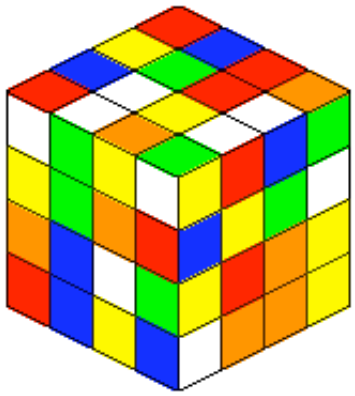
How to speedsolve the 4x4x4 cube

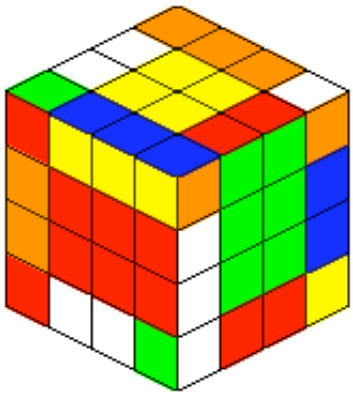
An advanced, optimized for speed approach to solving the 4x4x4

Step 1: Centers | **Step 2: Edges** | **Step 3: Fix parity**

Many thanks to Jon Morris for supplying the template for the 4x4 pictures used on this page

Turn this ... ... into this ...





in less than 40 seconds!

This page is meant as a tutorial for speedsolving the Rubik's Revenge (4x4x4) Cube in very fast times. Using this centers first method I am able to transform a scrambled 4x4x4 cube into a scrambled 3x3x3 cube, with the potential for parities (we'll get there) in 40 seconds or less. Your 4x4x4 times will depend very largely on your 3x3x3 times, but you might as well transform the cube into a 3x3x3 with a very efficient method, even if your 3x3x3 step needs work. Below is an example average I took of how long it takes to solve a scrambled cube into a 3x3x3, with the potential for parity errors.

36.82 38.34 39.88 42.86 42.29 (45.20) (33.43) 39.99 36.80 37.62 35.23 39.26 = 38.91

This tutorial is broken into three sections, 1) solving the centers of a scrambled 4x4x4, 2) Solving the edges after having solved the centers, and 3) fixing the parity errors that can occur in the 3x3x3 step.

For the third step, solving as a 3x3x3 cube, I will only provide parity fix algorithms, you are to supply your regular 3x3x3 solution. This tutorial is meant for you to be able to fully solve a 4x4x4 in fast times, but I will not give any 3x3x3 solving tips. Those you can find on other sites. The goal of this tutorial is to get you to be able to transform the scrambled 4x4 into a 3x3 with potentially either or both parity problems in 40 seconds or less.

NOTE This solution is optimized to give you fast times, whereas my beginner/intermediate solution is geared towards ease of learning the solution. If you are more interested in learning how to solve the 4x4x4 than in learning how to speed solve it then check out my other solution.

Step 1 Step 2 Step 3

Solving centers Solving edges Fixing the 3x3x3 parities

Step 1: Centers | **Step 2: Edges** | **Step 3: Fix parity**

Go back

Solving the Centers

Step 1: Centers | **Step 2: Edges** | **Step 3: Fix parity**
Know your color scheme | Example centers solve | Last two centers cases

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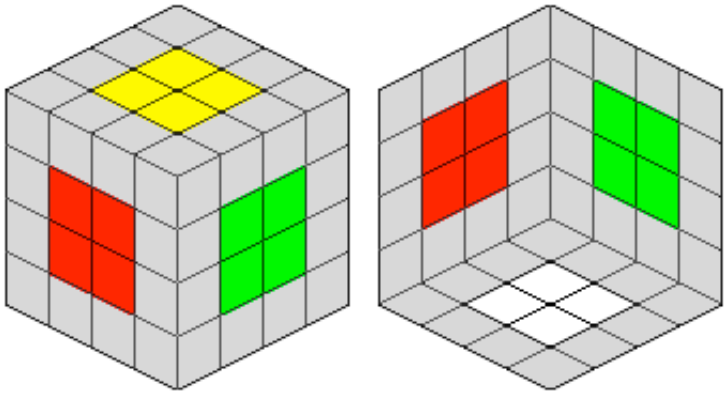
The first thing I need to say is that this is only one method of speedsolving the centers. To be honest I don't consider myself one of the fastest centers solvers, though I think my method could be very fast with lots of practice. If you want a really fast centers method then ask around and talk to Stefan Pochmann, Frank Morris, Ron van Bruchem, Yuki Hayashi, and others.

Ok so now that the disclaimer is over, here is exactly how I solve the centers of a 4x4x4.

Know your color scheme!

Ok so you want to know how to speed solve the 4x4x4. Well, you probably don't want to hear this but the very first thing you have to do is to completely and thoroughly memorize your color scheme. I don't just mean learn your opposite colors either, I mean given any two adjacent faces you had better know where the other colors are almost instantly. Below is a little system I use to memorize the colors of the cube.

1) Pick four adjacent colors like the setup below. The colors will be on the faces U,F,R, and D.



Top View Bottom View

These four centers, and knowledge of which colors are on opposite sides, are all you need to completely memorize your color scheme. When solving the centers the first thing you will do is solve two opposite centers. After that step you will solve two adjacent centers, and this is why you need to have your color scheme memorized. You will also be color neutral, meaning you have to solve the best setup pair of opposite centers in the beginning, so here is the method I use to know which centers are where, **no matter which centers I have solved first**.

The key to this step is to know the order the four middle layer centers are in after having solved any pair of opposite colored centers. Now you may think that you need to learn six groups of four colors in order. Say if orange is on top you would memorize green-white-blue-yellow as the counterclockwise order around the U face, and if red was on top you would have to know white-green-yellow-blue. However this isn't necessary.

If you solve the red-orange center pair first then always rotate the cube so either red or orange is the top face, just make sure it is always the same one.

So in each pair of opposite colored centers you have one "priority" face, and that is the one that always gets rotated to become the U face center after solving the first two. Now you only need to memorize three groups of 4 middle layer center orders.

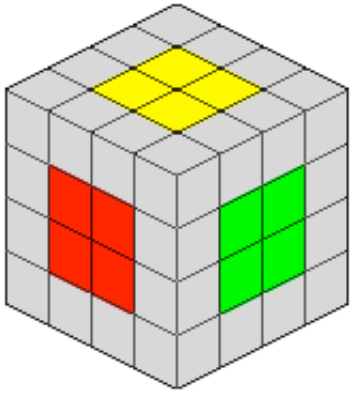
My opposite colored centers and the priority faces are as below,

Opposite color pair	Priority face
red - orange	red
yellow - white	yellow
green - blue	green

Notice that the three visible center groups in the "Top View" picture above are all my priority faces (yellow, red, green). It is very important when picking your priority faces that they are all mutually adjacent to eachother. Ok now here is how the method works. I will show you based on each pair of opposite centers.

Solving the yellow-white pair first

Remember that our priority faces look like this,

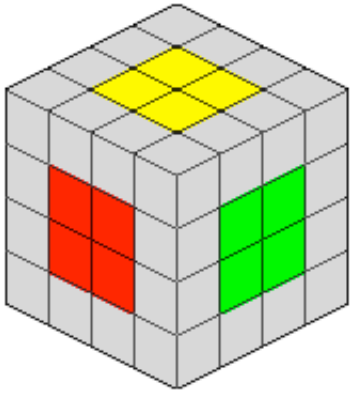


So if I have solved the yellow-white center pair first, the very first thing I do is rotate the cube so that the yellow center is on the **U** face. Now the order of the faces in the middle layer will be (counter-cockwise around the U face) red-green-orange-blue. Remember that this is a cycle of faces, so the order is also green-orange-blue-red, orange-blue-red-green, and blue-red-green-orange. This is very important to remember. This is because when solving the second pair of centers you must **always solve the best setup adjacent pair of centers**. So if you see lots of orange and blue centers together, you have to know that the order of orange and blue is orange-blue (going counterclockwise as seen from the U face). If you memorize your cycle as red-green-orange-blue you will be tempted to always solved red and green, since they are the first two colors in your memorized word string. So it is best when thinking of the order to think like this, red-green-orange-blue-red-green-orange-blue-red-green-orange-blue-red-green-orange-blue-red. That way you

see all the adjacent pairs. Ok so that takes care of solving yellow-white first.

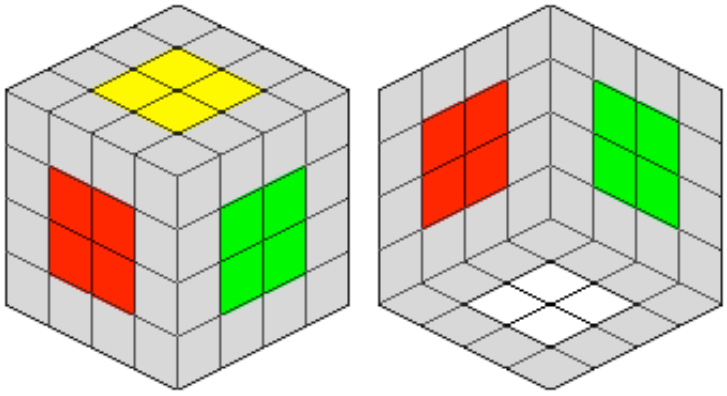
Solving the red-orange pair first

Ok so remember that our priority faces look like this,



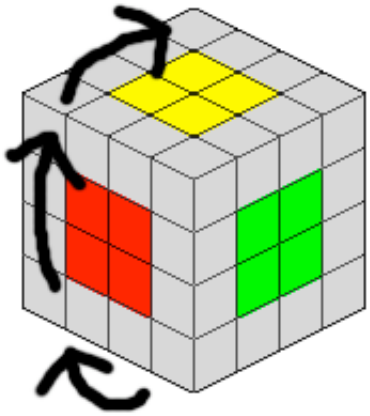
Now it isn't immediately obvious what the order of the middle layer centers is, so do this. Rotate your mental cube (the one with only 4 center groups on it) such that the red face becomes the U face and the white center on bottom **replaces the spot where red used to be**.

Before rotating



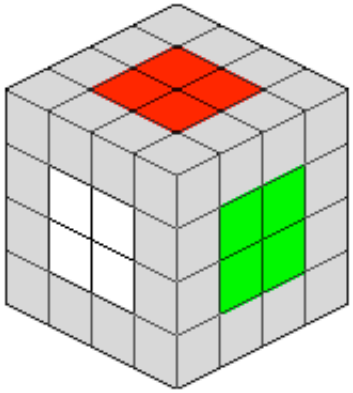
Top View Bottom View

How to rotate



Top View

After rotating

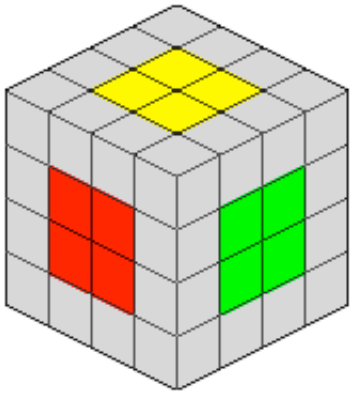


Top View

So now, using your opposite colors knowledge, the order of the middle layer colors (counter-clockwise around the U face) will be white-green-yellow-blue.

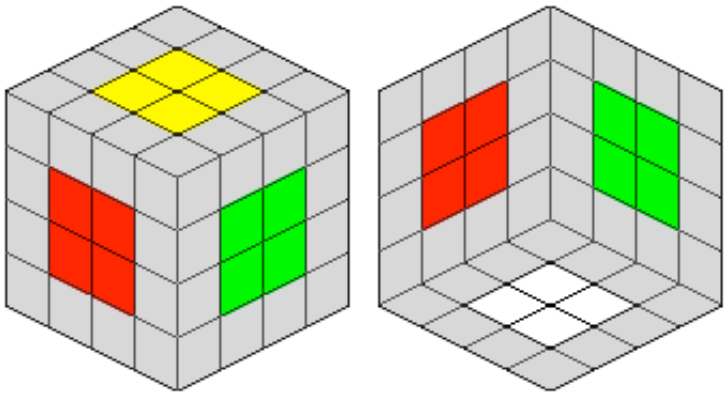
Solving the green-blue pair first

Ok so remember that our priority faces look like this,



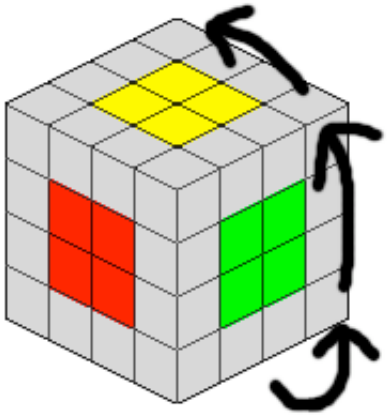
Now it still isn't immediately obvious what the order of the middle layer centers is, so do this. Rotate your mental cube (the one with only 4 center groups on it) such that the green face becomes the U face and the white center on bottom **replaces the spot where green used to be**.

Before rotating



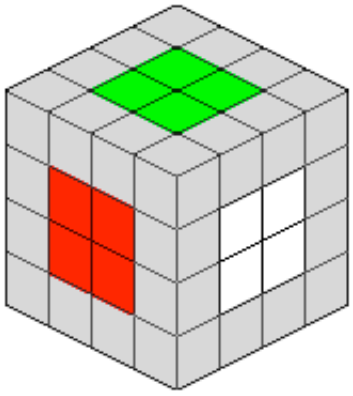
Top View Bottom View

How to rotate



Top View

After rotating



Top View

So now, using your opposite colors knowledge, the order of the middle layer colors (counter-clockwise around the U face) will be red-white-orage-yellow.

Move on to an example centers solve

Step 1: Centers | **Step 2: Edges** | **Step 3: Fix parity**
Know your color scheme | Example centers solve | Last two centers cases
Go back

Solving the Centers

Step 1: Centers | **Step 2: Edges** | **Step 3: Fix parity**
Know your color scheme | Example centers solve | Last two centers cases

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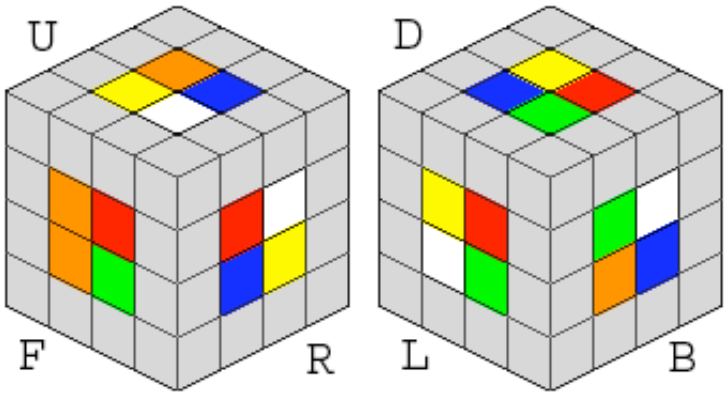
Ok so now you know your color scheme thoroughly. Now we are going to solve the centers. I'm going to do this via an example solve, only I will block out all non center pieces.

If you would like to follow along on your own cube the scramble I will use is **b F l L u2 B U' F2 R B F' l2 D2 l2 B L B' d2 b r l2 f u' f' R D' B u2 B' R' u F2 b2 U2 F2 f' R' D r d**. If you have my same color scheme then scramble with yellow on top and green on front.

So take this cube,



Top View Bottom View

Being color neutral

Step 1) Look for 2x1 rows of like-colored center pieces

Notice that the only 2x1 row we have is an orange 2x1 piece on the front face made up of two centers. Because there are no other 2x1 rows this makes me think I will likely solve orange-red first.

Step 2) Having decided a likely center group, see if there is anything nice for the other centers

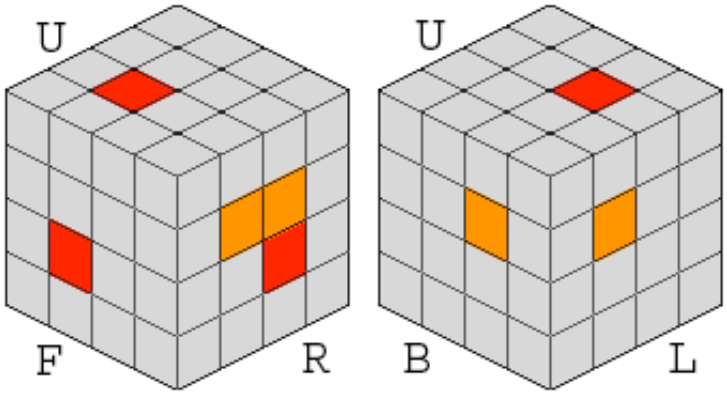
There doesn't appear to be anything nice for yellow-white or green-blue, so we will solve red-orange.

