UBL position, and apply the move. This has the effect of matching up two pairs of edge pieces.

Apply this move a total of 6 times, in order to match up all of the edge pieces with their double. The first 4 applications will sort out 8 pairs, then the fifth application will match one pair, and then on the last one, align the edge pieces so that the UFR edge and the FRU edge are the same (and both the F sides have the same colour), and so that the UFL piece and UBR piece are the same (and that the F face of the UFL piece is the same colour as the U face of the UBR piece) so that 3 pairs are sorted out simultaneously.

Now, all the edge pieces should be matched up with their pairs, and the centres are still intact

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Step 4 -- Almost Done!

In case you hadn't realized it, you're now holding a 3 x 3 x 3 cube. If you forget, or are not sure how to solve this, refer here. Simply solve the cube using the 3 x 3 x 3 technique. I knew recursion would have real-life applications! Note that you only need to use the quarter-cube (ie U, F, etc) moves, never the half-cube (ie 2D, 2B) moves. Note that the pairs of like edge pieces become one piece in terms of the regular cube, and that the centre pieces stay together.

Step 5 -- Fixing things that couldn't happen on a real 3 x 3 x 3 cube

Two problems may occur while solving your new 3 x 3 x 3 cube. One possibility is that you will get an odd number of green edge pieces when you are trying to form the cross (Step 3 from Rubik's cube instructions). Hold the cube so that the offending pair of edge pieces are in the BL position, and apply L2 d1 R2 d1 R2 d3 L2 u3 B2 u2 B2 u3 B2 R2 B1 r3 B3 R2 B1 r1 B1. Okay, I'm introducing some new notation for this and the next part: d means the face next to the D face (ie the 3rd layer from the top), and so forth. The number after the letter denoting the face refers to the number of quarter-turns clockwise that are needed. For instance, B3 means "turn the back face three quarter-turns clockwise, or one quarter-turn counter-clockwise." In my other notation, I'd have written B'. Also U1 = U, etc. Apparently this is the standard notation, so I'll change the rest of this page to make it consistent...sometime.

The other possibility is that you get to Step 5, where the corner pieces must be placed correctly. One possibile outcome with the RR is that there are two corner pieces correct, and two corner pieces that need swapping with each other. This cannot happen on a regular cube. However, this move swaps the UBL and UBR corner pieces: R3 F3 U1 F1 R1 B1 U2 F3 U1 B3 U3 F1 f1 D3 f1 D1 f3 D3 f3 U2 f1 D1 f1 D3 f3 D1 f3 f3 r1 f1 r3 U2 r1 f3 r3 f1 F3 U3 F2 D1 R1 U1 R3 D3 U3 F2 U2 F1 U1.

I know it's a bit long, however it's better than redoing the whole cube. So, hopefully, the cube is done right now. I think there's a probablity of 1/2 for each of these two problems happening, and since they are apparently independent, there's a 1/4 chance that neither will develop and you can solve the whole thing without having to resort to these moves, which, I admit, are a bit long.

Disassembly and Assembly

In a word, don't. I disassembled my RR once. It was **not** a good idea. Keep in mind that there are 56 pieces (plus a really neat ball-like device that holds everything together), which is nearly 3 times as many pieces as a regular cube (20, plus the centre).While the regular cube is easy to put back together, wait, what's that thing about Humpty Dumpty and all the King's horses and all the King's men again? Trust me, putting it together will take a while, especially the first time. Since the centre pieces are on these tracks on the centre ball, they kind of fly around. It's hard to hold onto all the pieces until there's enough to form a stable base on which to rest your partly disassembled RR. I used lots of tape as a sort of scaffolding while I reassembled it. Also, note that if you take your RR apart too much, it will get very loose.

But, if you have an enquiring scientific mind, you'll probably be interested in the inner workings of the RR. So, twist the U face a little less than 45 degrees (around 35 degrees is good -- dust off that protractor!) so that one edge piece is sort of over the side (ie not seen when the cube is correct) of the upper edge piece on the second layer of the cube. You should be able to prise this piece out with your fingers. Apply pressure **slowly** between the first and second layers of the cube, and the piece should pop out without too much difficulty (RR's are generally looser than regular cubes). The rest of the pieces will come out easily.

Putting it back together already?

1. Make sure you know which colours go on which face relative to each other.
2. Find the four centre pieces for one colour. Slot these together. You have to put them in one at a time, and slide them down their track while you insert the next one. Position them all together, at the centre. Get some tape (masking tape is good) and stick them together.
3. Do this for two other adjacent centres (ie three centres whose colours share a corner piece). Use lots of tape; it's easier than growing extra fingers.
4. Now insert the common edge pieces to two of these centres. It shouldn't be a problem since everything is so loose. Use more tape.
5. Place the common corner piece in place, then the remaining edge pieces. You should now be done a 3 x 3 x 3 part of the RR.
6. The hard part is over, now just place the remaining pieces into place, first completing the centres (use more tape!), and then the corners, and then the edge pieces.
7. For the last two edge pieces, don't forgot to push them into place gently.
8. Remove tape :-)

Miscellaneous

I haven't really tried to beat the clock when solving the RR. Since my method is far from perfect, it gets messed up a lot, which is not conducive to time trials. It generally takes me about 5 minutes if it works out right first time. I don't know what the world record is for the RR, I would imagine under a minute is possible.

Many thanks go to Wei-Hwa Huang for giving me the corner-swapping move in Step 5, and to Walter Smith for giving me the edge-pair flipping move, so that my solution is now fairly complete.

If you want to buy a Rubik's Revenge online, try Hessport's Rubik Shop. Price as of May 2003 was $21.89 U.S. plus shipping.

Searching on Ebay for Rubik's Revenge may well find a few matches.

If you are looking for a book on the Rubik's Revenge, try "Mastering Rubik's Revenge", by Michael Reid. It is a Wallby Book, published by Simon & Schuster, 1230 Ave of the Americans, New York, NY 10020, ISBN: 0-671-45952-4. (Thanks to Jeffrey Stephenson for the info.)

Feedback

Feedback of any kind can be directed to `mark [at] jeays [dot] net`. I do have a Rubik's Revenge now (I bought one from Hessport's Rubik Shop) so feel free to email me.

Home

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