

L7E: Last Seven Edges (Revision 1.0)

Revision History:

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This document describes a method to solve the last 7 edges in 2 looks (a couple of set up moves, one algorithm, then permute the midges). This is used in WaterRoux (Waterman-Roux hybrid), LMCF, and can be used as a variant of the original Waterman method.

It has been primarily developed for WaterRoux. An example WaterRoux solve is as follows:

1. FB
2. 2x2 Block on back right (partial second block)
3. Insert the DFR corner in random orientation (0-4 moves ultra fast)
4. Solve the corners now with either CMLL, TCMLL+, TCMLL- based on the DFR corner orientation
5. Based on the status of the last 7 edges, you finish the solve with a variable algorithm set based on your preference and how low move count you want

Here is an example:

https://alg.cubing.net/?alg=x2_D-_R...D2_U2_R-_D2_L2_R2_U-_F_L-_D_U2_F-_D2_L2_R_D2

Scramble: B2 R F2 R2 D2 U2 R' D2 L2 R2 U' F L' D U2 F' D2 L2 R D2

x2 D' R2 B L' U x // first block
L2 D' L2 U' F' U' F r' // partial second block
R U R' U F' U2 F // TCMLL-
U M U' M2 // solve UL edge
R U r' U M' U' r U' // Waterman L6E Set 1 case 7B
r' U2 M' U2 M2 // permute midges

Total 37 STM full step

It also works as a hybrid method where you can finish the second block Roux-style if the case is favorable, otherwise branch into the Waterman variant and insert the DFR corner in random orientation if the second block is unfavorable. In WaterRoux you can solve the FR edge intuitively with keyhole (U, M, R moves). Then you can finish with traditional Roux LSE. However this is not ideal as it can take up to 8 moves to solve the FR edge in bad cases. A much better option is to use an expanded algorithm set which primarily handles the 'bad' cases. In the 'good' cases, FR can still be solved in 0-4 moves intuitively, then you can finish with classic Roux LSE.

When you know algorithmic L6E/L7E, you solve UL, UR, and FR at the same time in a single algorithm which simultaneously orients all four midges (M-slice edges).

The general sequence for L7E is:

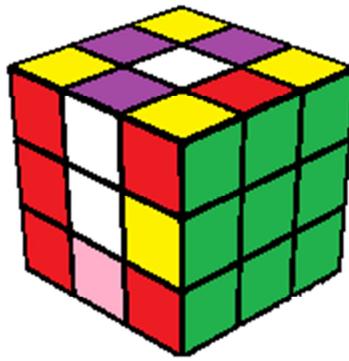
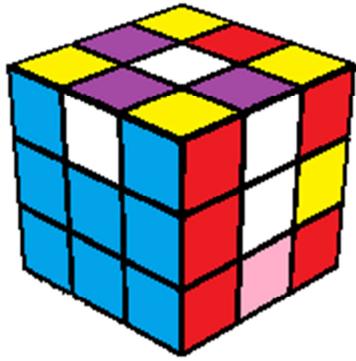
Set up into the algorithm: 0-5 moves maximum, average 2

Execute the algorithm to solve UL, UR, FR and orient midges (3 to 13 moves) [average is around 10]

Permute the midges (3-5 moves) [average 4.5]

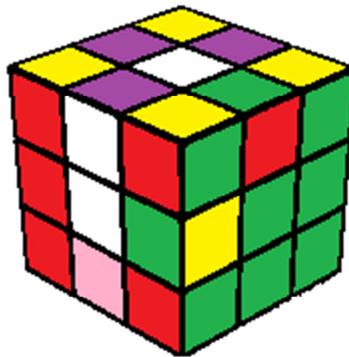
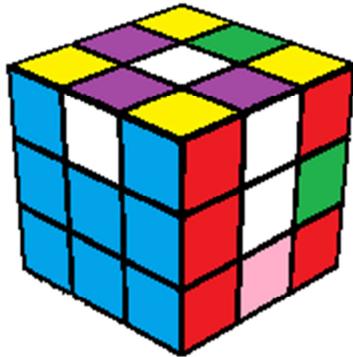
For minimum movecount, there quite a number of situations that need to be dealt with separately. This document provides 2-look L6E cases including classic Waterman L6E, as well as the newly generated L7E. It is extremely important to understand that ANY case of last 7 edges can be set up into the algorithm phase in an absolute worst case of 5 moves and the average is just 2 moves, assuming you know all the cases. The average move count for L7E is around 15-19.