Solving two opposite centers simultaneously

I've heard a lot of really fast big cube solvers say that they solve one center, then after it's solved they solve it's opposite. For some reason I've never been able to do that quickly, so here is my method for solving two opposite centers simultaneously.

The first thing you need to do in order to solve two centers simultaneously is to form a 2x1 row of centers of each opposite color. So our first goal will be to form a 2x1 red group and a 2x1 orange group. The second step is to get those groups onto opposite faces, and we may be able to do both steps at the same time.

Ok so what I am going to do for this solve is to form a red 2x1 and an orange 2x1 while preserving the current orange 2x1 we already have.

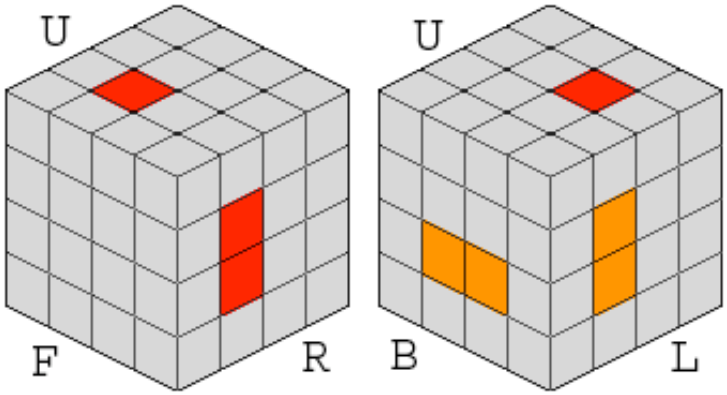


Front View Back View

If you're following along on your own cube do the rotation **z y'** after the scramble. If you're not following along on a cube just watch the images, I'll try to show each step.

Look at the front view picture above, notice that either **R2 d** or **F2 u'** will form a red 2x1. Also notice that **B2 d** or **L2 u'** will form an orange 2x1 as well. Notice that we can do both if we just do the setup moves so that both 2x1 pieces require either a d or u move to solve. Generally I prefer to do d moves so we'll do that.

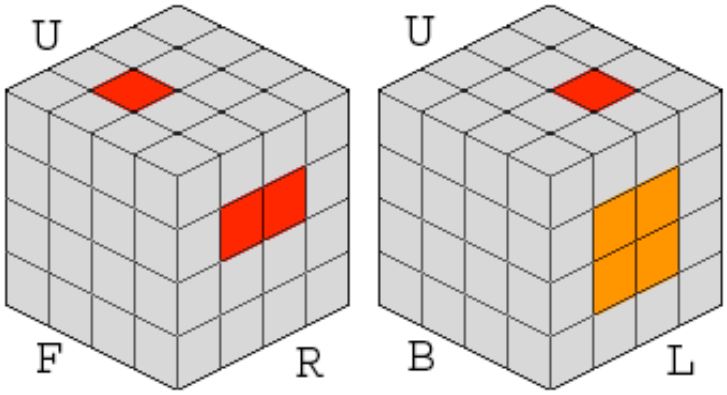
Ok so on your cube do **R2 B2 (Dd)**. Always do d and u turns when solving the centers as either (Dd) or (Uu), it helps you to do the moves quicker. Notice that we now have three 2x1's: two orange 2x1's and one red.



Front View Back View

Now that we have a 2x1 row of red and orange on opposite faces, we want to get them into the same layer, and since we have a third row (the 2nd orange row) we want to go ahead and solve orange. So from here, if

you're following on your cube, do **R L (Dd)**.



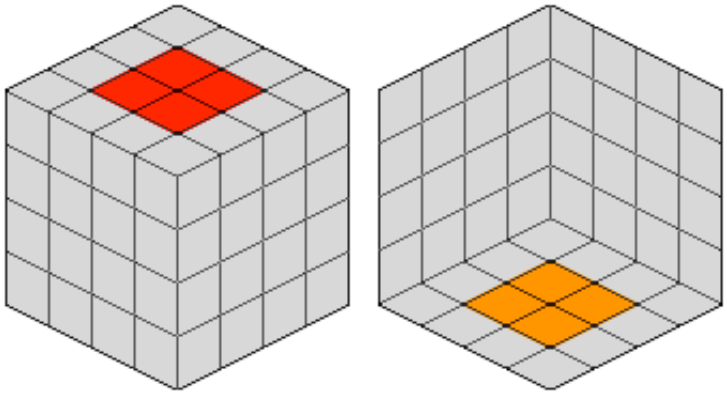
Front View Back View

Now the reason we wanted to go ahead and solve orange before red is because the other two red pieces are in the **U** and **D** layers, which is a position you generally want to try to avoid but we did get three rows in 3 moves so this solve will just sort of balance out.

What we are going to do is use the now solved orange face to bring those reds together then put them on the right face.

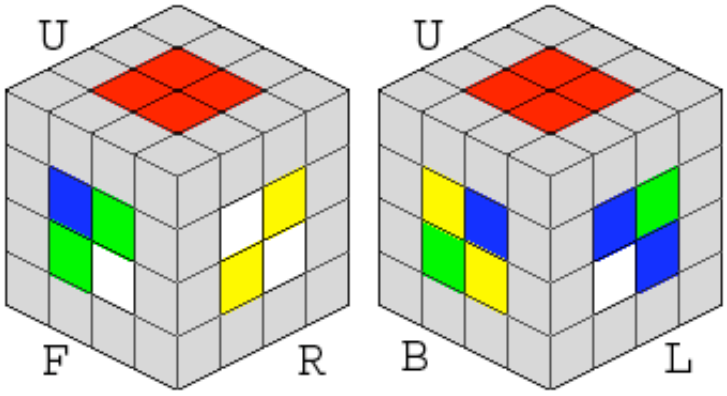
To bring the reds together do **U2 (Ll)2**, and then to place them on the right face do **R (Bb)' R2 (Bb)**. Lastly, and this is important rotate your **priority face** to the U layer. My priority face among red-orange is red, so I would rotate **z'** now to get the red center into the U layer.

Now the first two opposite centers are done.



Top View Bottom View

Now that the first two centers are done let's put the other center colors back in for this next step.



Front View Back View

Now looking at the middle layer we have here, it seems pretty bad. First off we don't have a single 2x1 row to start with. Also remember that we have to solve two adjacent colors, and we have a really nice setup for solving green-blue or white-yellow, but both of those are opposite pairs and you **never want to solve opposite pairs** in this step.

As bad as this looks it actually isn't that bad. We are actually sort of nicely setup to solve green and white.

Ok now let's test how well you have your color scheme memorized (if your color scheme is different, but you have been following along then try to see which two colors green and white for me would correspond to on your cube. If you have the same color scheme as me, remember that the color order (counter-clockwise around U) if red-orange is solved and red, my priority color, is on top is white-green-yellow-blue. Now green and white are the best setup adjacent colors, so they are in the order white-green.

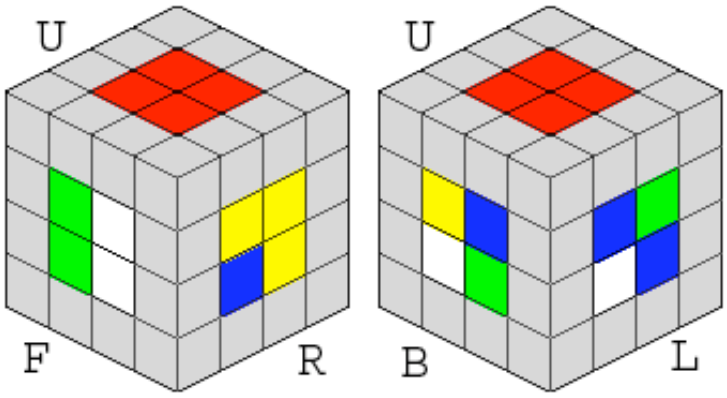
Ok let's get started. Now when solving the second set of centers you have to also pay attention to the other ones too. If you pair up some stuff for one of the other two centers, make sure to try to save it.

The strategy for this step is very specific. Those two centers all together make four 2x1 rows. You are going to use the **d** layer to put these rows together and put solved rows into the **u** layer. You will separate the rows like this on **all four faces**, and after that you will solve both centers simultanesouly again.

I'm going to leave all the remaining centers in view now, though focus on green and white, since you will always pay attention to all four center colors during this step.

OK so the centers are all scrambled up, and the first thing we need to do is to make some green and white rows. So do **(Dd)' F'** now we want to finish with **(Dd)** to form a white and a green row on **F** facve, but notice that we have a white and a green paired piece on the R face. So do **R'** to preserve that, then do **(Dd)**. So the whole move is **(Dd)' F' R' (Dd)**.

Here's what we have now,

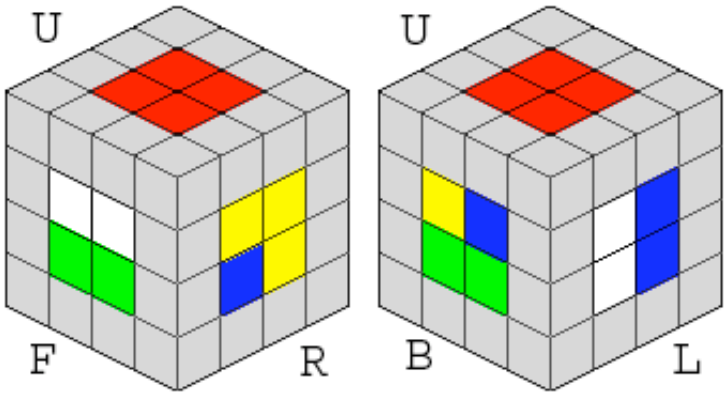


Front View Back View

Ok so from here a **(Dd)** turn will form a green pair on the **L** face. However, we need to preserve our two pairs on the **F** face too. Notice that the (Dd) turn will kick a white center piece from the **L** face onto the **F** face, so we need to keep the white center pieces on **F**.

So from here do **F' (Dd)**. Now we have three 2x1 rows, two green and one white. We can form the last white and preserve everything by doing **L (Dd)'**. So the whole move is **F' (Dd) L (Dd)'**.

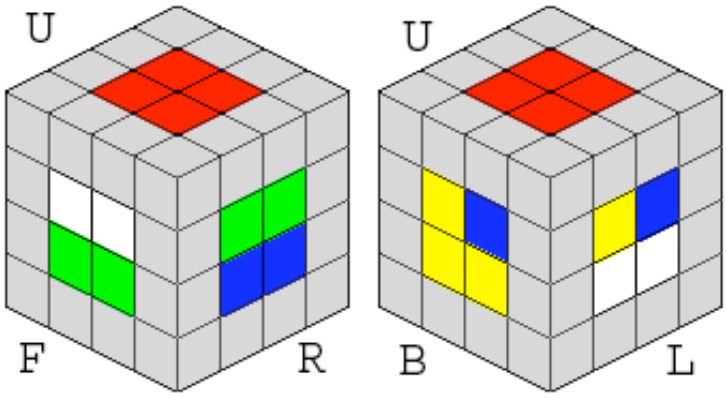
And now we have all four rows built.



Front View Back View

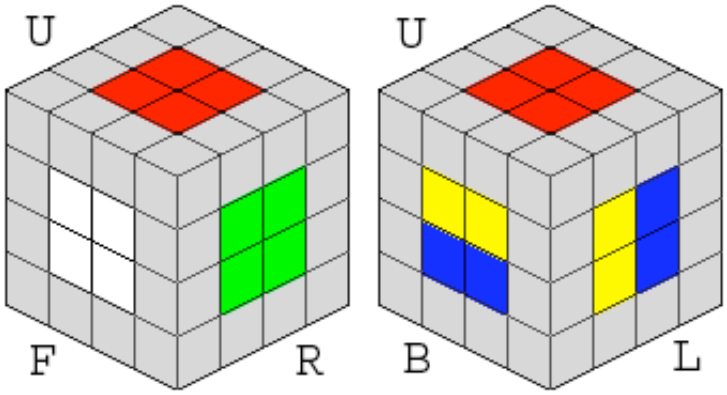
This solve is actually somewhat of a special case. Normally you try to build one row at a time and put it tucked away in the **u** layer somewhere. Here we actually had some nice setups to form rows quickly and still preserve the already solved stuff. This happens fairly often, so be aware when it does.

All that remains is to solve the rows such that we put white on the left of green. To do this do **L (Dd) R2 (Dd) L2** now we want to finish by doing a (Dd) move, but notice that we can form rows out of the blue and yellow pieces if we first do a **B** turn at this point. This concept is so important that I'll make a diagram for this point in the step.



Front View Back View

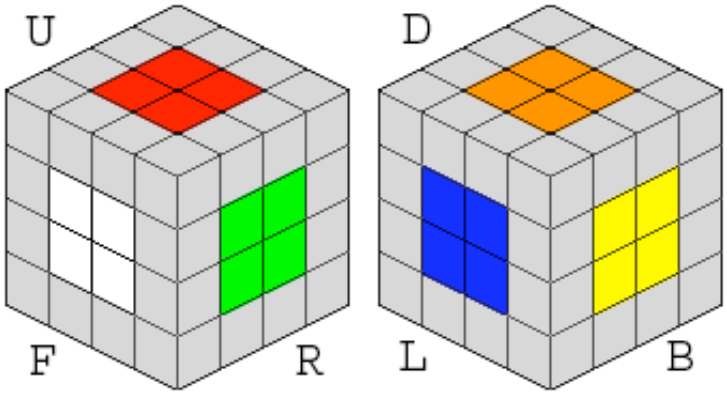
Notice that **(Dd)** will solve white and green, but it will leave a "dot" pattern of blue and yellow on the **L** and **B** faces. The first thing you do in this pattern is to do some moves to form 2x1 blocks. Well notice that if we do **B** right here, then do **(Dd)** we will form those 2x1 blocks already. So from here do **B (Dd)**. And now the first adjacent centers are solved, and at the same time we've already formed four 2x1 rows for the last two centers.



Front View Back View

Now that we planned ahead a little bit for the last two centers, this finish will be easy. To solve the last centers just follow your opposite colors, or continue the cycle of colors in your head. You can either say that white is on front so yellow has to be on back, or you could think that your cycle is white-green-yellow-blue, so yellow has to be adjacent to green. Whichever works best. To finish I would do **L (Dd) L2 (Dd)'**.

And now the centers are solved.



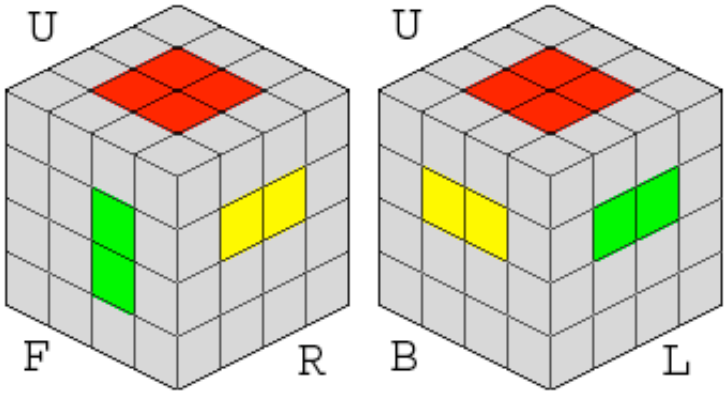
Front View Back View

Our whole solve took 31 moves, which actually is on the higher end for my approach. Generally you can get under 30 moves, and a good solve will be in the low twenties. So to give you an idea for using this particular centers approach (solving centers simultaneously) 31 moves is actually a little bit on the higher end. Again if you want a really fast centers method e-mail the people at the top of the 4x4 averages list. This is my method and the one I'm sticking to, but know that there are faster centers solvers than me out there. Ok now that you have an idea of how a centers solve goes, there's one more thing you have to do in order to speed solve the centers quickly. You have to memorize all the possible cases for the last two adjacent centers.

All the cases for the last two adjacent centers

Appendix

I mentioned above that our solve was somewhat of a special case in the way we paired the 3rd and 4th centers. Typically my centers solves put the 3rd and 4th centers together as below,



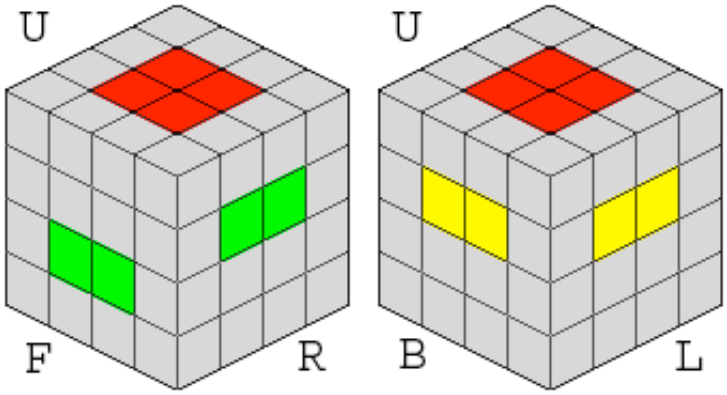
Front View Back View

Remember if red-orange is solved and the priority color red is on U, then the order of the middle layer is white-green-yellow-blue. So the green has to go to the left of the yellow.

