# Solving the Rubik's Cube

**as described by Neil Pomerleau on Rubikonline.i8.com**

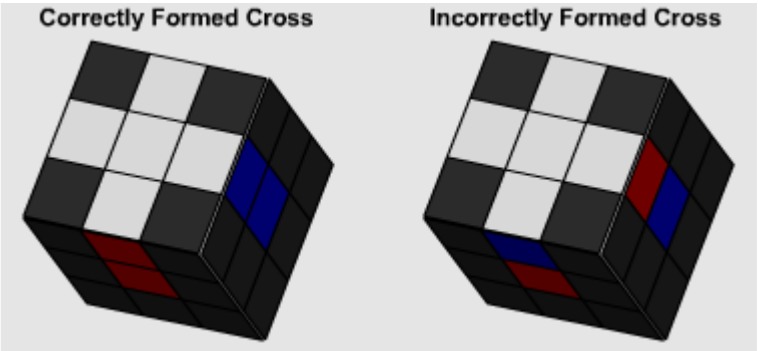
## Step 1- The First Layer Cross

First of all, if you haven't read the reference pages at the end, you should do that now. If not, you will probably get confused and end up needing to read it anyway, so don't challenge yourself to try without reading. It may take a while to read, but it's well worth it.

In this step, we will solve a cross on the first (top) layer. I prefer to start with the white layer because white is easier to quickly find on a completely scrambled cube. However, you can use any color. To solve the first layer, we will use two steps: solve the cross (solve the first layer edges), and solve the first layer corners.

The first layer should be done almost subliminally (without any intense thought). You need to understand it and solve it without learning algorithms. Until you can do this, I wouldn't even try attempting to solve the rest of the cube. Just spend some time with the cube, and familiarizing yourself with how to move the pieces around the cube. If you are having trouble with this, here are some tips to get you started.

As described in the "Cube Structure", we need to solve the edges like below.

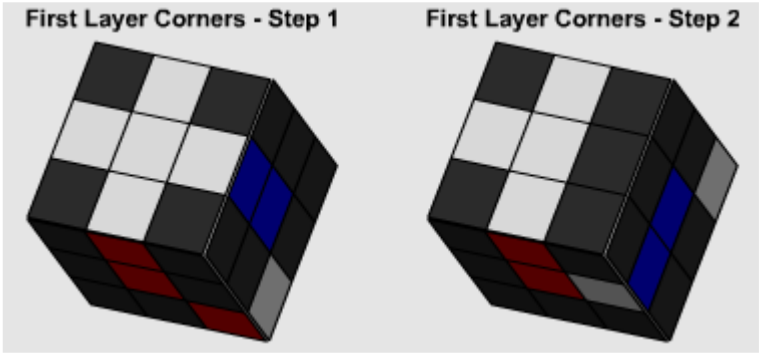



Note: Gray color indicates irrelevant squares... so just ignore those spaces for now. Also, your cube may have different colors in different positions, but just make sure that your actions on the cube follow what I tell you to do. In the future, the same note applies to the flash cubes.

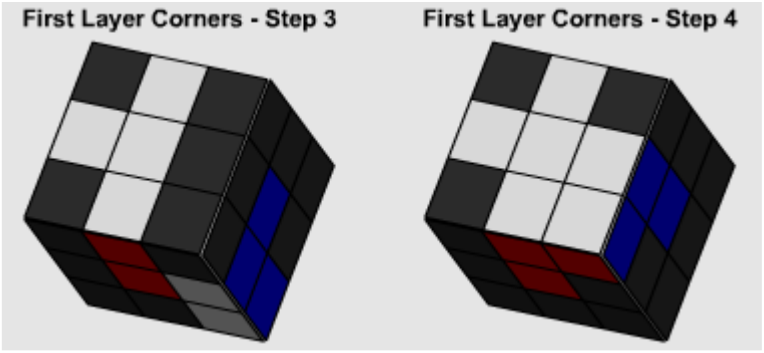
This is just one of those steps where it's impossible to fully explain how to do it. It's like trying to tell someone how to ride a bike. Just play with the cube, and you'll get it eventually.

## Step 2- The First Layer Corners

Once again, these first two steps should be done intuitively. Just use a little logic, it doesn't take that much to solve the first layer. You may not think so at first, but a little practice should work just fine. Here is an example of how to solve one of the corners in a certain situation. Each corner should be inserted, or put into position, individually.




Turn the R (blue) face counter-clockwise. Then turn the B (yellow/ bottom) face counter-clockwise.