We will now go over the many different scenarios that can occur and how to resolve them in minimum moves.



L7E Set 1: FR and UR are oriented and swapped. Solve DF or BD into UL, while simultaneously solving FR and UR and orienting all 4 midges. The blue facelet is on the D face. Observe the orientation of the three purple facelets and use the table below. Compare the color of the facelet with respect to the U center piece (same or opposite color = oriented, random color = disoriented).

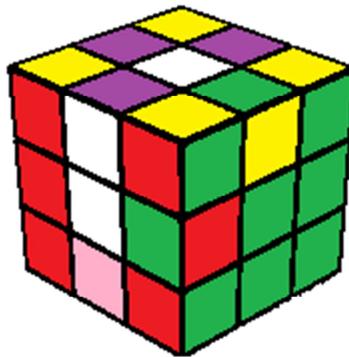
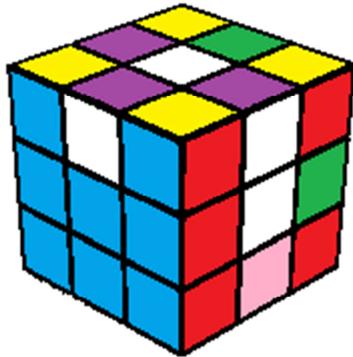
Top 3 facelet (black=bad)	<u>DFL (DF->UL + orient midges)</u>	<u>BDL (BD->UL + orient midges)</u>
	U' M' U' M2 U r U' M' U' r' U (11) R U' M' U R' U' r U' M U r' U (12) F U M' U' F' R U' M' U [9]	R U M U M2 U' r' U M U' r U' U M U' R U r' U M' U' r U' R B' U' M U B R' U M U'
	U R U2 M' U M U r' U' M2 U' M U [13] U M U M' U2 r U' M U r' U' M' U [13] U2 M U' M' U' R B' U' M' U B [11]	R U R' U M U' r U' r' U' M' U R U' R' M' U' M U R U M' U M2 U' r' U' M U R' F U M U' F'
	F' M2 U' M U M2 F R U' M' U [11] U' R' r2 U M U M' U M2 U R' U [12] U' M2 U R U' M2 U r' U' M U [11] x U R' U M U' I U M' U' F' [10] L U' M' U F' M2 U' M U F [10]	R U2 R' U' M U2 M' U' r U' M' U' R U' M' R' U' M2 U M' U M U' r U R M B' R' U' M2 U R U' M' U B
	U2 R U M' U2 M U r' U M U [11] U M R U M2 U' M U' M' U r' U' [12] M' F R U M2 U' R' U M U' F' [11]	R B M2 U M' U' M2 B' R' U M U' R U R r2 U' M' U' M U' M2 U' R U' R U M2 U' R' U M2 U' r U M' U' x R U' R U' M' U I U' M U B
	U' r U' M U r' U' M U M2 U [11]	R U r' U M' U' r U M' U' M2 U'
	U' M' U R U' M U R' U' M' U [10] U M U' R U M' U' R' U' M' U [11] U' M' U r U' M2 U R' U' M2 U [11] U' M' U' r U' M' U2 M U' R' U2 [11] U' M' U' r U' M' U2 M U' r' U2 [11] U R U M U' R2 r U' R U' M' U [12]	R U M U' R' U M' U' R U M U' R U' M' U R' U' M U R U M U' R U M U' r' U M2 U' R U M2 U' R U M U r' U M U2 M' U R U2 R U M U r' U M U2 M' U r U2 R U' R' U' M' U R2 r' U R' U M U'
	U' R U' M' U r' U r U M U' [11] U R M U M' U' R' U' M U' M2 U [12] M U M' U' R B' U' M' U B [10] M U M' U' I U' F' M' F U [10]	R U' R' U2 M U' M' U' r U M2 U M' U' R U' M' U' M U2 r' U M' U' r U M U' R U2 M' U M U R' F U M U' F'
	M' U r M' U M2 U' M2 R' U' [10] U' M' U r B' U' M' U B [9] U' M' U L U' F' M' F U [9]	R M U' r' M U' M2 U M2 R U R U M' U' r' F U M U' F' R U M' U' L U B M B' U'



L7E Set 2: UR and FR are swapped and disoriented. Solve DF or BD into UL, while solving FR & UR, and orienting all 4 midges. Observe the purple facelets orientation with respect to the U center (same or opposite color = oriented), and select the algorithm from the table below.