Now what I was doing on this solve was to form a row on each face, then turn that face such that the row is

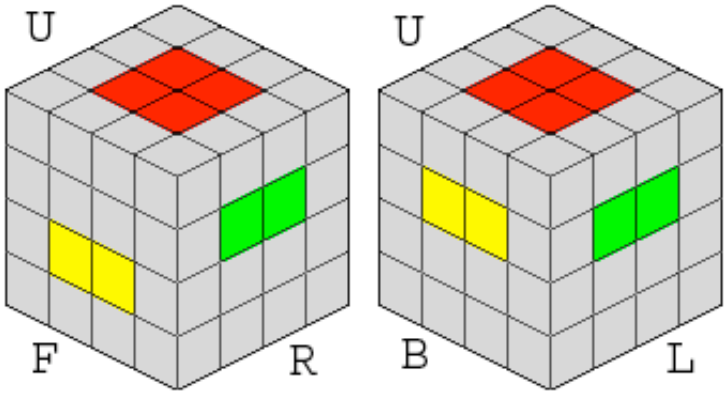
tucked away in the **u** layer. I then used the **d** layer to line up 2x1 rows on other faces. On the **F** face you can see a row that I've just completed. Ok now here's the trick, are the rows in **F and R** correctly placed or the ones in **B and L**? Remember the green is to the left of yellow so the ones in **F and R** are the "correct" rows. Ok so to finish here do **F' L2 (Dd)2 B2 (Dd)'**.

If you've done some thought then you've realized that there are only two cases the four rows placed like this can be in. Below I list both cases.



Front View Back View

From here do **(Dd)2 L2 (Dd)'**



Front View Back View

From here do **L2 (Dd)2**

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Solving the Edges

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Intro | 2 pair chain solving | Other pairing methods

The most important step

First off you should know that, in my opinion, the edges step is the most important step in transforming a scrambled 4x4x4 into a scrambled 3x3x3. This step takes the most time when compared to the centers. You will find, however, that solving edges will be similar to learning F2L for you Fridrich solvers, or solving the 2x2x2 and expanding to the 2x2x3 for you Petrus solvers. When solving edges you will be required to make lots of small decisions and do some very fast thinking, the same as the intuitive steps I just mentioned. So bear in mind that this step will take a great deal more practice than the centers in order to get fast. Don't be discouraged by this, just bear in mind that this step is **very** important in the course of a solve, so it needs a lot of work to be made fast.

There are multiple methods for solving edges

You also need to know that there are lots of different methods for solving the edges of a 4x4x4, and I am going to try to list all of the ones that I know. However, you need to realize that I personally have one method that I prefer over all others, and I will advocate that method over all others on this page. I will give reasons and examples of why I prefer the method I do, but it is up to you to decide which method you want to use. Just bear in mind that these pages will consist of me teaching the edges method I use, but I will also be fair and show all the other edge pairing methods that I know.

For reasons that I will discuss much more in depth as you read on, I greatly prefer what I'm going to call the 2 pair chain solving method to any other edge method. I do, however, use bits and pieces of other methods for certain very special cases. Basically I don't think anyone should learn just one method and stick to it, it is much better to be a very well rounded cuber and know lots of methods so you can use the best of each one. I would say that I do about 90%-95% 2 pair solving and 5%-10% bits and pieces from other methods as special cases to speed up my solve.

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6 pair solving vs. 2 pair solving

Here I want to address the issue of 6 pair vs. 2 pair solving. Basically 6 pair solving means you use a technique that places, as a goal, 6 pairs together at a time. Now this isn't always possible and sometimes you can only place together 5 pairs. However if luck is on your side you can place up to 7 or 8 together just by doing the 6 pair strategy. 2 pair solving is exactly that, you always solve two pairs at a time. Both methods have pros and cons, and to be honest nobody really knows if one method is faster than another, at least as far as I know. I actually use a combination of the 6 pair idea and the 2 pair idea, as I think it is better to combine methods than to just do one blindly. So on this page I'll list all the edge solving methods that I know, and you can choose how you want to combine them.

So if you're ready to get started choose the method you're most interested in. The way I solve edges is to use what I'm going to call 2 pair "chain" solving about 90%-95% of the time and bits and pieces of the 6 pair idea the rest of the time. Again please realize that some people use the 6 pair method 90% of the time and the 2 pair method the rest of the time, so my way isn't the only way. If you are interested in my method of solving edges please read the 2 pair "chain" solving page. If you are interested in the 6 pair method, I will be fair and provide a full example solve on that as well on the "other methods" page.

2 pair chain solving	Other edge methods
The method I use over 90% of the time	Includes the 6 pair method and others

Step 1: Centers | Step 2: Edges | Step 3: Fix parity
Intro | 2 pair chain solving | Other pairing methods

Go back

Solving the Edges

Step 1: Centers | **Step 2: Edges** | Step 3: Fix parity
Intro | 2 pair chain solving | Other pairing methods

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2 pair "chain" solving

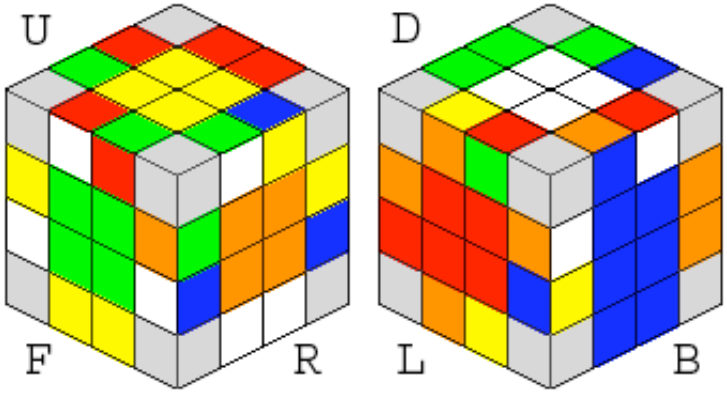
This is the method that I would use about 90% of the time. In reality I use a combination of this idea and the 6 pair solving idea. I will provide examples of when in the appendix at the bottom of this page. Below I will continue our example centers solve using this edge method.

If you have just come from the centers page your cube is already correct, skip to the edges stuff below.

If you have the same color scheme as I do then scramble with yellow on top and green on front. To get to this scramble from a solved cube do:

b F (Ll) u2 B U' F2 R B F' l2 D2 l2 B L B' d2 b r l2 f u' f ' R D' B u2 B' R' u F2 b2 U2 (Ff)' F' R' D r d F2 U2 (Rr) F B (Rr) L2 (Bb)2 F (Uu)' F2 (Uu) (Bb)' D' R' (Bb) D' (Bb) L (Bb)' L (Bb) R2 (Bb) L2 U (Bb) L (Bb) L2 (Bb)' y

Now your cube should look like this:



Front/Top View Back/Bottom View

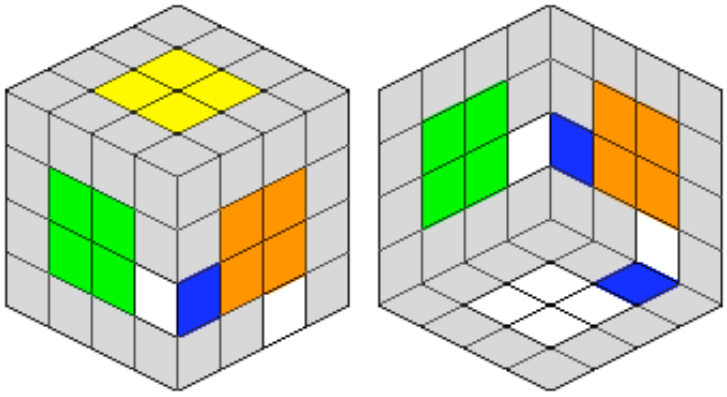
If your cube does not look like the diagram, please solve and rescramble with that alg above. I know it is long, but I double checked and it does get to the position shown here.

How to solve 2 pairs and chain each one together

What we are going to do for this method is solve two pairs at a time, but also make sure that the end of the 2nd pair for one round leads right into the beginning of the first pair for the 2nd round. So we'll sort of chain our way through all the edges until we're done. The benefits of this method are that there are no bad or problem cases really, however the downside is that we only solve two pairs at a time. So it all sort of balances out I guess.

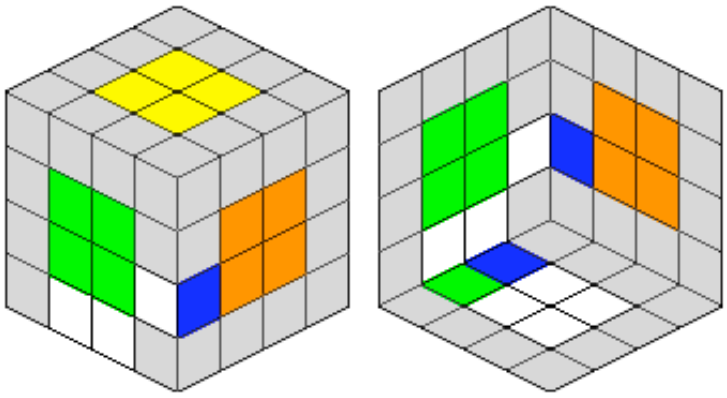
Ok so we've just finished solving the centers. Now in the last few moves for the centers you should be looking for two edge pieces that belong together when the cube is solved. While finishing the centers I probably would have noticed the blue white edge pieces first. These pieces are in dFR and bDR. The first thing we need to do is to put them into the middle layers. It is in the middle layers (**u and d**) where we will pair up edges. The only real way to describe this is to just jump right into an example, so let's solve blue/white.

When I notice a pair I have a **very** regimented, unwavering set of recognition steps. I'll detail those here.



Top View Bottom View

First I just find the two blue white pieces. Now I need to do the move D2 L' to get those two pieces into the middle layer such that I can line them up. However, as I am doing the D2 move (which I do as (D')2 so that the pieces pass in front of my eyes) I see the piece connected to the blue white piece that will end up in the **d** layer. So let's do the first D' ,

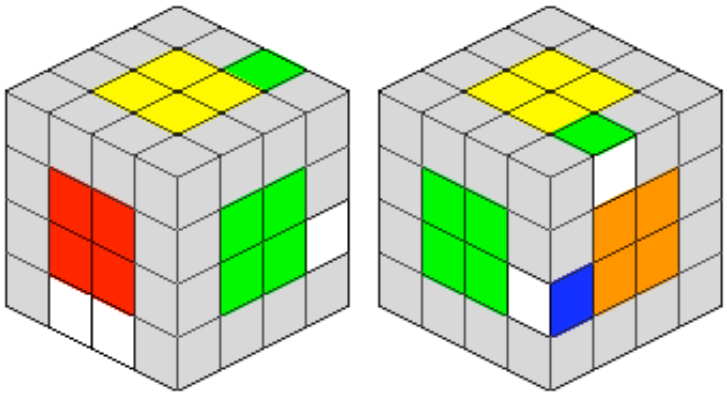


Top View Bottom View

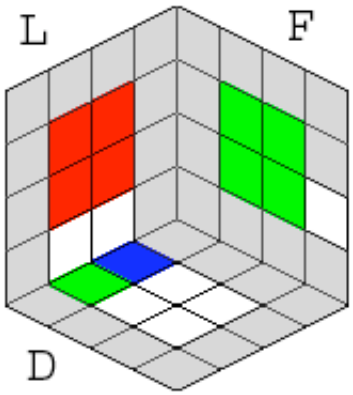
Now remember we are literally in the middle of the (D')2 turn, and at no point are we going to slow down. Basically I am highlighting the edges that I look for at the point that I would recognize it. So you see the edges at the same time that I would.

Now at this point I glance at the edges on the visible parts of the **U, F and R** faces and try to find the other white green edge. *NOTE* remember we are actually still doing the setup moves to solve white/blue, but we are almost ready to solve green/white too!

This is what I call an easy case, since the other white/green edge is easily visible at fUR. I am going to draw the next diagram with the (D')2 turn completed, since realisticly but the time we found the other green/white piece we would have already completed that turn.



Top/Left View Top/Right View

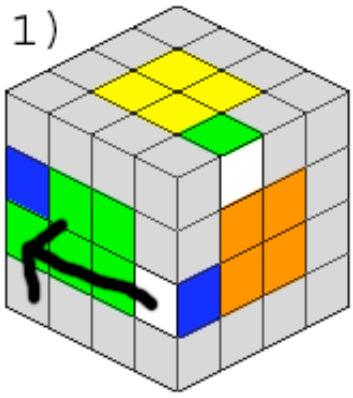


Left/Bottom View

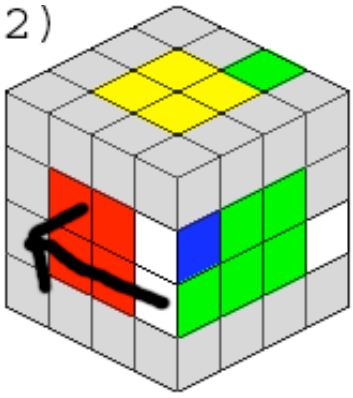
Now remember, the moves we're doing do not line up with the pieces we're following mentally. Physically we are just about to do the L' move to ready blue/white to be solved. Mentally though we're going to plan on how we're going to solve **green/white**! At this step you are now, mentally, 6 moves ahead of what your hands are doing!

So let's plan 6 moves ahead. Now remember our very next move is going to be **L'** which will ready the blue/white pieces in the **u and d** layers such that a **(Dd)'** move will align them in the FL position of the cube. Now here's the key, notice that the green/white piece that is next to the blue/white one (the green/white piece that in the above diagram is in bDL) that will be in dFL after our **L'** move will be kicked back to the dBL position. After I have paired up blue white with the **(Dd)'** move at FL, replacing that solved pair with the edge pair at UR with the move **L' U2 L** will mean that undoing our **d** layer turn with **(Dd)** will solve green/white in the FL slot. If you're having trouble following this here is a diagram of what we're going to do. Remember, we haven't actually done **any** of these moves yet, no net even the **L'** move. This is all stuff that should be in your head ready to do.

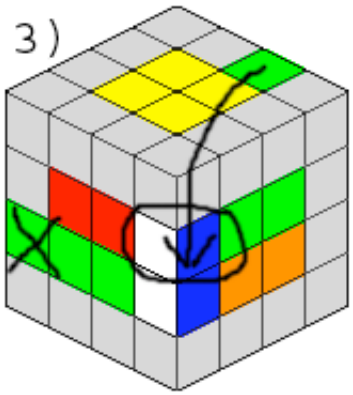
Ok so mentally we are picturing this (read the steps in order),



1) After the **L'** move we want to do **(Dd)'**. This will pair up blue/white...

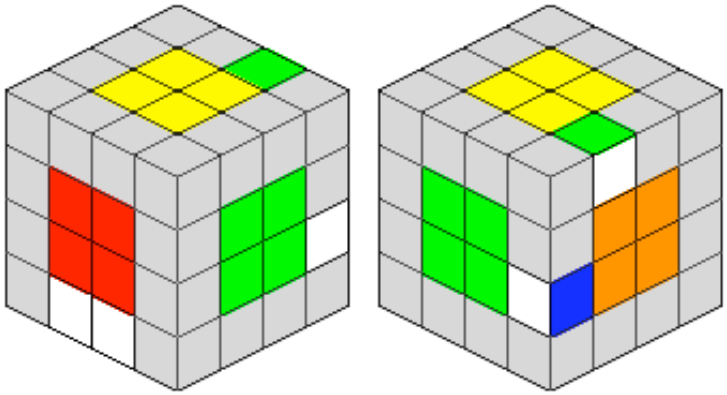


2) ...and kick that green/white piece to dBL.

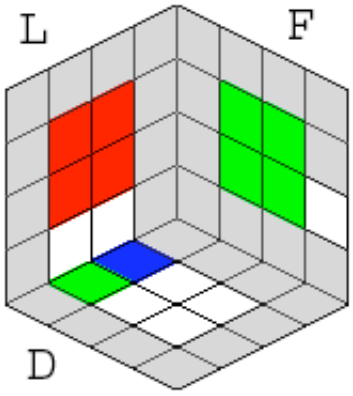


3) Aftering pairing up blue/white we want to replace that solved edge group with the green/white at fUR such that it ends up in the **u** layer (the circled spot in the diagram). Notice that by doing so the green white piece at dBL (the one with the "X" on it) will pair up with it after undoing our **d** layer turn with **(Dd)**.