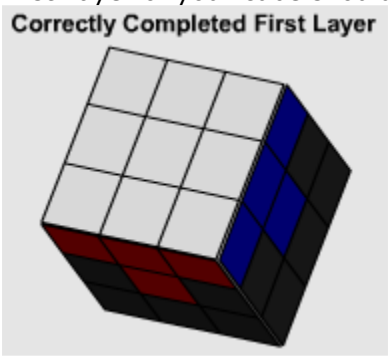



Finally, turn the R (blue) face clockwise. You cube should look like the Step 4 one above.

Here are some additional tips for solving the first layer corners:

- Start with a First Layer corner that is already in the bottom layer.
- If there are more than one First Layer corners in the bottom layer (which is usually the case), start with one that does not have the white part of the corner on the D (white/ bottom) face.
- When working with a First Layer corner that is in the First Layer in the wrong position, you need to get it out of the First Layer into the Last (bottom) Layer, reinsert it into the right First Layer corner position. Follow the example above in most cases.

When this step is completed, the First Layer of your cube should look like this...

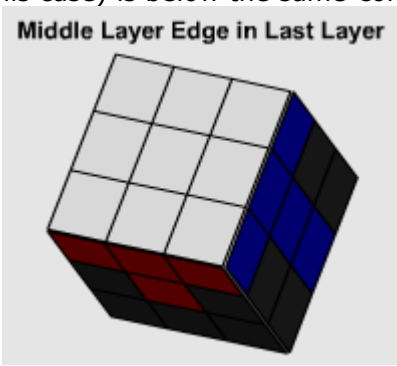


## Step 3- The Middle Layer Edges

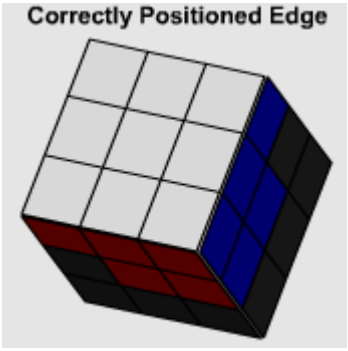
Here is where things should get somewhat easier than the previous steps, because I can be more specific on what to do. Take a look at the Middle Layer. Since the centers are already "solved" (they always are) and since there are no corners in the Middle Layer, then all we have in this layer to solve are the edges.

Just like the First Layer Corners, we are going to insert each piece (in this case, edge) individually. You only need to learn one algorithm (along with a very similar "mirror algorithm") for the Second Layer. There are some faster, more complicated ways to insert the Middle Layer edges, but this one is the easiest to understand.

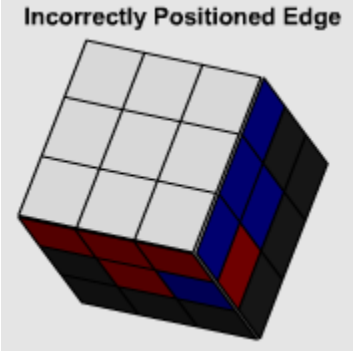
First, locate a Middle Layer edge that is already in the last layer. I'm going to use the blue-red edge for this example. Now, position the blue-red edge piece so that the color of the edge that's on the side of the cube (blue in this case) is below the same-colored center.




Now, you need to perform the following algorithm: **D L D' L' D' F' D F**.
If the blue-red edge piece was flipped the other way so that the blue side of the edge was on the bottom instead of the red, you need position the red side of the edge under the red center. Then, perform the following algorithm: **D' F' D F D L D' L'**. After the required steps are done, your cube should look like the flash cube below.

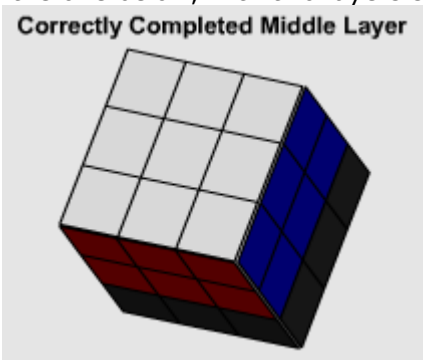



Sometimes, the edge isn't in the Last Layer, and it's in the incorrect spot. Here is an example.