There are 16 cases (8 for DF->UL, 8 for BD->UL).

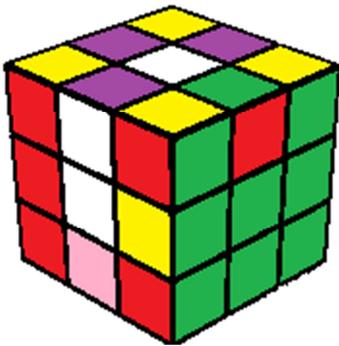
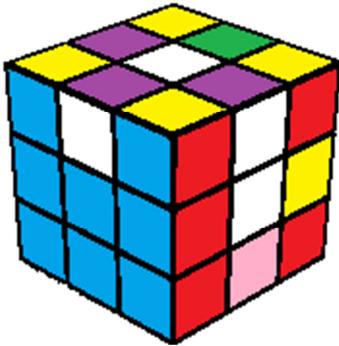
Top 3 facelet (black=bad)	DFL (DF->UL + orient midges)	BDL (BD->UL + orient midges)
	U [M R] U M U M' U M2 U r' U' [12] or U r U2 M' U M' U M2 U' M U R' U' [13]	R U' [M' R'] U' M' U' M U' M2 U' r U R U' r' U2 M U' M U' M2 U M' U' R U
	U2 r U' M' U r' U2 M U' M2 U [12] or U2 r U M U M' U2 [M' R'] U' M2 U' [12] U2 r U' M' U [M' R'] U2 M U M2 U' [12] F U' M2 U2 F M' F' U' F' [9]	R U M U M' U r' U M U' M2 R U r M' U r' U' M2 U' M' U2 r U2 M U R M U2 R' U M U M U2 r U M2 U R U' r' U M U' M' U2 M U M2 U R U
	M U' M2 U' R U M' U' R' U2 [10] or U2 r U2 M' U M' U R' U' M2 U' [11] U' M' U M' U2 R U M' U' R' U2 [11]	r U2 R' U' M' U r' U' M' U' [10] R U M U r' U' M U R U2 [10] R M U2 r' U M U' R U M2 U
	M U2 R U M U' r' U M U [10] or U' M' U' r U M' U' R' U2 [9] M' U2 r U' M' U R' U' M2 U' [10]	r U M2 U R' U' M U R U2 R U2 r' U2 M U' M U' R U M2 U R U M U' M U2 R' U' M U R U2
	U' M2 U M U' R U M2 U' r' U [11] or M2 U M U R U' M2 U r' U' M2 U' [12]	R U M2 U' M' U R' U' M2 U r U' r M' U' M' U' R' U M2 U' r U M2 U
	U2 R U M U' R' U M2 U [9] or R U2 R' U M U' R U M2 U [10] U2 R U' M U R' U2 R U' M2 U (11) r M' U2 r' U' M' U r U' M' U' (11)	R U2 R' U' M' U R U' M2 U' U2 R U' M' U R' U' M2 U' [9] R U2 R' U M' U' R U2 R' U M2 U' M2 U2 r U M U' r' U M U [10]
	U' M' U' M U' r U' M' U [M2 R'] U' [12] or M2 U' r U M2 U M U2 r' U2 M' U' (12) M' U2 R U' M' U' M' U2 r' U' M2 U' (12) U r U' M' U M U2 M' U' M2 U' R' U' (13)	R U2 r' U M U' r U2 M' U M2 U' R U2 r' U' M' U' M U2 [M R] U M2 U R U2 r' U M U' [M R] U2 M' U' M2 U R B' U M2 U2 B' M B U B
	M F U' M2 U F' [6]	r B' U M2 U' B [6] L U' F M2 F' U [6]



L7E Set 3: UR and FR are in place but disoriented. Solve DF or BD into UL while solving UR & FR and orienting the midges. Observe the orientation of the purple facelets with respect to the U center (same or opposite color = oriented), then select the algorithm from the table below.

There are 16 cases (8 for DF->UL, 8 for BD->UL).