Ok so that is what we're going to do, but remember as of right now our cube still looks like this,

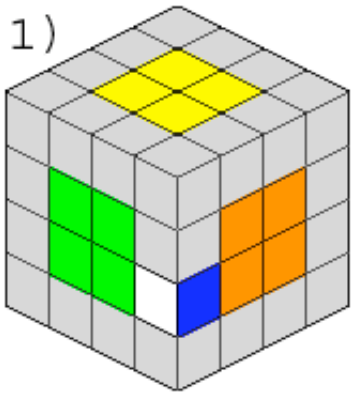


Top/Left View Top/Right View

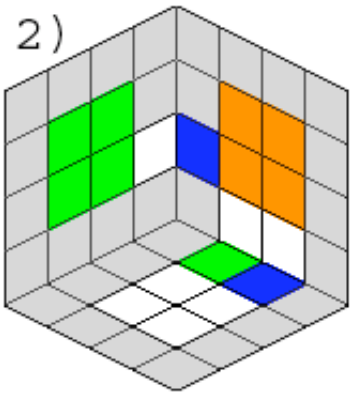


Left/Bottom View

So based on the diagrams and examples above, the move we want to do to pair up both blue/white and green/white is **L' (Dd)' L' U2 L (Dd)**. ***NOTE*** Don't actually do this move yet! So now you know what we are trying to do, but I haven't actually been fully honest with you yet. My recognition is actually even a bit more complicated. I didn't want to do too much at once, so now let me step you're through **exactly** how I would solve those two pairs. At this point please actually follow along and do the moves as I do.

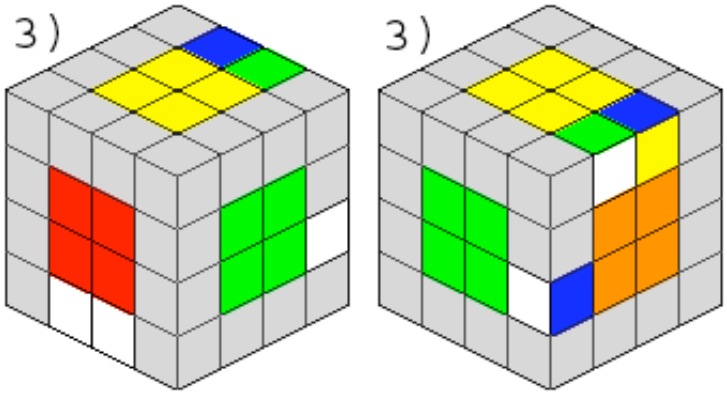


1) The first thing I notice is blue/white. It stands out to me, I don't know why.



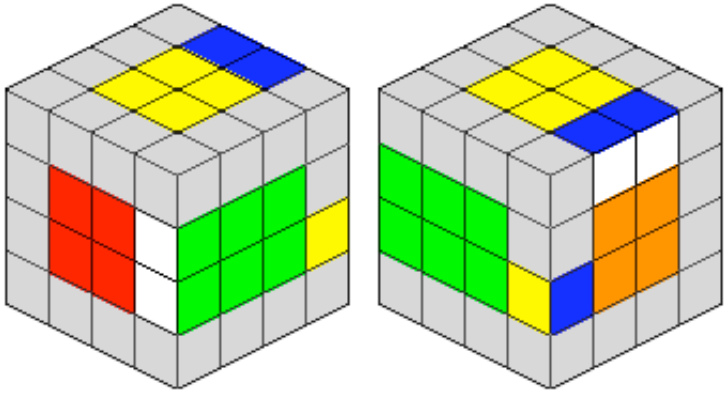
2) I twist the cube around like a madman until I spot the other blue white. However I don't just look at the blue/white piece, I **always** notice the piece that is next to the one I'm looking for. This is the secret to making the chain method work. At this point I also notice that **(Dd)2 L'** will place the **D** layer blue/white such that I can pair it up with the one already in

the **u and d** layers.



3) So I just finished doing the **(Dd)2** move, which I would still have done as **[(Dd)']2** in case I missed the green/white edge the first time. This gives me a chance to double check should I need it. Ok so by this time I would have spotted the other green/white **and** the blue/yellow piece next to it. Remember, when I am looking for a specific piece somewhere on the cube, once I see it I **always** remember which piece is next to it. At this point I know that **L' (Dd)' L' U2 L (Dd)** will solve both the blue/white and green/white edge pairs, **and** leave that blue/yellow piece I spotted at dFR. Notice this is exactly where we started with the blue/white piece! The only difference is that the colors of our base piece have changed, and we have two more solved edges on the cube!

So now our cube looks like this,



Top/Left View Top/Right View

However, again I haven't been completely honest with you. Again my recognition is a bit more complicated

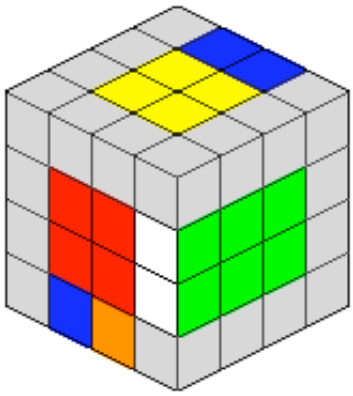
than this. If you have already done the moves on your cube to solve both blue/white and green/white, then undo right now with **(Dd)' L' U2 L (Dd)**. In other words don't undo all the way, just to where we haven't paired up blue/white yet.

Now in order to continue the chain solving we have to find the other blue-yellow piece **before** we finish doing the move **(Dd)' L' U2 L (Dd)**. This is very important. Now you are going to be twisting the cube around like crazy, so it's better to get the **(Dd)'** turn out of the way before you start twisting, as double layer turns done while twisting are very hard to do. So do **(Dd)'**.

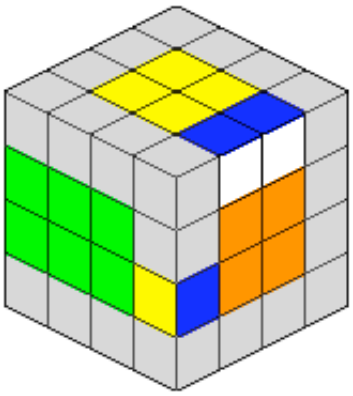
Now twist around frantically looking for the other blue/yellow piece **while at the same time** doing the moves to solve the blue/white and green/white edge.

Now I actually didn't notice the other piece until just after I had done the **(Dd)** at the very end, as I happened to be looking at the bottom left side of the cube at the time. Sometimes you can spot the piece immediately and track them through all the moves you do, and other times like this example you may finish the moves before you spot the piece. Just try to make sure you have no delays in transition from one chain to the next.

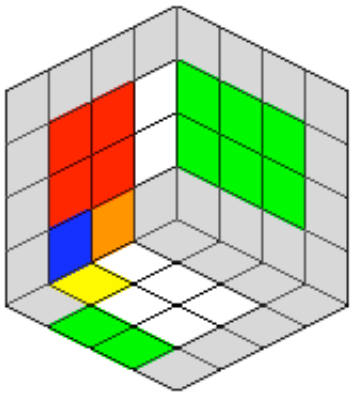
OK so here is our new cube, with all the new pieces we've recognized drawn in.



Top/Left View



Top/Right View



Left/Bottom View

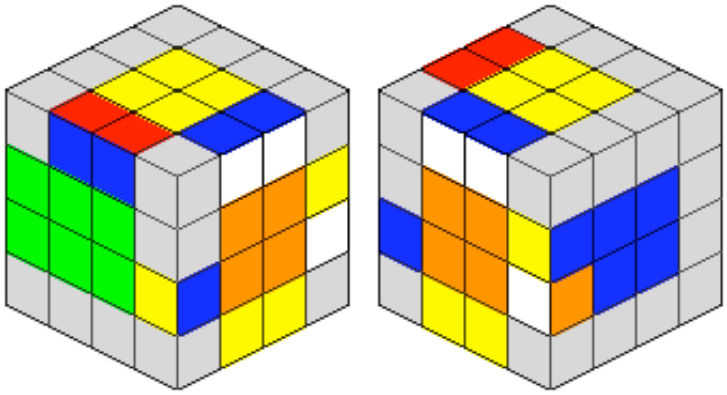
So these are the pieces I've noticed on this solve. Notice that I am also still drawing all the solved edge groups too. This is because that's another really important thing you have to focus on as well. Trust me, it is

hard enough to try to chain the edges together that you **will not** be able to count the number of solved edges without it potentially slowing you down. Notice how in DB we have the green/yellow edge pair solved. This was solved right when we started the edges, so even if we were counting we would undercount by at least one edge unless we tried to take into account the colors of edge groups we've solved and catch any ones we haven't solved before.

Trust me, it is not economical to count edges during a speed solve, in my opinion it would only slow you down. Just try to keep a "feel" of how many solved edges there are. Also, keep in mind you do two edges at a time each time, so you *should* have to chain around 5 times on average before you have to worry if there are any other unsolved edges left. So I'm drawing the solved edges since you really need to keep an eye on how many are solved in order to get an idea if you are done or not.

Ok so notice how I've not only drawn the other blue/yellow piece, but also the one that was next to it. Remember, when looking for a specific piece on the cube, once you find it **always** remember the piece that is next to it, as it becomes the next step in your chain. Ok so now looking at where the two blue/yellow pieces are I would rotate the cube with the rotation **y**, or if you don't know xyz notation spin the whole cube as if you were doing the move **U**. Now do **D' R**. Here's the trick though, while you are doing the cube rotation and the two moves to setup blue/yellow, look frantically around for the other white/orange piece (the one that was next to the blue/yellow piece in the **D** layer). Now to be honest I didn't notice it while doing these setup moves and the cube rotation, which happens sometimes. However, it's ok because there is a cool trick to use here.

Now remember our cube is setup to solve blue/yellow already, but we have no idea where the other white/orange piece is!



Front/Left View Front/Right View

Ok now here's what we're going to do. We need to look for the other white/orange piece. Now what is the most devasting place it could be in? Remember the most visible locations to look are the **U and D** layers. So an edge is hard to find if it is in either BL or BR, in fact being in these spots also throws off our chain solving. So it is **devastating** to have the edge we need in either BR or BL. So to solve this problem simply check there first. Rotate your whole cube towards you as if you were doing the move **L**. Is the piece we need in either BL or BR? The answer is no! There are only two scenarios here. Either the piece we need is not in BL or BR (that's good), or the piece we need is in BR or BL (that's bad). If the piece is in either BR or BL then do a quarter turn on the B face such that the piece ends up in the **U** layer. If the piece is in BL then do **B'** and if it is in BR then do **B**. If the piece is not in either BR or BL then do the required (Dd)

move to pair up the pieces you have setup to pair.

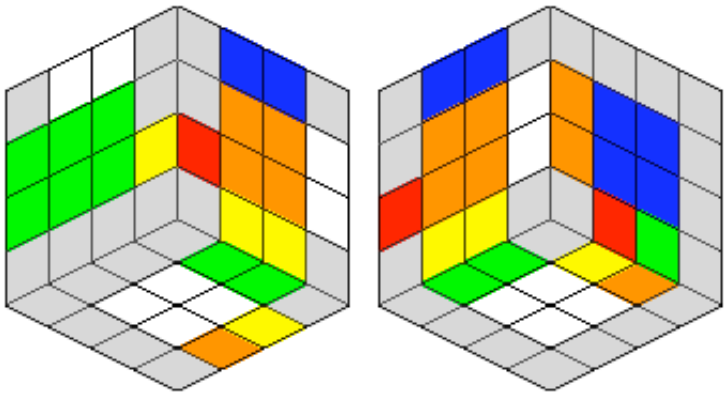
Ok so blue/yellow will pair up in FR if we do **(Dd)**, and the other white/orange piece is not in either BR or BL, so we can safely do **(Dd)**right here. After you have done the **(Dd)** move, then you can safely start looking for the other white/orange piece. The reason for this is, had we done the **(Dd)** turn right at the start, and the white orange piece was in either BR or BL, then when we finally did finish scanning the **U and D** faces, we would find it in the middle layer and the centers would be misaligned. This means there's nothing we can do but to either replace the solved blue/yellow pair with some random pair, solving only 1 pair, or undo our **(Dd)** move, get white/orange out of the middle, then redo the **(Dd)** move. So now you see why it is so terrible to have the piece you need in either BR or BL.

Now our example was actually a lot easier than this. After rotating the cube towards you to see if white/orange was in BR or BL I'm sure you saw that it was right in front of your face at what had become UF! Now 11/12 times that won't happen, so when it does that's good! Just keep in mind that having the piece you need in either BR or BL is so terrible, that you always, **always**, always check there first if you haven't found a piece by the time you are ready to solve the first pair in your chain.

Ok so we found the other white orange piece, it is in lUB. Now what else should we know by now? Correct, that the piece next to white/orange is red/yellow.

Ok so the chain goes like this, **(Dd)** to pair up blue/yellow and kick our middle layer white/orange to dBR, **R U R'** to replace our solved blue/yellow edge pair such that undoing our first **d** turn will also solve white orange and kick our red/yellow piece to dFL. So now, before doing any moves, we know where the red/yellow piece will end up. So scan the cube frantically looking for the other red/yellow piece as you do the moves **(Dd) R U R' (Dd)'**. Now I noticed the other red/yellow piece immediately after having finished the **(Dd)'** turn. I was scanning the bottom face as I did that move (I always scan the **U** face first since I can already see it, then the **D** face afterwards). Now what else do we need to know at this point too? Correct, the piece next to the **D** layer red/yellow piece is green/orange.

So our cube looks like this now,



Front/Left View Front/Right View

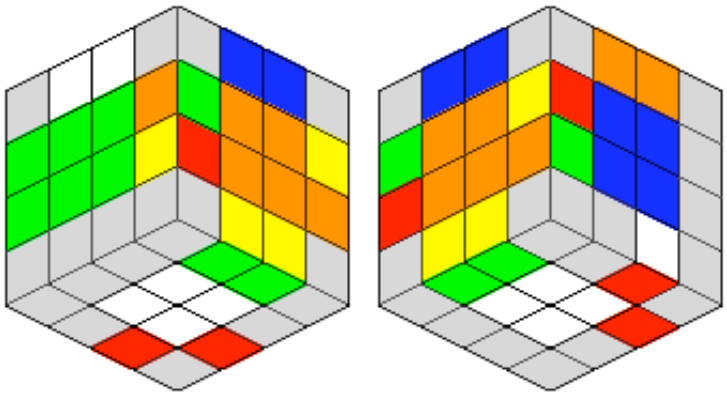
Ok so now notice that the setup move to get ready to solve red/yellow is **R**. Do that move now. Ok now at this point we don't know where the other green/orange piece is yet. So the first thing you do is to glance where? Exactly, at the BR and BL slots. Is the other green/orange piece in either spot? No, it isn't. So now

do the move **(Dd)**, and at the same time look around frantically for the other piece. I always look at the **U** face first, since you are already looking at it, then spin to the bottom. Now if you do that, scan the **U** and **D** faces you won't find our piece. Ok now this is important. You know exactly where it is now, and **we haven't even seen the piece!** Remember, you checked the BR and BL slots already, so it isn't there. Now you have scanned the entire **U and D** layers and it wasn't there either. You know the red/yellow piece that starts the chain is in dFL, so our piece **has got to be in uFL**! This is a very, very important trick for you to learn, using the process of elimination like this. It is exactly for that reason that I always scan BR and BL, then the U layer, then the D layer. If after having done that I know 100% for a fact that my piece is connected to the first piece in my chain! Pretty cool huh?

Ok think about this. How do we handle it when the piece that we need to complete the chain is in a place such that we **cannot** use it the way we have been doing our chain before? We're going to have to break our chain right? Wrong! This case is actually awesome, because we will now solve 3 pairs in the same sequence rather than 2!

Ok so here is how this works. I know now by the process of elimination that the piece I need is in uFL. Well if you look real hard I could either pair red/yellow up at FR with **(Dd)** or green/orange at FL with **(Dd)'**. Is there a way to take advantage of this? Yes there is! Find a random unpaired edge in the **U** layer, and do it fast! Now if the **U** layer contains nothing but solved edges at this point, then find a random unpaired edge in the **D** layer. Notice on our cube that all the edges in the **U** layer are solved. So the edge I would pick is in the **D** layer at DB. Now I am picking this edge for several reasons. First off notice that the red/white piece is in the DB edge at rDB. And also notice that the other red/white edge is very visible right now at bDR. So we are going to solve not only red/yellow and green/orange, but red/white as well!

Ok, so our cube looks like this right now (including all the pieces that we have recognized, **and** all our solved pairs).