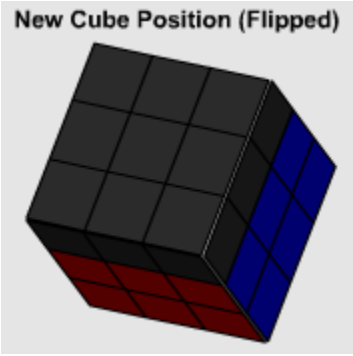

To get the edge into the Last Layer, simply use either of the algorithms used above on this page, then continue by follow the instructions where they apply for the current state of you cube after you perform the algorithm.

Now, perform all of these steps to every edge in the Middle Layer individually. When this step is done, your cube should look like the one below, with two layers solved.

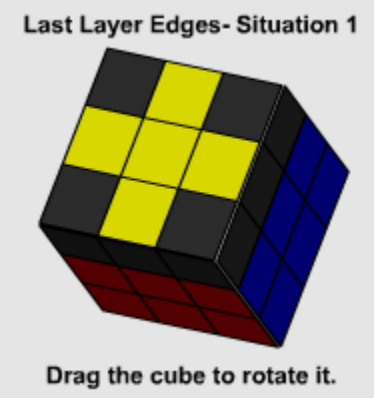



## Step 4- The Last Layer Edge Orientation

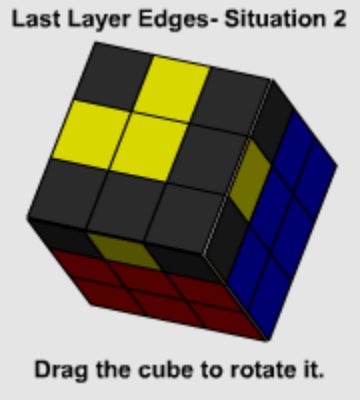
This is the first of 4 steps to solve the Last Layer. In this step, we only going to orientate the edges so that they are all in the correct orientation. As of now, it doesn't matter if the Last Layer edges are in the correct position. First, flip your cube upside-down so that it looks like the one below. This is the way we will hold the cube for the rest of the steps.




Now examine the cube. If the previous steps have been performed correctly, your cube will be in one of the following positions. Follow the corresponding steps for the matching cube.




You should be very happy to find out that you can completely skip this step! Your cube is already ready for Step 5.




Perform the following algorithm:
**F U R U' R' F'**


Perform the following algorithm:
**F R U R' U' F'**


Perform either of the above algorithms. Then re-examine the cube and find the correct situation above. Then perform the correct algorithm.

When this step is done, your cube should look like the Situation 1 cube.

## Step 5- The Last Layer Corner Positioning

This is the next step for Last Layer. We will do something different than what we did to the edges. We're going to position the corners in the correct position, regardless of their correct orientation. This step is simple enough to be done with any assistance of flash graphics.

To understand this step, you need to realize that for the corners to be in the correct position, certain rules must apply. Look at the corner. Ignore the color on that corner that is the same color of the center of the Last Layer (yellow or blue in most cases). Notice the other two colors. When the corner is in the correct position, the corner with two colors (red and blue for example) would be adjacent to the red and blue centers.

Now, follow the correct steps for the corresponding situation. You may need to rotate the Last Layer a little bit to have it match one of the situations

**Situation 1-** The corners are all in the correct positions.
This step is already completed. You can go on to Step 6.

**Situation 2-** Two adjacent corners need to be switched.
This is the most likely and easiest situation. Put the corners that need to be switched on the right side of the top of the cube. Then perform the following algorithm: **L U' R' U L' U' R U2**

**Situation 3-** Two diagonal corners need to be switched.
Perform the algorithm above, then re-examine your cube and follow the Situation 2 steps.

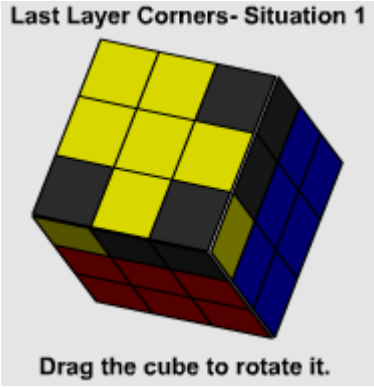
Now, all of your corners should be in the correct position

## Step 6- The Last Layer Corner Orientation

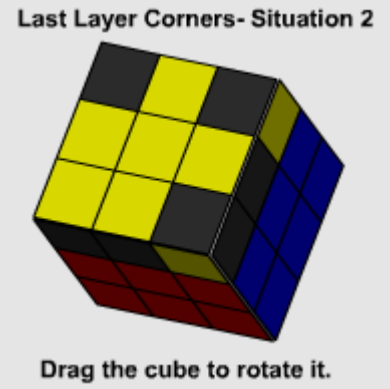
Now, we're almost done with the Last Layer, as well as the cube itself. For your information, your cube could become solved at any moment now, because there is a small possibility that some of the steps are already done. Just keep an eye on it.