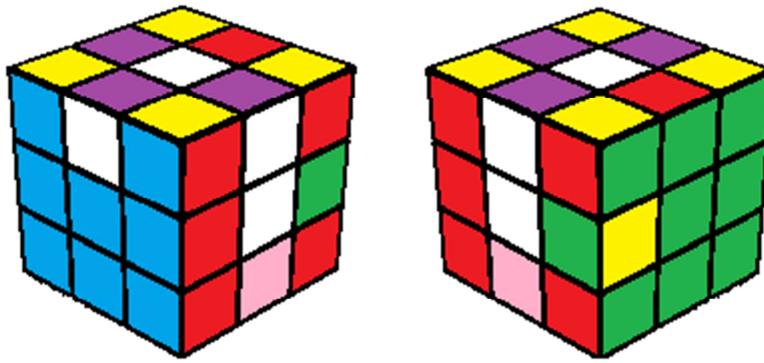
Top 3 facelet (black=bad)	<u>DFL (DF->UL + orient midges)</u>	<u>BDL (BD->UL + orient midges)</u>
	$U' r U M U' M' U' M' U R r2 U$ [12]	$R U r' U' M' U M' U M' U' R' r2 U'$
	$r U M2 U2 M U r' U' M2 U2 M' U'$ [12]	$R U M2 U2 r' U M U2 M2 U R U$
	$r U M U2 M2 U r' U' M2 U2 M' U'$ (12) or $R U2 r' U' M' U2 M2 U' r U' M' U'$ (12) $r U' M2 U2 M' U' r' U' M2 U2 M' U'$ (12)	$R U M U r' U' M' U2 M2 U' R U2$
	$U' M' U' r U M U2 M2 U R' U2$ [11]	$M U' M' U2 M2 U' r U M2 U2 M U$ [12] $U2 r U M U2 M2 U r' U M U$ [11] $M U M2 U2 M U r U M2 U2 M U$ [12]
	$R B' U' M2 U2 M' U' B$ [8]	$F U M2 U2 M U F'$ [7]
	$R U2 R' U' M' U2 M2 U' R U' M2 U'$ (12) $U M2 U' F U M' U2 M2 U F'$ [10]	$U2 R U M U2 M2 U R' U M2 U$ [11] $R U' M2 U B' U' M U2 M2 U' B$ [11]
	$U' M2 U2 r U' M' U2 M2 U' R' U'$ [11]	$M U' M2 U2 M' U' r U M2 U2 M U$ [12]
	$R U M' U' r' F U' M2 U2 M' U' F'$ [12] $U' r U2 M' U M' U' M' U' M' U' r' U$ [13]	$U' M U r B' U M2 U2 M U B$ [11] $R U r' U2 M U' M U M U M U r U'$



L7E Set 4: UR and FR are swapped; FR is oriented, UR is disoriented. Solve DF or BD into UL while solving UR & FR and orienting the 4 midges. Observe the orientation of the purple facelets with respect to the U center (same or opposite color = oriented), then select your algorithm from the table below.

Top 3 facelet (black=bad)	<u>DFL (DF->UL + orient midges)</u>	<u>BDL (BD->UL + orient midges)</u>
	U2 R2 r' U M U' R' U' M' U' [10] R U' M' U' R' U' M U R U2 [10] R U' M' U' R' U' M U r U2 [10] M U2 R U M U' R' U' M' U' [10] U2 R U2 M U' M U' R' U' M' U' [11] U2 R2 r' U M U' R' U' M' U' M' U2 [12] M2 U2 R2 r' U' M' U R' U M U [11] R U' M' U' R' U' M U' M U2 r U2 [12] R U' M' U' R' U' M U' M' U2 R U2 [12] R U' M' U' R' U' M U R' r2 U2 [11] R U' M' U' R' U' M U R2 r' U2 [11] R U' M' U R' U2 R U M U' r' U2 [12] R U' r U' R2 U' M U R2 U R' U [12] R U2 r' U' M U R U2 R' U M' U' [12]	R U M U R' U M' U' R U2 [10] U2 r U' M' U R' U M U [9] M2 U2 r U M U' R' U' M' U' [10]
	U' M2 U M2 U' R' U' M' U' r' U [11] M' U2 R2 r' U M U' r' U' M2 U' [11] U' R' r2 U' M U2 M2 U M' U2 R' U [12] U' R' r2 U' M U2 M2 U' R' U2 M' U' [12] U' M2 U' M2 U' R U M U' R2 r U' [12] M U' M2 U M2 U' r U' M' U' r' U [12]	R U' M' U2 M' R' U' M2 U r U' [11] R U R' U2 M' U2 M' U' M2 U r U' [12] R U M2 U2 M U2 r' U' M2 U r U' [12]
	R U R' U2 M2 U M2 U r U' [10] R U' M2 U2 R' U' M2 U r U' [10] U M U2 R2 r' U M' U2 M2 U r' U U2 M' U R U2 M U M2 U R r2 U U2 M' U r U M2 U M2 U2 R' U [11] U2 M' U r U M2 U' R' U2 M2 U' [11] R U R U2 M2 U2 R2 U' M2 U r U' [12] R U R r2 U M2 U M2 U2 R2 r' U' [12] R U R r2 U M2 U' r U2 M2 U [11] R U R2 U2 M2 U2 R U' M2 U r U' [12] R U R' U2 M2 U M2 U r U M U2 [12] R U' M2 U2 R' U' M2 U r U M U2 [12] R U' M' U2 R' U2 M' U M2 U r U' [12]	M U' r U M2 U M2 U2 R' U [10] R U R' M2 U M2 U M U2 R U' [11] M U' r U M2 U' R' U2 M2 U' [10]
	M' U R2 r' U' M2 U R' U2 M2 U [11] M' U R2 r' U' M2 U' M2 U2 R' U' [11] M' U r U2 M2 U' M2 U' R r2 U' [11] U M2 U' R U' M U r' U M U' [11] R U' R r2 U' M2 U' M' U2 R U [11] R U' R r2 U' M2 U R U2 M' U' [11] M' U R U2 M' U' M2 U' R r2 U' [11]	R U' R' U2 M2 U' M2 U' M R U [10] R U M2 U2 R' U M2 U' M R U [10] R U' R' U M2 U' M2 U' M2 U r U [12]