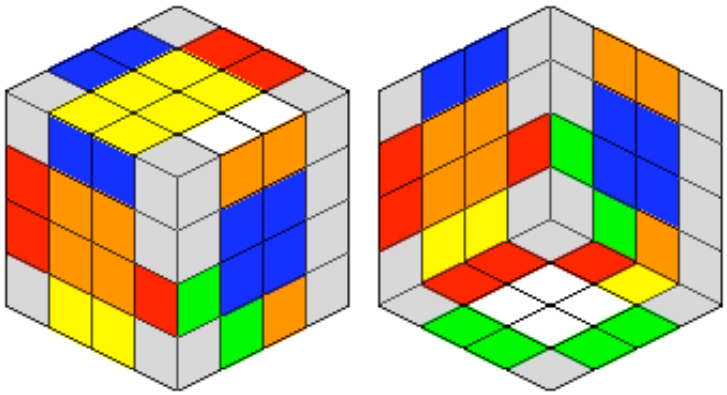
Front/Left View Front/Right View

From here do the move **(Dd)** to pair up red/yellow at FR. Now remember, we did the double layer turn, so the edge we're using to replace our solved pair went from DB to DL. So place the DL edge into FR such that the red/white piece ends up in the **d** layer. So do **F D F'**.

Now our green/orange piece in the **d** layer is in dBR and we want it to be in dFL to pair with the other green orange, so go ahead and do that. Do the move **(Dd)2**.

Now replace the solved pair in FL with the other red/white edge such that the red/white one ends up in the **u** layer. So do the move **L D2 L'**. Now do **(Dd)** to line up the centers again, and viola we've also paired up red/white at FL! 3 pairs at once for only 3 more moves than our regular way! This is actually very good, since it is impossible to pair an edge and leave the centers aligned properly in 3 moves. We utilized this special case to pair an extra pair in extremely few moves!

Now that we did 3 pairs the way we did we are thrown completely out of the chain and have to get back into a chain solve. So look for two pieces that belong together, and the ones I saw are green/red because they are so close together at dFR and fDR.



Top View Bottom View

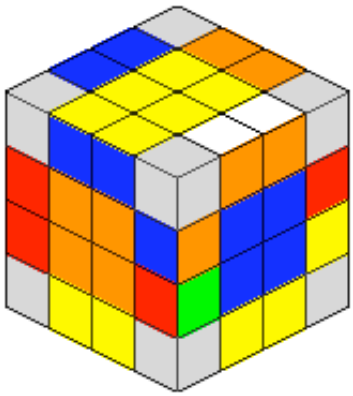
Notice that the edge next to the green/red already in the middle layer I don't care about, but the one next to the edge in the **D** layer I do care about, it is yellow orange.

Again we have no idea where that edge could be right now since we were thrown out of a chain solve. So where is the **very first** place we look? Exactly, BR and BL. So check there and viola our edge is in BR!

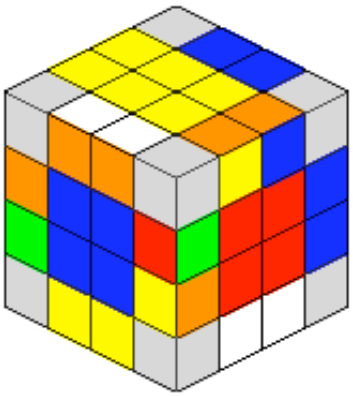
We can actually setup green/red to solve, and get our other orange/yellow edge out of the middle layer with the move **D B**. However if this were an actual speed solve I would do this move as **(U u d') R**. So do the move **(U u d') R** on your cube right now.

Now remember by now we should have noticed that the piece next to the other green/red is blue orange. Well remember, we've done a lot of 2 pair solves by now, and lots of edge pairs are solved, so check at the edge above our first green/red (the one now at dFL). It is also blue/orange! So this tells us that these three edges will solve togehter, a good indicator that we might almost be done.

So your cube should look like this now,



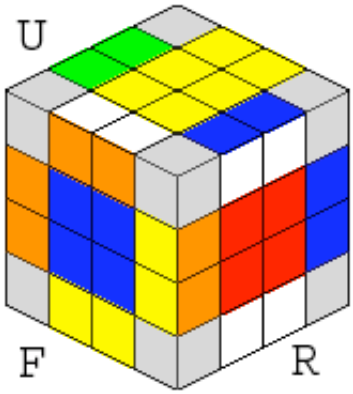
Front/Left View



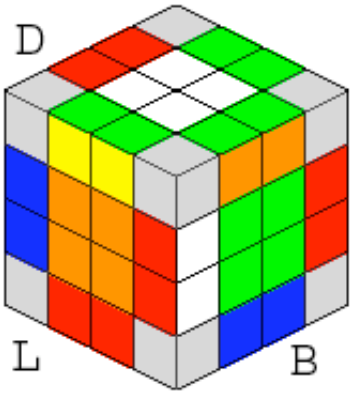
Front/Right View

To solve those three edges together pair up green/red and kick the middle layer orange/yellow back with **(Dd)**. Then replace the solved pair with the **U** layer orange/yellow such that the orange/yellow piece ends up in the **u** layer with the move **F' U F**. Now undo the **d** layer move with **(Dd)'** and those three are solved.

Actually if you noticed, we had two edge pairs solved right from the start too, so now we're done!



Front/Top View



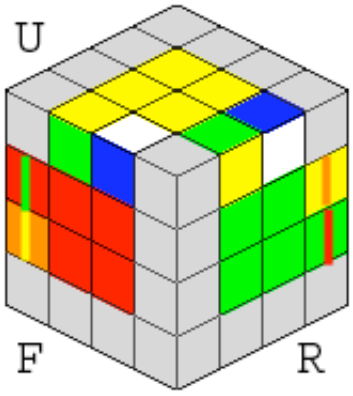
Back/Bottom View

Other endings for the edges step

Other than ending on a special case like in the appendices below, here are two other endings that I see as well.

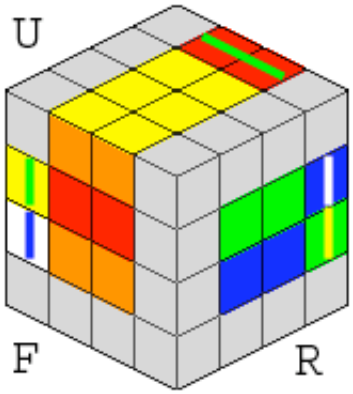
4 edge pair ending - two double swaps

At this point there are only four edges left to solve on the cube, and they are in the configuration below,



This is an uncommon way of doing 4 edges at a time. What we will do is pair up the pairs at FL and BR with a **(Dd)2** move. Notice also that the two edges in the **U** layer can pair up the same way, so replace them in the **u and d** by doing the move **L' U L B U2 B'**.

Now your cube should look like this,

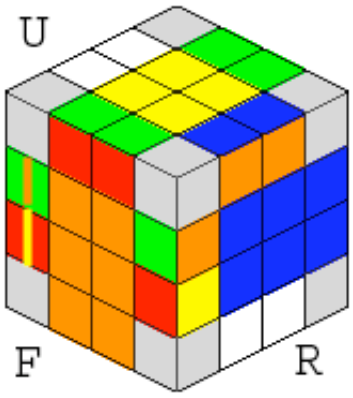


And lastly a **(Dd)2** turn will line up the other two edges.

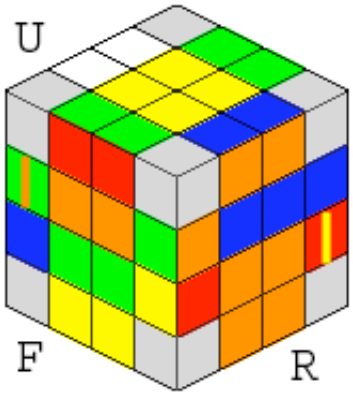
Two edge ending

This ending is very common. If you noticed, for our chain solving we actually use 3 edge groups, even though we only actually solve 2. So what do you do if you end with 10 edges solved and 2 unsolved?

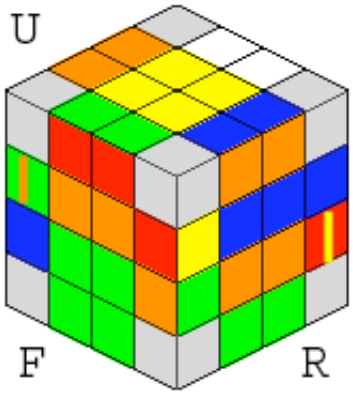
First off get them adjacent to eachother like this, or also on opposite diagonals at FR and BL works just as well, just replace all the **(Dd)** moves in the following alg with **(Dd)2** if you start with them at opposite diagonals of the middle layer.



Now do the move **(Dd)** to move the dFL piece over to dFR, and also kick the dFR piece back to dBR.



Now if we flip the edge in FR, undoing our **d** layer turn will solve those two edges. To flip simply do the move **R F' U R' F**. For flipping the edge some people prefer **R U2 R' F' U' F** but I would definitely suggest the first, shorter alg.



From here do a **(Dd)'** to pair up the two edges again and you're done!

Appendix A

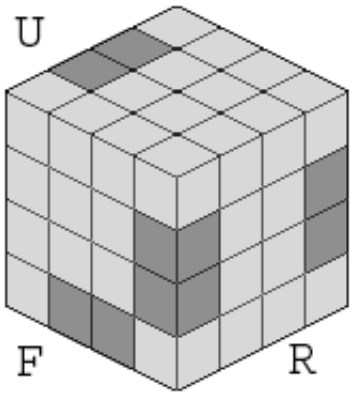
Special case scenarios when I would use the 4 or the 6 pair method

At the top of this page I mentioned that I only use the 2 pair method about 90%-95% of the time, so here is what I am doing the other 5%-10%. Predominantly I would use the 4 pair method, which is in between the 2 and 6 pair methods, but there are some very rare special cases where I would use the 6 pair method.

So here is an example of when I would use the 4 pair method. I would say I use this about 5%-9% of the time, with the less than 1% left over left for the 6 pair method.

Here is the scramble to set up what I am going to do. If you want this to look like a real solve, you can do this. Scramble your cube then solve the centers. Now solve 4 edge groups and place them in the UL, DF, FR, and BR locations. See picture below,

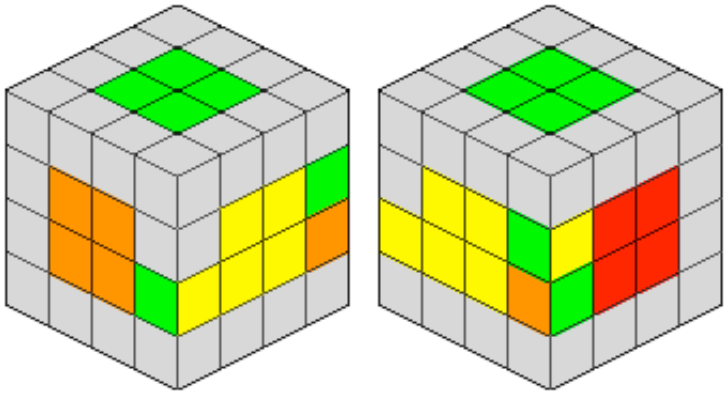
Start with the solved edges here,



Now apply this scrambling algorithm and you will be setup for this example: **(Dd) R U2 R' B' D B (Dd)'**

Remember this is only a special case for me, so my approach to this case is still to just do a 2 pair chain solve. So let's start with a 2 pair chain solve where I am ready to pair up dFL with uFR by doing a **(Dd)** move. I will include diagrams, but remember that our colors are very likely to be different since there are 495 different ways to solve 4 edges ;-)

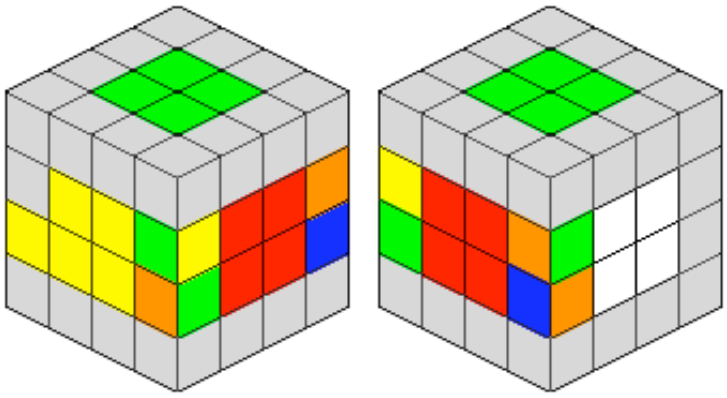
So here is all I see so far thinking in my regular 2 pair mode,



Front/Left View Front/Right View

Let's say also that this happened at the right situation from the previous chain that I have no idea where the other green/orange piece is. If that happens where's the very first place I look? You gotta remember this, it's very important. Exactly, I look in BR and BL. Now let's look in BR and BL and viola green/orange is in BR and not only that it is in uBR! That's even better! Notice now that a **(Dd)** move will make a pair in FR and BR! Now I could do my regular thing and kick that green/orange to the **U** layer by doing **B** then pairing up green/yellow and chaining this, but in actuality the 4 pair method is perfect to use in this situation!

Now again your colors are very likely to be different from mine, so we need another diagram. After noticing the other green/orange remember that I always look at the piece next to the one I am looking for, there is never an exception to this.

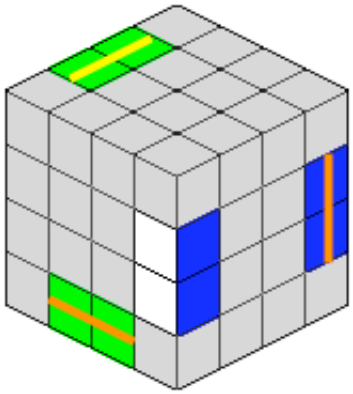


Front/Right View Right/Back View

Now on my cube the other color next to the green/orange piece is the blue/orange. Ok now we're going to take a concept that I've detailed in the example solve and expand it to this addendum example. There is one position that the other blue/orange can be in that would absolutely destroy the special case taking advantage of a position for a good end and turn this into a move wasting approach. The usual places I check are BR and BL since they are the spots in the middle layer not being used. Well now we have pieces in FL, FR, and BR that are very important to our chain. So the horrible spot would be if the other blue/orange was in BL. So check BL right now for the other blue/orange piece. It's not there, so immediately pair up the two edge pairs at FR and BR with the move **(Dd)**.

Now the rest continues like a chain solve. We need to find the other blue orange piece and put it into BR such that the blue orange is in the **u** layer and we'll solve blue orange when we undo our **d** layer turn. That edge is right now in DL. Ok now what is the other thing you should have noticed already as well? Correct, the edge next to the blue/orange piece is blue/white. Ok now while we are placing the blue/orange and blue/white edge group into BR such that the blue/orange piece ends up in the **u** layer we will be looking around for the other blue/white piece. To place that edge into BR correctly you need to do **B' D' B**, so do that now, **while** looking for the other blue/white.

The other blue/white edge is in UL. Again what else should you have noticed by now? Exactly, the edge next to blue/white is red/yellow (or whatever it is on your cube). Now do the move **R U2 R'** and finish with **(Dd)'** to pair up four more edges. Your four correct edges should now be in the spots shown below.

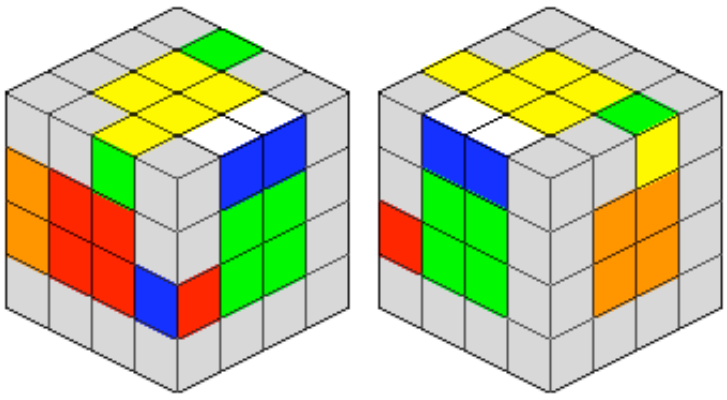


To extend this to six pairs you would do this. After realizing that the first two edge pairs at FR and BR will pair up with a **(Dd)** move, you would check BL to make sure that the piece that pairs with the dBR piece isn't there. If the piece that pairs with it is in uBL then you will pair three edge pairs with the **(Dd)** move. At this point you will have checked the edge in dBL. If it pairs with the piece in uFL then you will do four pairs with the **(Dd)** turn (extremely low probability). So now chain your way through all the edges on the way back, the same way I've described for the 4 pair example and you will do 6 pairs at once. If you are able to do 4 pairs on either the first **d** layer turn or on the second then you can do 7 pairs at once. If you can do 4 on both **d** layer turns (extremely ridiculously low probability) then you can do 8 pairs at once.