This step should be done semi-intuitively, but with some specific and important steps. Your cube is currently in one of eight possible situations in regard to the Last Layer corners. One of those eight positions is where all of the Last Layer corners are completed, which can be easily identified by checking if the entire yellow "side" is completed. In that case, skip to the next and final step, Step 7.

There are seven other more likely situations. I have listed two below.




Perform the following algorithm: **R' U' R U' R' U2 R U2**




Perform the following algorithm: **R U R' U R U2 R' U2**

Notice that three corners are twisted counter-clockwise for the Situation 1 algorithm, while three corners are twisted clockwise for the Situation 2 algorithm. Any of the five other situations (I won't take the time to show you them) can be solved in one of four ways:

- By Performing the Situation 1 algorithm twice.
- By Performing the Situation 2 algorithm twice.
- By Performing the Situation 1 algorithm, then the Situation 2 algorithm.
- By Performing the Situation 2 algorithm, then the Situation 1 algorithm.

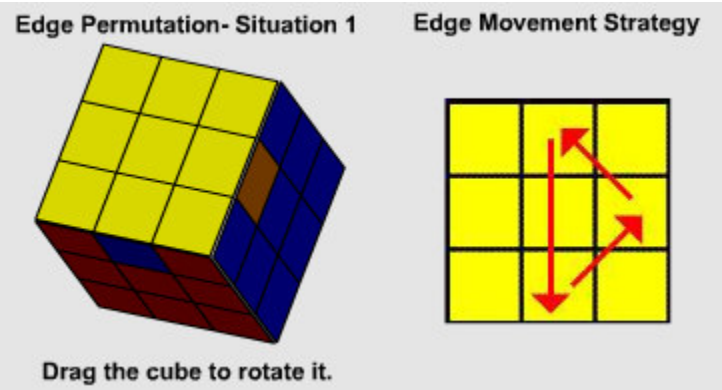
You will have to logically decide which way to solve the Last Layer corners. Don't worry, if you decide to do the wrong combination, nothing will happen to the work that you performed in the previous steps, unless you mess up the algorithm! This can be a learning experience, although there is only one step left.

## Step 7- The Last Layer Edge Positioning

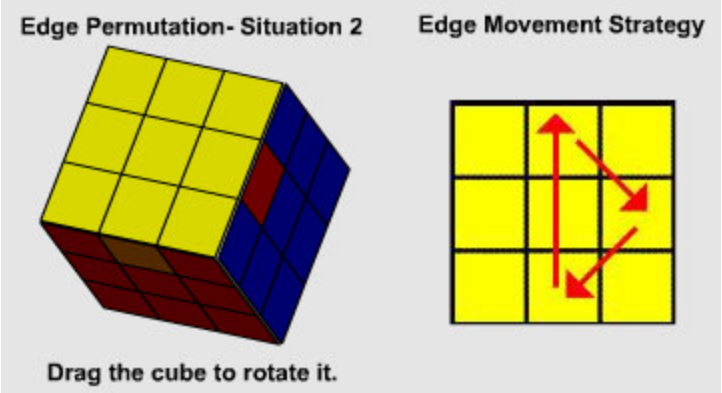
As well as this is the last step for solving the Last Layer, it is also obviously the last step for solving your cube! You should be very proud that you have made it this far, unless you have been skipping through the links and peeking at the steps ahead. In that case, shame on you! Just kidding.

Once again, your cube could already be solved. Now, there is a good (well, better) chance of that. In that case, stop now; there is no point in reaching for a goal that you've already met.

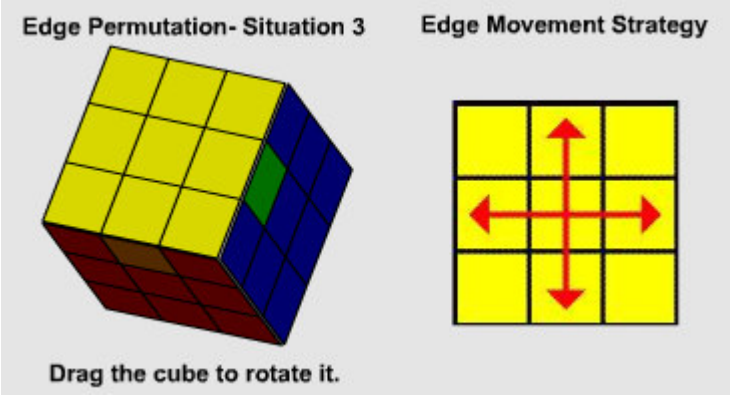
If not, your cube should look very close to solved now, which is a very exciting thing to someone who hasn't seen their cube solved for a long time, or ever. Your cube is in one of four possible situations. Next to each possible situation, I have a diagram of where we would want to move the edges for reference. Follow the steps to the corresponding cube.