	U M2 F M F2 M F M U' [9] U M2 x U M U2 M U M U' [9] U' r U M2 U' R2 r U2 M' U' [10] U' M' U' R U M U2 M' U' r' U2 [11] U R2 r' U M U2 M U R r2 U' [11] U' r U M2 U M2 U2 r' U2 M U' [11] U' r U M2 U' R2 r U2 M' U M U2 [12] U' r U M2 U' r U2 M' U2 R2 U [11] U' r U M2 U' r' U2 M U2 M2 U [11] U' r U M2 U' M' U2 M' U2 R' U [11] U' r U' M' U2 M' U M U2 r' U [11] U' M' U' r U M' U' R' U M U' [11] R U M' U' B' U M U2 M' U B [11] R U' M' U2 M2 U' B' U M2 U' B [11]	R U R' M2 U' M' U2 M' U' r U' [11] R U' R U R U R2 U' R' U' r' U' [12]
	U' M2 U M F U M' U' F' [9] U R U' M' U' M2 U' M' U' r' U' [11] U' R' r2 U M' U' R' U' M2 U M U [12] U R U' M' U' M2 U' M' U' r' U M' U2 [13] U R' r2 U' M' U R r2 U' M' U' M2 U [13] U r U2 M2 U' M2 U' r' U' M' U' M' U' [13] U' R' r2 U M U M' U' M' U' r' U [12] U' R' r2 U M' U' R' U M2 U M' U' [12] R U' M' U r' F M2 U' M' U M' F' [12]	U M' U' r' F' U M U' M' F [10] M' U' r' U' M' U' M2 U' M' U' R U [12] U' M U' M' U' r' U' M2 U' M2 U2 r U [13] U2 M' U r' U' M' U' M2 U' M' U' R U [13] U R' U' M2 U r U' R r2 U M U' [12] R U M2 U2 M U M' U' r' U' M2 U r U' [14] R U r' U R' r2 U M U' r' U' R U' [13] R U M U' R' U R' r2 U' M U' r' U' [13] R U M U' M2 U' R' U' M' U' r U2 M' U' [14] U M2 U2 M2 U R B' U' M' U B [11]
	U R U' M2 U' M' U' M2 U' r' U' [11] M2 U2 R U M' U' r' U' M2 U' [10] U R U M2 U' M' U' M2 U' r' U' [11] U2 R U2 M2 U' M' U' r' U' M2 U' [11] U2 R' r2 U' M' U R2 r U M2 U [11] R U M U2 r' U M2 U' R2 r' U [11] R U M' U2 r' U' M2 U' M2 U2 r U [12] R U' M' U M U2 r' U M' U' R U2 [12] R U' M' U M' U2 r' U' M U R U2 R' [12]	U M2 U M2 U R U' M' U' r' U [11] M U2 r U' M' U' r' M' U M2 U [11] R U M U r' U2 M' U' M' U' R U2 [12] R U M U' r' U2 M' U' M' U' r U2 [12] R M2 U2 M' U M2 U' r' U' M U r U2 [13]
	U' M' U M U' r' U' M' U' r' U [11] U' M' U' F R U' M' U' R' F' U2 [11]	r U' M U R' F' U M U' M' F [11] R U r' U2 M U' M U M2 U M' U R U' [14] R U r' U M' U' R M U' M U M' U' [13] R U r' U M' U2 M U M U' M' U' r U' [14] R U r' U M2 U M' U' M U' R U2 M U [14] R U r' U M2 U M' U' M U M U2 R U' [14] R U M' U2 r' U' M' U' M2 U M' U R U [14] R U M U2 r' U M U' M2 U' M' U R U [14]