Appendix B

Knowing when to break the chain

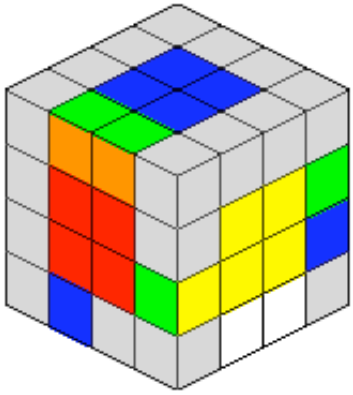
It isn't always beneficial to continue the chain when 2 pair solving. In fact sometimes it is **better** to break out of the chain you are in and start a completely new one. Consider this example,



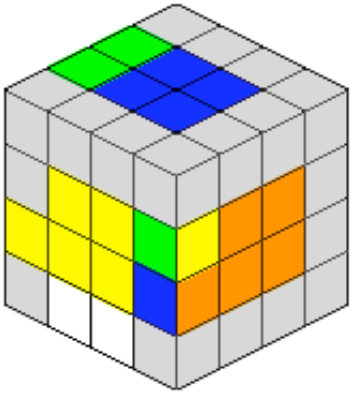
Front/Left View Front/Right View

We have just solved two pairs and they ended up in BL and UF. The last piece in our chain, the one that leads into the next one is blue/red. However, you have not yet found the other blue/red piece. Now, while scanning the **U** layer you noticed that the two green/yellow pieces are ready to be paired up with an **(Ff)** move. So why continue looking for blue/red when you can already pair up two pieces right now?

Here's the key to making this work though. First you have to rotate your cube such that your new chain has the pieces to be paired up in the **u and d** layers. So do x' if you know rotation notation, or if not rotate the whole cube towards you one quarter turn. Now you have to create a new chain, so the move **(Dd)** after our rotation will pair up green/yellow at FR, so look at which piece is in dFR. This is all detailed on the diagrams below,



Front/Left View



Front/Right View

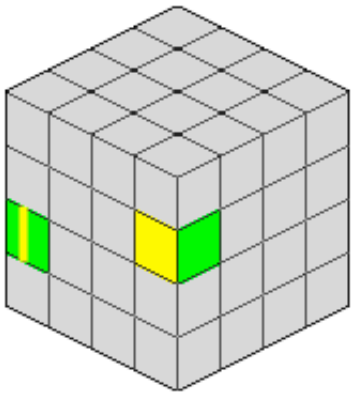
Now we're starting a new chain, so we have no idea where the other blue/orange piece is, it could be anywhere right now. In that case where is the **very first** place we look always? Exactly, in BR and BL. So glance in BR and BL first, if you see the piece you need you have to either kick it to the **U** layer, or use it in a 4 or 6 pair chain special case. If the piece you need is not in BR or BL then go ahead and do **(Dd)** to pair up green yellow and continue searching for the piece. Now just continue your chain solving from here, you are well into your new chain already.

Appendix C

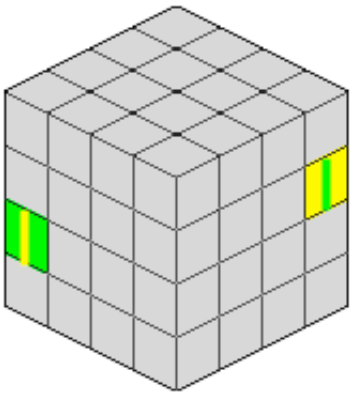
Avoiding opposite diagonal pairing of edges

This is something I've come to realize from solving the 4x4x4 for a while, and that is that pairing over an opposite diagonal is harder than pairing on adjacent spots and should be avoided as much as possible.

Here is what I mean,



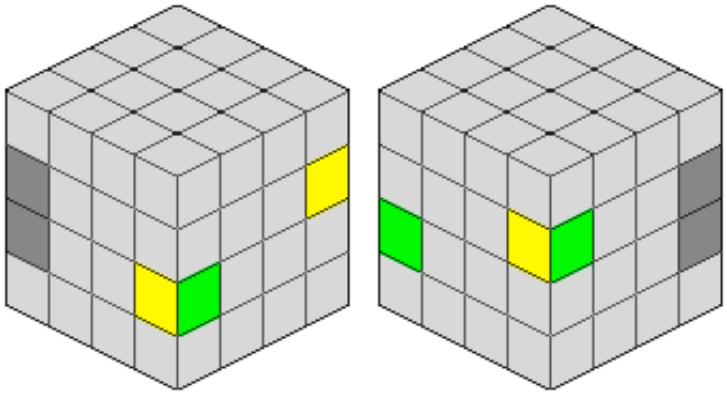
Adjacent pairing



Opposite pairing

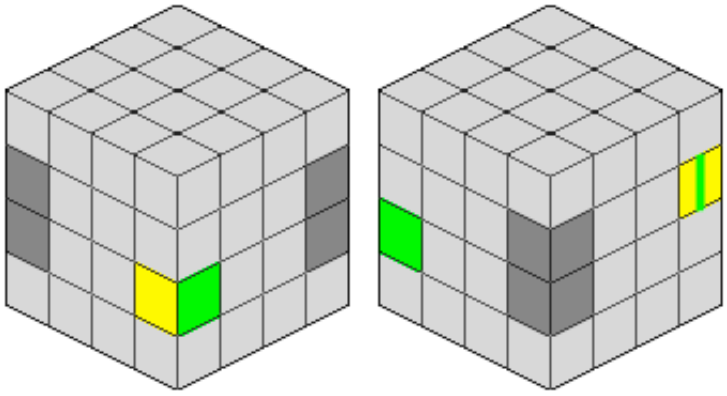
Try as hard as you can to avoid setting up edges such that they pair across opposite diagonals. However, if you notice that two edges are ready to pair but are on opposite diagonals, don't do any setup moves to place them adjacent just solve them as is. The time it is ok to setup two edge such that they are on opposite diagonals is if they start off both in the **u and d** layers adjacent to eachother in the same layer. Such as if the pieces were in uFR and uFL, or dFR and dFL. In that case it's ok to just do a double turn to get one into the other middle layer.

The only other thing you need to remember is that solving opposite diagonal edges means your "problem" locations change. Remember, our problem spots for adjacent pairing are BR and BL, but for opposite solving they are FR and BL, or FL and BR. Below is a diagram,



Front/Left View Front/Right View

Problem spots for adjacent pairing are in BR and BL



Front/Left View Front/Right View

Problem spots for opposite pairing will either be FR and BL or FL and BR

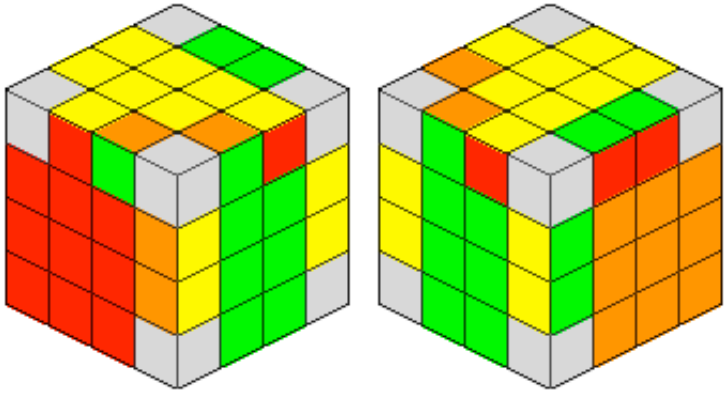
Appendix D

What to do if you miss 2 edge pairs

Ok, so here's the scenario. You're done with the edges step and you start solving the 3x3 step with the F2L method. You're over halway through with your F2L when you realize you only solved 10 of the edge groups, 2 are still unsolved! That's bad right?! ... Well ... not really actually.

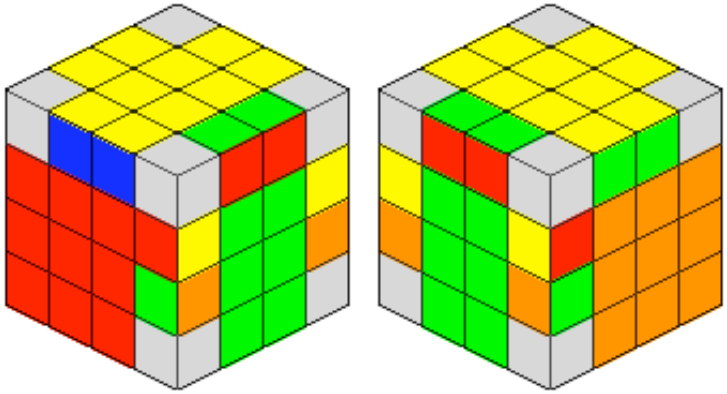
If you do run into this situation there is a 19/33 = 57.58% chance that one of the misaligned edges will be one of your cross edges, so you would spot it before even starting the F2L. However, what do you do on the 14/33 = 42.42% chance that your cross edges are fine? You may not notice the messed up edges until well into your F2L solve.

Well here is what you do on the 14/33 chance that you get well into your F2L solve without noticing the misaligned edges.



Front/Left View Front/Right View

The way to solve this is easy, put each unsolved edge into an F2L slot, such that the pieces that belong together end up in the same layers, like so,



Front/Left View Front/Right View

Now just do a regular 2 edge ending, but to flip the edge you have to use an F2L-preserving alg. So I would do **(Dd) R U' R' F' U2 F (Dd)'**. And now you can continue your F2L solve.

Definitely try to avoid this situation, but don't freak out if this happens. Remember, you would have had to solve those edges earlier anyway, so the only way you are wasting moves is that the setup alg to get the pieces next to each other will be around 6 moves instead of 1-3. Also your flip move is 1 extra move long now since you have to preserve the F2L. So you've wasted only about 4-5 moves this solve, which translates to about 1-2 seconds. So don't freak out, just take care of it.

Step 1: Centers | Step 2: Edges | Step 3: Fix parity
Intro | 2 pair chain solving | Other pairing methods

Go back

Solving the Edges

Step 1: Centers | **Step 2: Edges** | Step 3: Fix parity
Intro | 2 pair chain solving | Other pairing methods

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6 pair solving

This page definitely requires a disclaimer, so here it is. If you're reading this I assume you are interested in learning the 6 pair method, but you need to realize that I am no an expert in this method. The best I was ever able to average with the 6 pair method is sub-1:20, and I don't even think I ever made it to sub-1:15 with it. I use the 2 pair "chain" method now to average sub-1:10 frequently, and there are 6 pair solvers who also do the same. So bear in mind that my 6 pair advice might not be able to get you to sub-1:10 averages. However, other than the videos with Frank Morris on bigcubes.com I haven't found any really good 6 pair tutorials on the internet at the time I am writing this page. I did spend a lot of time in winter of 2003 into spring of 2004 trying out the six pair method though, so here is at least one more online tutorial for this method.

Again, using what I will write on this page I was able to average between 1:15 and 1:20 for solving the 4x4x4, but please bear in mind that I am not an expert in this method. If you would like to ask tips from an expert please contact those at the top of the 4x4x4 speedcubing.com list, or post on the yahoo group.

Even though I use the 2 pair method almost exclusively, I will be as fair as I can and try to show everything I learned about 6 pair solving from when I was still trying it out.

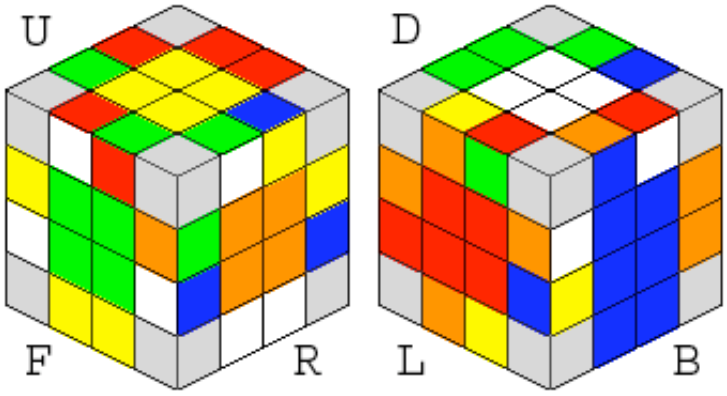
Setting up your cube

If you have just come from the centers page your cube is already correct, skip to the edges stuff below.

If you have the same color scheme as I do then scramble with yellow on top and green on front. To get to this scramble from a solved cube do:

b F (Ll) u2 B U' F2 R B F' l2 D2 l2 B L B' d2 b r l2 f u' f ' R D' B u2 B' R' u F2 b2 U2 (Ff)' F' R' D r d F2 U2 (Rr) F B (Rr) L2 (Bb)2 F (Uu)' F2 (Uu) (Bb)' D' R' (Bb) D' (Bb) L (Bb)' L (Bb) R2 (Bb) L2 U (Bb) L (Bb) L2 (Bb)' y

Now your cube should look like this:



Front/Top View Back/Bottom View

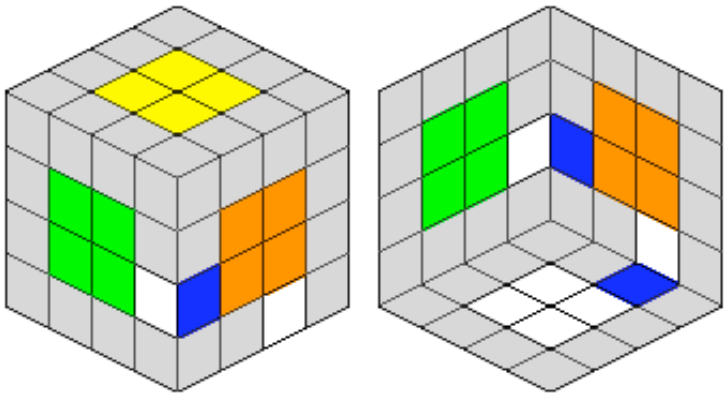
If your cube does not look like the diagram, please solve and rescramble with that alg above. I know it is long, but I double checked and it does get to the position shown here.

Solving 6 pairs at a time

What we are going to do for this method is solve anywhere from 5-8 pairs at a time, though generally we will solve 6. However, you can't do this twice and solve all 12 edges very often. Rarely will a solve work out that well. Generally what you are going to do is to solve 6 pairs right at the start, then try to solve 4 pairs, then finish off with whatever is left with the 2 pair method. The benefits of this method are that you solve the edges in relatively few steps, and on very rare cases you can knock out 8 edge pairs in one go! The downside is that on the cases where you can only solve 5 pairs, you had to have done the same number of moves as you would do to solve 6 pairs, so you end up wasting a few moves, which translates to wasting a second or two. So like the 2 pair method, it all sort of balances out.

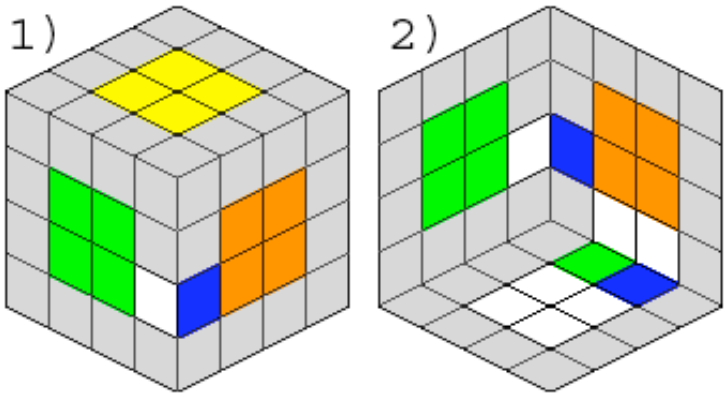
Ok so we've just finished solving the centers. Now in the last few moves for the centers you should be looking for two edge pieces that belong together when the cube is solved. While finishing the centers I probably would have noticed the blue white edge pieces first. These pieces are in dFR and bDR. The first thing we need to do is to put them into the middle layers. It is in the middle layers (**u and d**) where we will pair up edges. The only real way to describe this is to just jump right into an example, so let's start with blue/white.

When I notice a pair I have a **very** regimented, unwavering set of recognition steps. I'll detail those here.



Top View Bottom View

The above diagram just shows you where the blue/white pieces are, what I would actually notice however, is this,

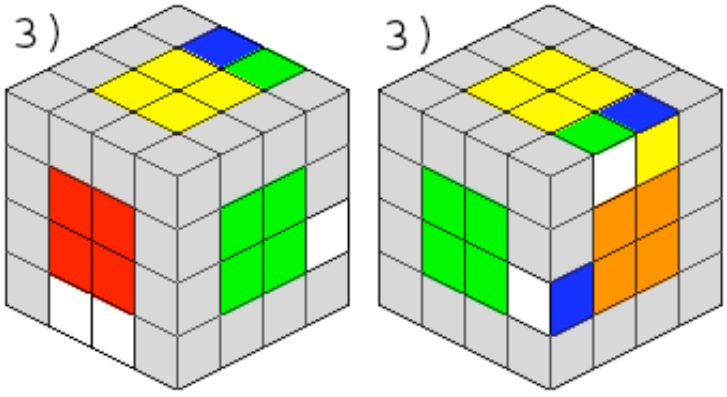


Top View Bottom View

Following the numbering scheme first I would notice the white/blue piece at dFR, since it stands out to me for some reason. I would then twist the cube around looking for the other blue/white, which is in bDR. Whenever I find a piece that I was looking for, such as the blue/white, I **always** look at the piece that is next to it. In this case that piece is green/white.