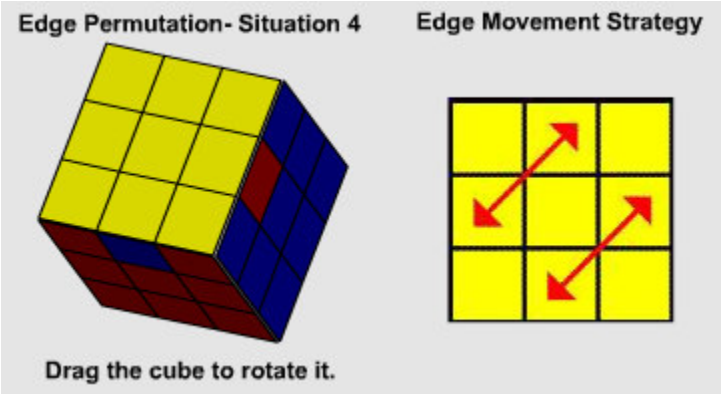

Perform the following algorithm: **R2 U' F B' R2 F' B U' R2**




Perform the following algorithm: **R2 U F B' R2 F' B U R2**
Note: The only difference between this algorithm and the Situation 1 algorithm is the U-turns. (As in the U face on the cube, not the one no the road!)




Perform either algorithm, re-examine your cube, and perform the corresponding steps.




Perform the same steps as Situation 3.

## What Else?

That's all there is to it! It seems intimidating, but with some practice and slow memorization, you should start getting somewhat fluent with you cube. If you want to go beyond this, here are some tips to learning how to solve the cube without this guide and with better times:

- Don't rush yourself into memorizing algorithms. Have someone mix up your cube, or if you're brave, mix it up yourself. Then use this guide to solve the cube. Eventually, you will be performing the algorithms by feel or sight, without even thinking of the letters. If you try and rush into learning the algorithms, you'll never actually be fluent with the cube, because you are just trying to remember letters.
- Don't worry about rushing to get the cube done. Sure people would be amazed if you could solve the cube faster than they can mess it up, but hey, I can't even solve it that fast, so don't be discouraged. The Rubik's cube freaks, excuse me, enthusiasts use specially made cubes at competitions that you can practically turn with just one finger. If you're concerned with time, just don't worry about it when you're solving the cube. You'll find out that you get better times when you just concentrate on solving the cube.
- Find shortcuts and other things that work for you. The reason that I was a little vague on some of the steps was so that you could find what works for you. Every cube-solver uses their own customized technique, so this is just a template for that.

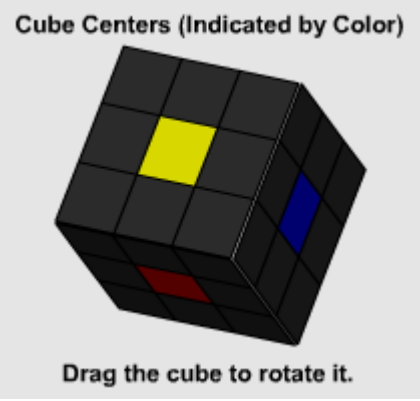
Happy cubing!

# Reference

## The Structure of the Cube

If you plan to solve a Rubik's Cube, then I assume that you already own one or are borrowing one from a friend. Also, if you have one, then you should already know how to use it. It's not difficult at all; just twist and turn the sides and layers. With this simple knowledge, you should now learn some of the more advanced information that will lead you to solving a cube.