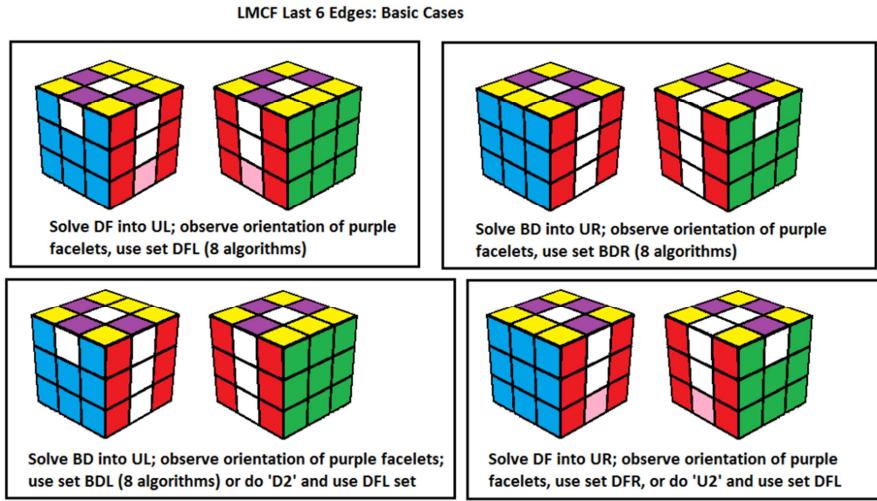


L7E Set 5: UR and FR are swapped; UR is oriented, FR is disoriented. Solve DF or BD into UL while solving UR & FR and orienting the 4 midges. Observe the orientation of the purple facelets with respect to the U center (same or opposite color = oriented), then select your algorithm from the table below.

Top 3 facelet (black=bad)	<u>DFL (DF->UL + orient midges)</u>	<u>BDL (BD->UL + orient midges)</u>
	U' M' U' R U' M U R' U2 [9] R U2 r' U M U' R U' M' U' [10] R' r2 U2 r' U' M' U R U M U [11]	U M U R U M' U' R' U2 [9] r U2 R' U' M' U R U M U [10]
	U' M' U' r U2 M U M U R' U2 [11] U' M' F' M2 F U R' F M' F' [10] U' x M' U' M2 U B R' U M' U' [10] U' M' U' r U2 M U M U r' U2 [11] r U2 r' U M U' R2 r' U' M2 U' [11] M2 U2 M U' M2 U r U M' U' r' U2 [12] R U' M2 U' M2 U' R' U M U' r U' [12]	U' M' U2 r U' M2 U M' R' U' [10] U M U' M U2 r U M' U' R' U2 [11]
	U R U2 M2 U M2 U M' R' U' [10] U M' R' U M2 U M2 U2 r' U' [10] U' M2 U2 R U' M2 U M' R' U' [10] U R U' M2 U M2 U M2 U' r' U' [11]	U r M' U M2 U M U2 R' U' [10] U r M' U M2 U' R' U2 M U [10]
	r U r' U' M2 U' M2 U2 R U' [10] U' R' r2 U' M2 U R' U2 M' U' [10] U' R' r2 U' M2 U' M' U2 R' U [10] r U r' U' M2 U R U2 M2 U [10] F' M U M' U' F R U' M' U [10]	U' R U2 M2 U' M2 U' r' U [9] U M2 U2 R U M2 U' r' U [9]
	U' M' F M F2 M F U [8] U' R' r2 U M U2 M U r' U [10] U R' U' R' U' R2 U R U r U [11]	R U r' U' M2 U M U2 M U2 R U' [12] U' M U F U' M' U2 M U' F' [10] U M U2 M2 U F U' M2 U F' [10]
	U' M U r B U' M' U M B' [10] BAD M U r U M U M2 U M U R' U' [12] U M' U M U' r U M2 U M2 U2 r' U' [13] U2 M U' r U M U M2 U M U R' U' [13] U' R U M2 U' r' U R' r2 U' M' U [12] U' r U' R r2 U' M' U r U R' U [12] U' M2 U M' U R' r2 U' M' U R r2 U' [13] U' M2 U2 M' U' M U' r U M2 U' r' U [13] U' M' U R U' R r2 U M' U' r U [12] U' M' U M2 U R U M U' r' U2 M U [13] R U' M2 U2 M2 U' R' F U M U' F' [12]	R U' R' U M U M2 U M U r U [12] R U R' M2 U' M' U' M U M U R U' [13] R U R' M2 U' M U R U' M2 U' M U [13] R U M2 U' M' B' U' M U B [10]