Now I need to get the blue/white that is in bRD into the middle layer such that blue/white piece is in the **u** layer. To do this I would do **D2 L'**.

In order to make the solve smoother though, while I am doing the moves to setup the two blue/white pieces, I go ahead and start looking for the other green/white edge, since I will want to pair up green/white as well.



Front/Left View Front/Right View

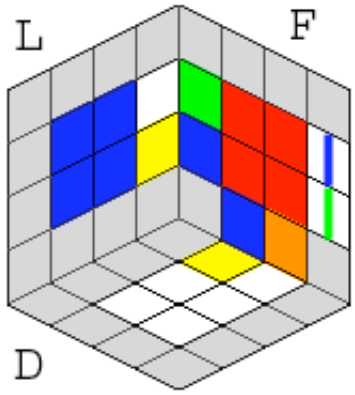
By the time I would have completed the **(Dd)2** move I would have found the other green/white at fRU. I also would have noticed that blue yellow piece that is next to it. Remember, when looking for a specific piece on the cube, once you find it **always** pay attention to which piece is next to it.

So far we haven't yet done our **L'** move to get blue/white ready to be solved. Also, we are going to want to

place the other green/white piece into the BL spot, such that the green/white pieces will line up in BL as well. See the diagram below,

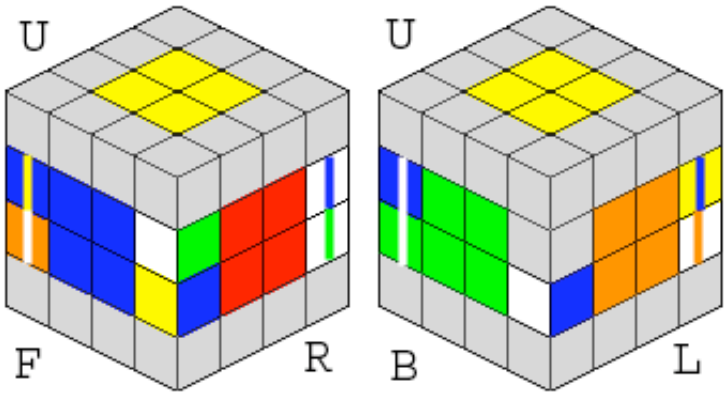
Notice that the alg we need to do to setup the pieces this way is **L'** to ready blue/white then **B' U' B** to ready green/white. Doing this move will set us up for solving two pairs on our first **(Dd)'** turn. We will solve blue/white in FL and green/white in BL. However we want to do three pairs on the first turn, and three pairs on the return. So we need to find the other blue/yellow piece while doing the alg to setup blue/white and green/white.

So go ahead and do the **L'** to setup blue/white. Now I would rotate my cube with **y'** (if you don't know rotational notation that means to spin the whole cube like your were doing the turn **U'**). Now I would do the alg above translated as **L' U' L**. I didn't notice the other blue yellow until the last **L** move, and it is in lDF. Also I would have noticed that white/orange is next to the blue/yellow we just found.



We need to place that blue/yellow edge into the BL spot so that on our first **(Dd)'** turn, the blue/yellow edge pair will form as well. To do that do the move **L' D' L**. Afterward spin the cube with **y'** (like **U'**) again so we can track the white/orange piece better.

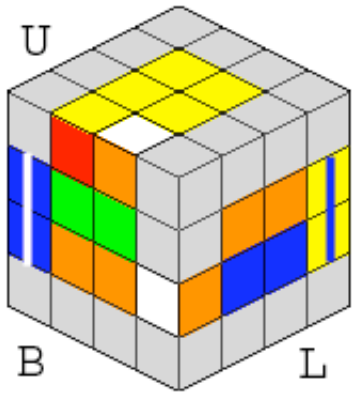
So here is the setup, with a **(Dd)'** move we will pair up 3 pairs, at FL, FR and BR.



Now in order to solve on the return **d** layer turn, we have to find the **d** layer piece in our setup that does not pair with it's mate in the **u** layer. This piece is white/orange.

Now go ahead and do your **(Dd)'** turn, but at the same time glance around frantically for the other white/orange piece.

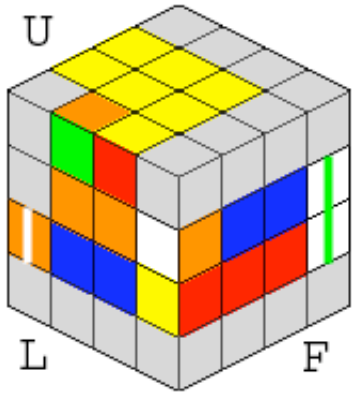
The white/orange piece is on the back at lBU.



Now we are going to do the same thing, but starting with the white/orange edge. This will allow us to pair up 3 more edges as we fix our **d** layer.

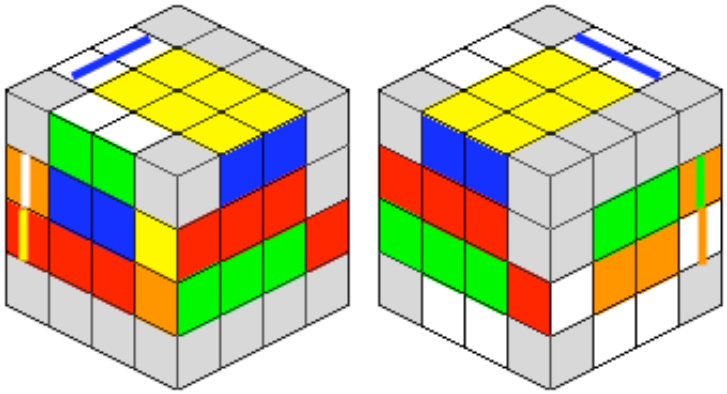
Notice that the piece next to the white/orange at lBU is red/yellow. So as we are placing the white/orange piece into the **u and d** layers such that it will pair with the other one when we do **(Dd)**, start looking around for the red/yellow piece. The move we need to do to line up the two white orange pieces is **F U2 F'**.

As you do this move you will probably spot the other red/yellow piece in the **U** layer. It ends up in UL after the move to ready white/orange. Also notice that next to the **U** layer red/yellow is green/orange.



To ready red/yellow to solve we will want to do **R U2 R'**. Now while we are doing that move, remember to look around for the other green/orange. Don't look too hard in the **U or D** layers though, because you won't find it. The other green/orange is in uBL. I don't know of a way to handle cases like this very smoothly, so here is what I am going to do.

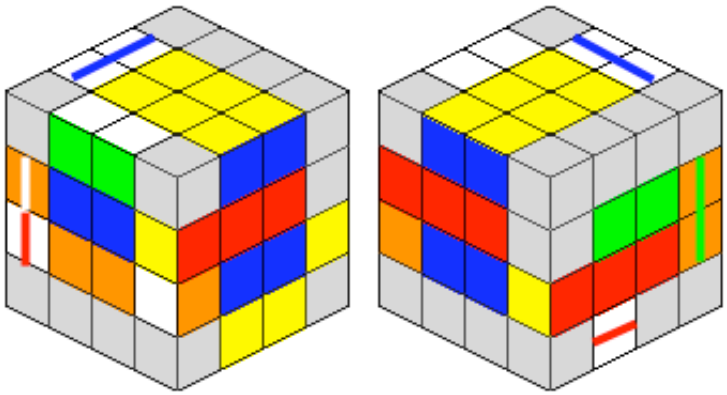
Go ahead and do, or finish, the **R U2 R'** move to ready red/yellow to solve at FR right now. Now we are going to replace the solved white/blue edge at BR with any random edge, but remember which piece you end up placing into the **d** layer in BL. So track which piece ends up in dBR. I personally would rotate the cube as **y** (like **U**) and do **R U' R'**. This will insert the red/white and green/red mismatched edge pair such that the red/white piece ends up in the **d** layer of that spot.



Front/Left View Front/Right View

Now we're going to step out of our 6 edge solve and use a little trick to fix this situation. Notice that doing a **(Dd)** turn will pair up two edges. This is the end of a regular 6 pair technique. However, ideally the edge you need for the last pair won't already be in the middle layer. So notice if we end the regular way we will only solve 5 pairs, this is the worst case scenario. But, we are going to use a little trick to salvage this situation and actually solve 7 pairs.

Notice that doing a **(Dd)2** will pair up those problem green/orange pieces at BR. Let's go ahead and do that now.



Front/Left View Front/Right View

Now our two edges that we've already setup are still setup to be solved, but we're going about solving them after we take care of this problem case of green/orange.

Remember how when we replaced our last solved edge with random edge how we marked which piece would end up in the **d** layer? That piece was red/white, and I've marked where the other red white is. Now if you replace our now solved green/orange edge group with the one containing red/white, such that the red/white piece ends up in the **u** layer, our center fixing **d** layer turn will solve three additional edges. That's 7 total!

So first replace green/orange with the red/white edge like this, **B' D B**. Now if you do a **(Dd)'** turn you will solve three more edges. Do that now.

So we took our worst case scenario, and luckily we were able to efficiently turn it into one of our better

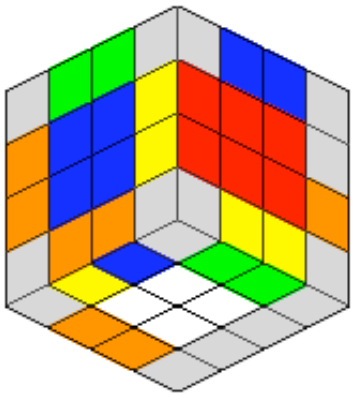
scenarios, solving edges at once.

Now usually we would continue from here with the 4 pair method, in this method you only pair up two edges on the first **d** layer turn, then you pair up two edge on the return turn. This is done in the same way as the 6 pair idea, only with one less edge at each step.

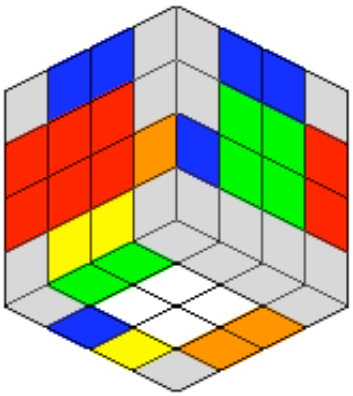
However, we started with two edges solved at the beginning of this step. So we had two solved, and we just solved 7, that leaves 3 edges left to solve.

From here we have to finish with the 2 pair method, since it will pair up the last three edges at the same time. First notice the blue/orange piece at dFR. This piece was attached to our red/white piece during our earlier 6 pairing, and it ended up at dFR. So now glance around the cube and look for the other blue orange piece.

Luckily it is in a good location at fDL. Also, the edge it is next to is orange/yellow.



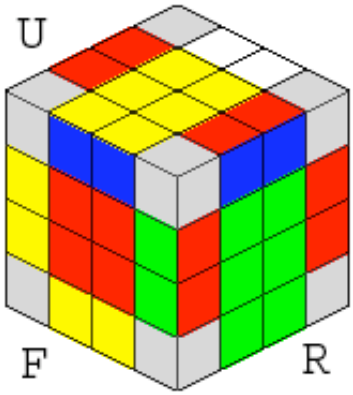
Front/Left View

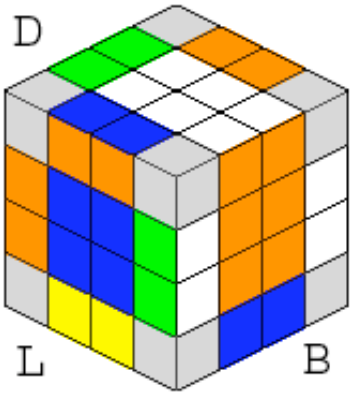


Front/Right View

From here do the move L' to get blue/orange ready to pair up with a **d** layer turn. Now as you are doing that look around the cube for the other yellow/orange piece. It is in bDR.

After you do the **L'** move go ahead and pair up the blue/orange edge group at FL by doing **(Dd)'**. Now replace the solved edge group with the edge group containing the other yellow/orange edge, such that the yellow/orange ends up in the **u** layer. So do the move **L D' L'**. Now fix your centers with **(Dd)** and the edges are done!





Front/Left View Front/Right View

Shortfalls of my explanation

Again I'm no expert of the 6 pair method, so I don't have an efficient solution handy every time if we get a weird case like we had in this example solve. Now, pairing up the edge pairs can be viewed as transposing piece between edge pairs, thus solving them. This can always be simplified down to a maximum of 12 transpositions, so you're left with cycles exactly like in BLD solving!

Now what happens if you don't have a 6-cycle of edges, yet you are working on trying to solve 6 pairs at a time with that cycle? That is when you run into problems like we did above. Now sometimes, if you can look ahead well, you can see a way to fix that. I'm not very good at seeing fixes like that quickly, which is why I prefer the stability of the 2 pair method. Solving with 2 pairs uses many more substeps but it has no bad cases.

So in short, if you plan on using the 6 pair method, be ready to improvise when you try to use the 6 pair method on a cycle of edges that is shorter than 6 in length. This will give you a bad situation that needs to be fixed, and on a worst case scenario you would only solve 5 edges.

For a video explanation of the 6-pair method see the bigcubes.com 4x4 edges page.

Step 1: Centers | Step 2: Edges | Step 3: Fix parity
Intro | 2 pair chain solving | Other pairing methods
Go back

Solving the 3x3x3

Step 1: Centers | Step 2: Edges | **Step 3: Fix parity**

Theory

Just a little theory here, but one thing I think that is important to realize is that the power of centers first solving is that you reduce to a 3x3x3 cube, where you can use all of your normal speedsolving tricks. The major drawback of centers-first solving though are the two parity errors that come up. However, I think that the ability to really use your specialized 3x3 tricks makes up for that

Taking care of parity cases

So this last step is a page on how I handle the parity cases. If you want a really good page on this visit Stefan Pochmann's big cubes page. Also check out bigcubes.com.

The stuff below is how I would do each case, but there are lots of different option for how to handle them.

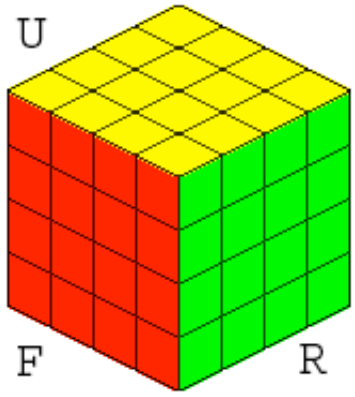
OLL parity

This is the parity that is caused by solving the centers such that the edge permutation is odd. If the scramble has the edges in an even permutation and you solve the centers in an odd number of inner face quarter turns you will cause the orientation parity. If the scramble starts with the edges in an odd permutation and you solve the centers in an even number of inner face quarter turns then you will also cause the parity.

This parity **is not** caused by the centers. I've seen that erroneously stated on many different sites and posts on the group. The one-edge flipped parity is caused by solving the centers such that the edge pieces are in an odd permutation.

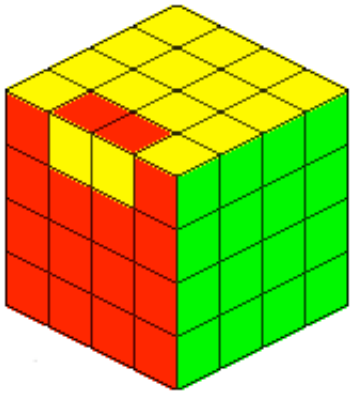
Here are all the tricks I use for this case.