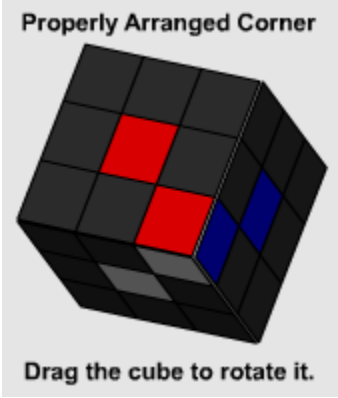
I am now going to try and arrange you thinking about how the cube works, in order to help you solve the cube. Think about the cube having 6 fixed centers that can rotate on their own axis. In other words, if you were to look at one side of the cube, the color in the center will always be in the same place on the cube; it can only rotate, but can't switch positions with other centers or pieces. It works like the North Star at night... all of the other stars appear to move around slowly, but the North Star only rotates on its own axis without moving its position.



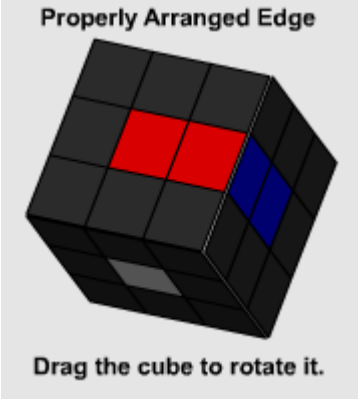

Now look at with 8 corners and 12 edges which rotate around it. Since the centers are in a fixed position (they don't move around the cube), the center color defines the color that the cube will have on that side when it is solved. It's important to remember this, since if you don't you could find yourself with all but the center color done on a side, and it would take forever to fix,

because all of the work you did to get the color on that side would be pointless.

Here's another thing about the corners and edges. If you don't know what I mean by corners and edges, see "New Vocab." Anyway, many people fail to see that the colors on a corner will always be the same way. In other words, let's say that you have a corner with blue on one part of it, white next to the blue, and red on the top of the corner. Physically, those stickers are on that corner in a certain way, and they will not change positions on that corner. The corner may rotate, but those colors are always going to be together. This means that the corners will go in the corner between the three fixed centers, so the Blue-White-Red described above would go in the corner that had blue, white, and red on the sides next to it. More specifically, when the corner is in the correct position, it must have the blue side of the corner adjacent (next to) to the blue center, and the same goes for the red and white sides of the corner.




The edges work very similarly to the corners. Those stickers are on the edge in a certain way, and the edges can only be flipped (switch positions); you can't change the colors on an edge. When the cube is solved, (let's have a Red-Blue edge) the edge will be between the red and blue centers, and the colors on the edge should be next to the corresponding centers.




This may seem very complicated, but if you take the time to look at the flash guides and try to understand what I am saying, it isn't that complicated at all. Feel free to e-mail me if you need any elaboration.

FYI- This is probably the hardest part of learning how to solve the Rubik's Cube, so from here, things should get easier.

# New Vocabulary and Terms

Here is a collection of words and terms that I will use when describing how to solve the cube.

***Face-*** What most people call a "side". Try to grow out of using the word "side," because other Rubik's Cube sites will probably use the word "face," and if they don't, they're probably not a good website to be learning from!

***Layer-*** This is very difficult to explain. When you turn a part on the cube, you are turning a layer. A layer consists of 9 cube pieces, and there are three layers in the cube, no matter which way you hold it. You will quickly learn that almost all cube solvers solve a cube by the layer... NOT BY THE SIDE! Trying to solve a Rubik's Cube by the side is completely pointless and a waist of time.

***Corner-*** A piece on the cube that is, well, a corner. It has three stickers on it.

***Edge-*** A piece that has two stickers on it.

***Center-*** A "piece" that has just one sticker on it. Self explanatory; it resides in the center of a face.

Here's something else that you'll notice I use when showing you how to solve a cube. Algorithm's. I might show you a code like RUR'URU2R'U2. First, break it down by the letters. You can look at the code like R U R' U R U2 R' U2. Each segment is a step. Prior to one of these steps algorithms, I will tell you which position you should start with by showing you a diagram like the one below.

The "face" that is on top (in this case, the one with a yellow center) would be the U (Upper) face, the bottom (white) face would be the D (down) face, the right (blue) face would be the R (right) face, the left (green) face would be the L (left) face, the front (red) face would be the F (front) face, and the back (orange) face would be the B (back) face. There was a long sentence. How about this simplified version:

| | | |
|---|---|---|
| **F**= Front | **B**= Back | **R**= Right |
| **L**= Left | **U**= Up | **D**= Down |

In addition, the letter alone means "turn (that face) one time clockwise (right)", the letter with an apostrophe after it means "turn (that face) one time counter-clockwise (left)", and the letter with a "2" after it means "turn (that face) two times in either direction (it doesn't matter which direction)."