	U M U2 R2 r' U M2 U' r' U [10] U M' U2 r U2 M2 U' M2 U' r' U [11] U' R U2 M U2 M U M2 U' r' U [11] U' M2 U2 M' U2 r U M2 U' r' U [11] U' M' U r U2 r' U M U' R U2 [11] U' M' U r U2 r' U M U' r U2 [11]	R U M2 U' M2 U R' U M U' r U' [12] R M U2 R' M' U' M' U r U M2 U [12] R U R' M2 U M' U2 M2 U' M U2 R U' [13] R U R' M2 U M' U2 M2 U R U2 M U [13] R U M2 U M2 U R' U' M' U R2 r' U [13] R M' U M2 U' M2 U r' U M U' r U' [13]
	M U M' U' R B U' M' U M B' [11] BAD U' r U2 M' U M' U' M2 U' M U' R' U [13] U' r U' M U R2 r U M' U' M U [12] U' r U' M U2 M' U' M' U M U' r' U [13] U' r U' M2 U' M U M' U' R' U2 M' U' [13] U' r U' M2 U' M U M' U' M' U2 R' U [13] U' M U2 r U M U M2 U' M U' R' U' [13] U' M' U2 r U' M' U M2 U M U' R' U' [13]	R U M U' M' U r' U M U' r U' [12] R U M U B' R' U M U' R B U2 [12]

The next case is both UR and FR are unsolved but UR is solved. This is similar to Roux LSE except the L/R faces may be misaligned, making Roux LSE recognition difficult. The first variant is where you intuitively solve UR or UL, leaving just one of UL/UR unsolved as in the following diagram. When observing the orientation of the purple facelets, compare them with the U center piece; same or opposite colors compared to the center means oriented, and random color means disoriented.

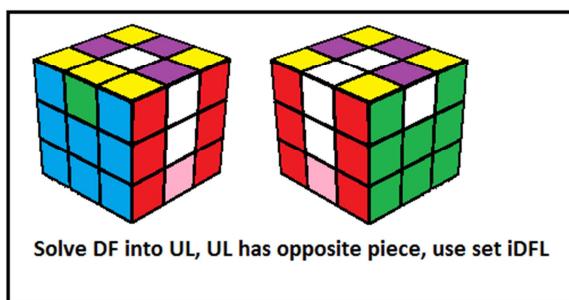
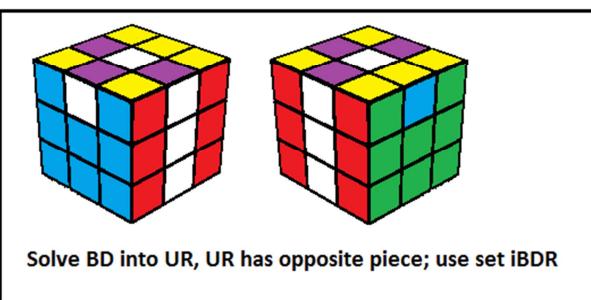
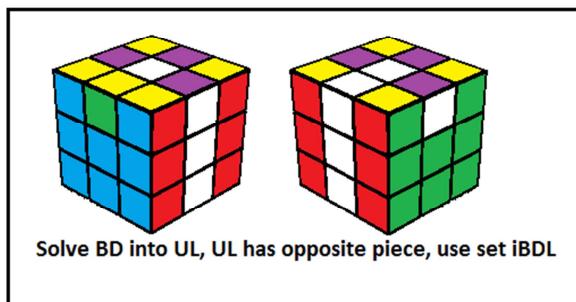
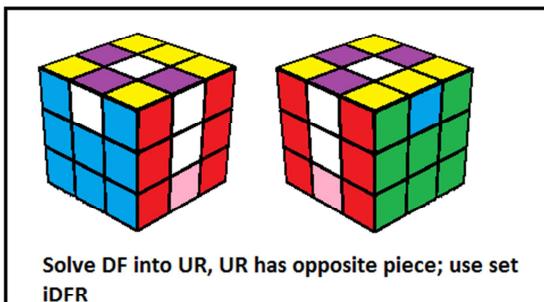


Average move count for this set is 8.12.