All cubes are in the same orientation, as defined by the below diagram,



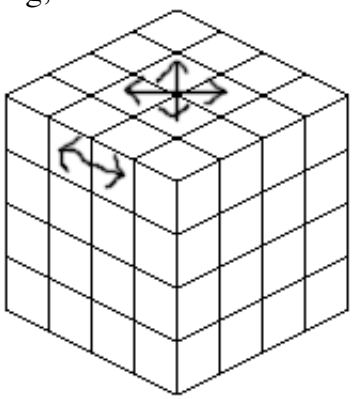
The pure form

Here is the pure form of the alg I use,



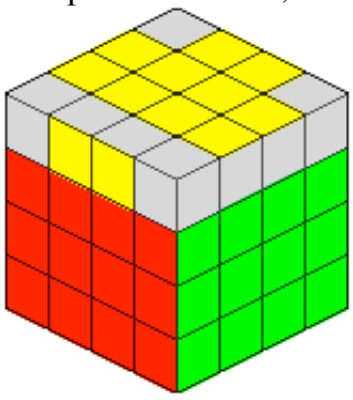
r2 B2 U2 l U2 r' U2 r U2 F2 r F2 l' B2 r2

And here is the affect on the cube of this alg,



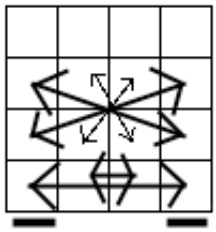
Speedsolve forms

This is the most general case of applying the speedsolve form,

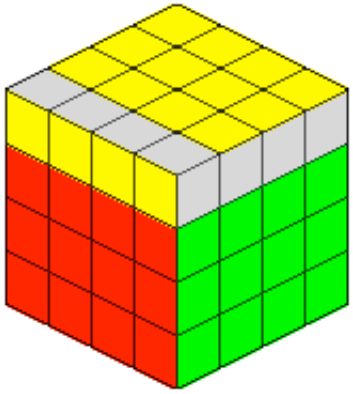


(Rr)2 B2 U2 (Ll) U2 (Rr)' U2 (Rr) U2 F2 (Rr) F2 (Ll)' B2 (Rr)2
performed as: **[(Rr) (Ll)] U2 x U2 (Ll) U2 (Rr)' U2 (Rr) [(U') (u d' D')] L2 y' x (Rr) U2 (Rr') B2 (Rr)2**

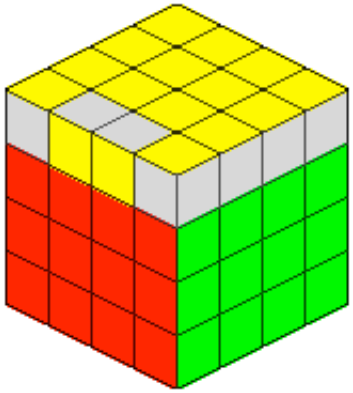
And here is how that alg affects the U layer of the cube,



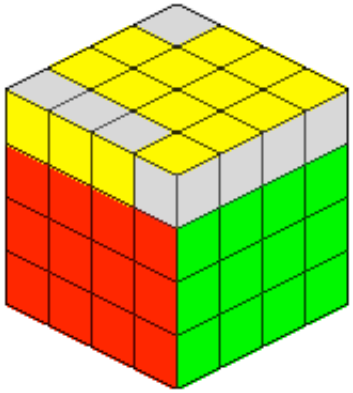
Using these two algs you can influence the LL a little bit,



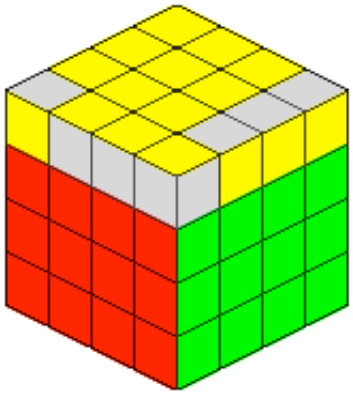
If you use the speedsolve version of the parity alg it will leave the LL completely oriented, taking you straight into a PLL case.



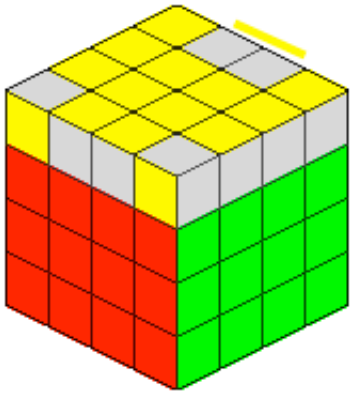
If you use the pure form of the parity alg you will end with the LL completely oriented.



To solve the parity and end with oriented LL do: **R2 B2 R2 (speed solve form of the parity alg) R2 B2 R2**



To solve the parity and end with oriented LL do: **L U L' (speed solve form of the parity alg) L U' L'**



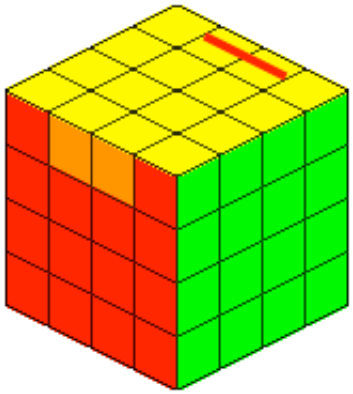
To solve the parity and end with oriented LL do: **(r' l) (speed solve form of the parity alg) (r l')**

Click here for some more OLL parity tricks

PLL parity

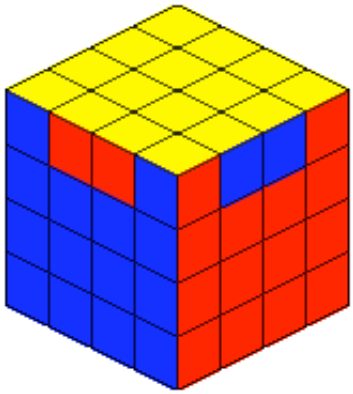
The PLL parity is caused during the edges step. When forming the edges you only have a 50-50 chance of creating a cycle amongst those edges that has the same parity as the corner permutation. The parity of the corner and edge permutation must be the same in order for the cube to be solvable as a 3x3x3. If this is not the case, you will get the PLL parity.

There aren't really any tricks for this case, just two cases.

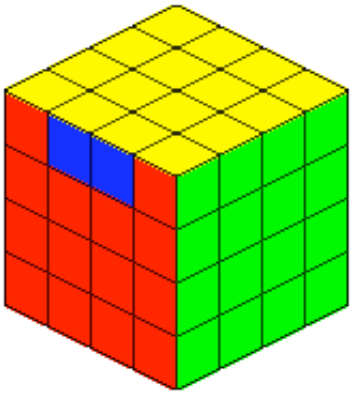


(Uu)2 (Ll)2 U2 l2 U2 (Ll)2 (Uu)2

performed as: **[(Uu)']2 [(Ll)']2 (U')2 ([(Ll)']2 L2) (U')2 [(Ll)']2 [(Uu)']2**



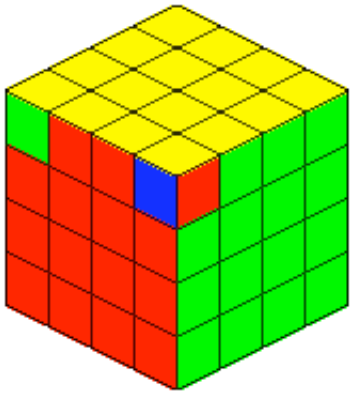
Front/Left View



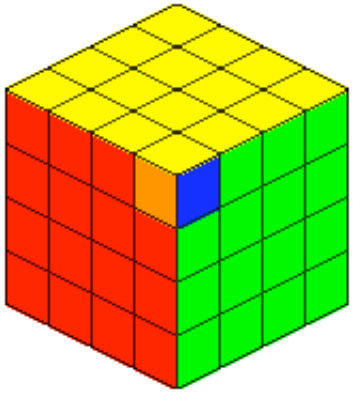
Front/Right View

L2 D (Ff)2 (Ll)2 F2 l2 F2 (Ll)2 (Ff)2 D' L2
performed as: **L2 D x [(Uu)']2 [(Ll)']2 (U')2 ([(Ll)']2 L2) (U')2 [(Ll)']2 [(Uu)']2 x' D' L2**

These last two cases can be avoided almost 100% of the time with some careful planning ahead, but if you do run into one of them you should know how to solve it.



(Uu)2 (Ll)2 U2 l2 U2 (Ll)2 (Uu)2 F' U' F U F R' F2 U F U F' U' F R
performed as: **[(Uu)']2 [(Ll)']2 (U')2 ([(Ll)']2 L2) (U')2 [(Ll)']2 [(Uu)']2 y [(L U' L) (U)] [(L F' L2) (U)] (L U L') (U' L F)**



(Uu)2 (Ll)2 U2 l2 U2 (Ll)2 (Uu)2 R U' L U2 R' U R L' U' L U2 R' U L' U
performed as: **[(Uu)']2 [(Ll)']2 (U')2 ([(Ll)']2 L2) (U')2 [(Ll)']2 [(Uu)']2 (R U') (L U2) (R' U R) (L' U' L) U2 (R' U L') (U)**

Appendix A

I'm working very hard on applying ZBF2L and ZBLL to the 4x4 when solving as a 3x3. So far I have a page up to help me with ZBF2L, but I have yet to get something online for ZBLL. This is still something I'm working on, but if you're interested you can see the page.

Using ZBF2L on the 4x4x4

Step 1: Centers | **Step 2: Edges** | **Step 3: Fix parity**

Go back

My notes for using ZBF2L for the 4x4x4

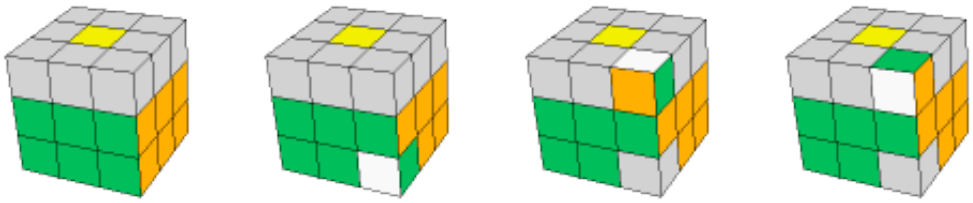
This page is really meant just for me, though I include it on my page on the offhand chance that one day someone may have the interest to study it. The purpose is so that I can have a single place where I can easily tell which ZBF2L cases should have an even number of edges showing in the top layer, which ones should have an odd number showing, and which ones may have both. This will help to 1) sometimes identify the parity error before finish ZBF2L, and 2) allow myself to solve an easier ZBF2L case than I actually may have when I do have the flipped edge parity error.

I will split these into two categories, when the middle layer edge is in the middle layer, or in the top layer. For each case I find it easiest to see whether the middle layer edges is flipped or not flipped.

Middle layer edge is in the middle layer

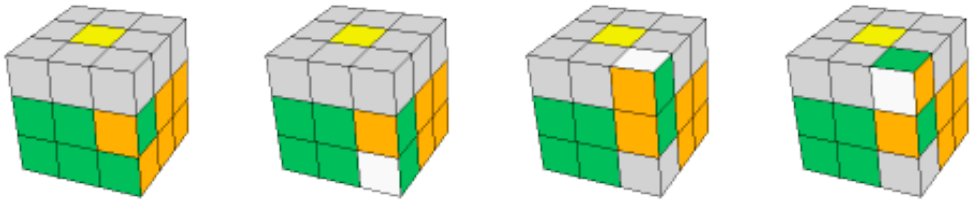
Even parity cases: Obvious

Given a solvable 3x3x3 cube configuration, these cases **must** have an even number of edges showing in the top layer.



Odd parity cases: Obvious

Given a solvable 3x3x3 cube configuration, these cases **must** have an odd number of edges showing in the top layer.



Middle layer edge is in the last layer

I'm still working on a way to handle these cases, based on how recognition seems to go for me when solving. What I think will be useful is to look and try to identify 1) the F2L case, 2) whether the middle

layer edge is flipped or not, 3) whether the number of flipped edges is even if the middle layer edge is correct or odd if the middle layer edge is flipped. I haven't practiced this method much, but it seems that it might work.

Middle layer edge correctly flipped

Even number of correctly oriented last layer edges in the last layer
Odd number of correctly oriented last layer edges in the last layer

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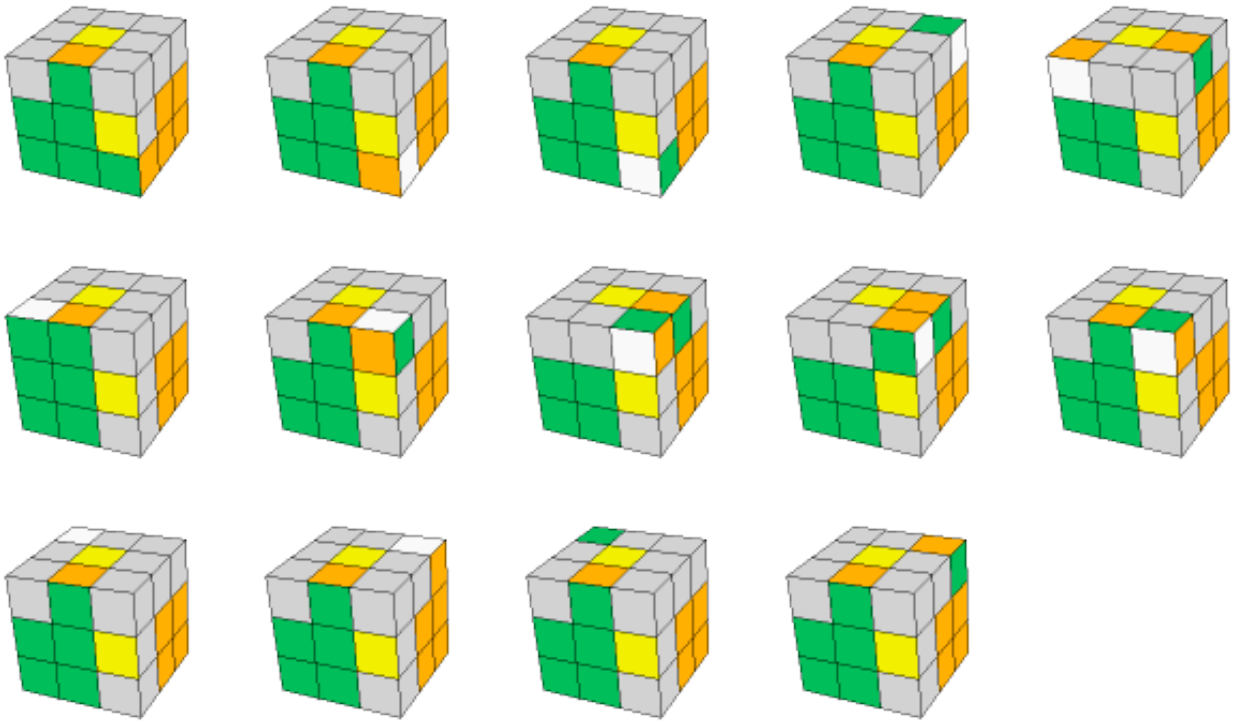
Go back

Middle layer edge correctly flipped

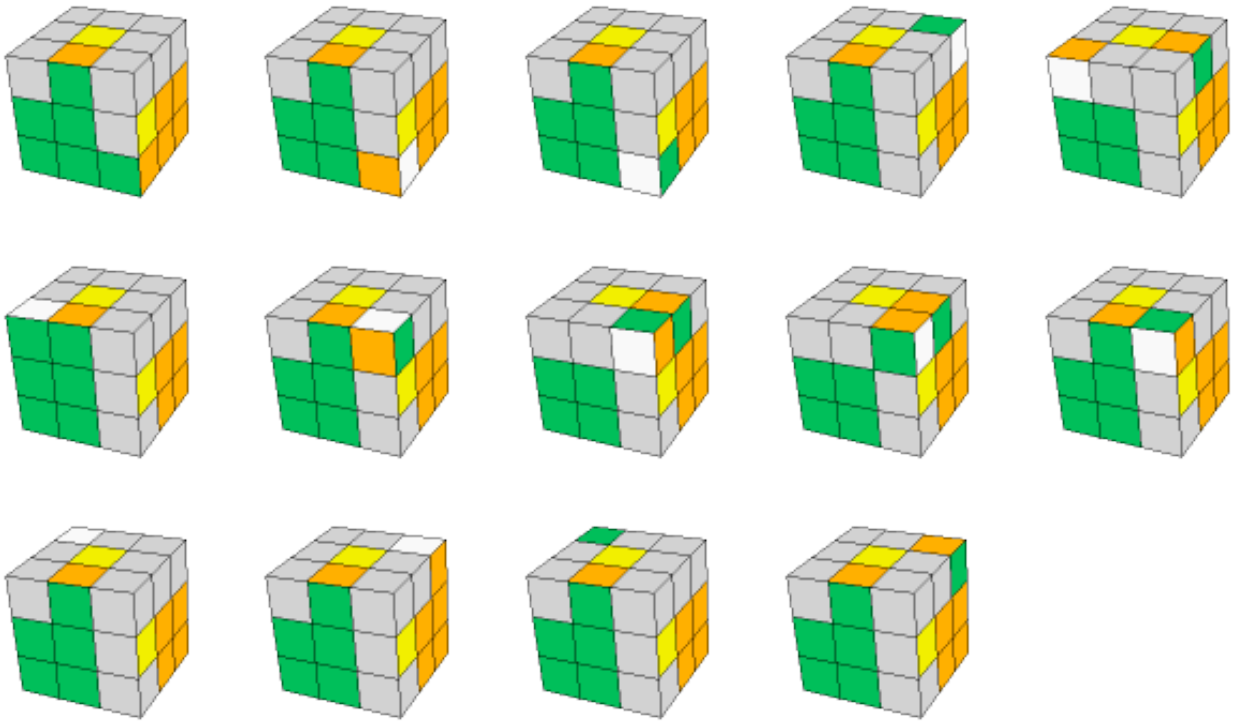
Even number of correctly oriented last layer edges in the last layer



Go back

Middle layer edge correctly flipped

Odd number of correctly oriented last layer edges in the last layer



Go back