Top 3 facelet orientations (black=bad)	<u>DFL (DF->UL + orient midges)</u>	<u>BDL (BD->UL + orient midges)</u>
	M' U M' U' M U' M' U [8]	M U' M U M' U M U'
	M' U' M U' M' U' M U' [8]	U2 M U' M' U' M U' M' U
	U' M U M' U' M' U [7]	U M' U M U' M U'
	U' M U' M' U M' U [7]	U M' U' M U M U'
	U' M' U' M U' M U M' U M U [11]	U M U M' U M' U' M U' M' U'
	U' M' U' M' U' M U2 M U [9]	U M U M U M' U2 M' U'
	U2 M' U M U M' U M U' [9]	M U M' U M U M' U
	M U M' U2 M' U [6]	M' U' M U2 M U'
	<u>DFR (DF->UR + orient midges)</u>	<u>BDR (BD->UR + orient midges)</u>
	M' U' M' U M U M' U'	M U M U' M' U' M U
	M' U M U M' U M U	U2 M U M' U M U M' U'
	U M U' M' U M' U'	U' M' U' M U M U
	U M U M' U' M' U'	U' M' U M U' M U
	U M' U M U M U' M' U' M U'	U' M U' M' U' M' U M U M' U
	U M' U M' U M U2 M U'	U' M U' M U' M' U2 M' U
	U2 M' U' M U' M' U' M U	M U' M' U' M U' M' U'
	M U' M' U2 M' U'	M' U M U2 M U

The next important variant is where one of UL/UR contains the opposite edge piece as shown in the following diagram (this case is also important because you can force it to happen in very few moves, quite often).

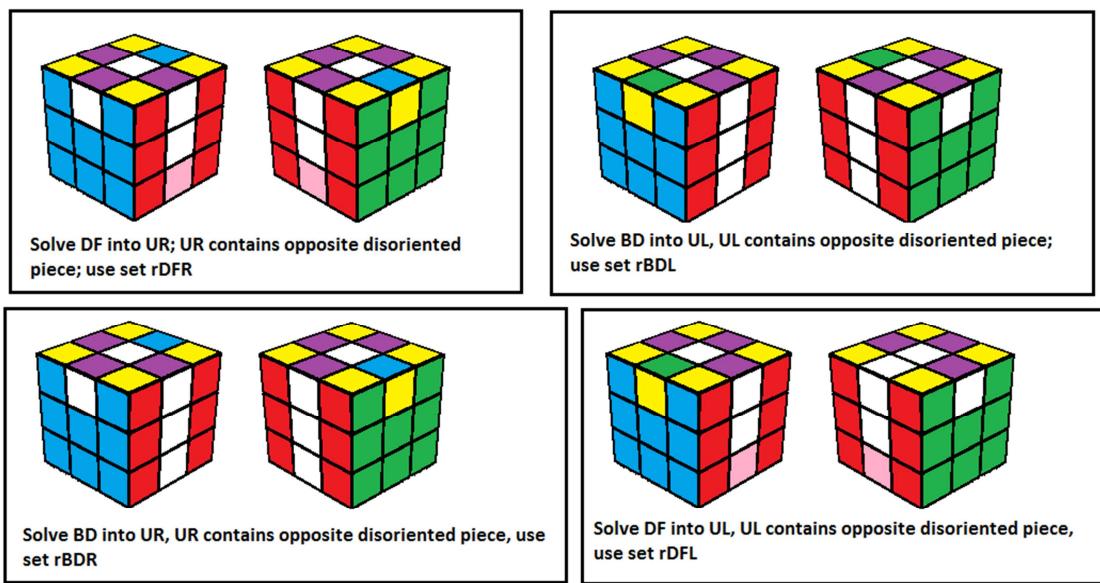
LMCF L6E inverted cases



Average move count for this set is 8.50.

The next variant is where UR/UL is has the opposite edge, disoriented:

LMCF L6E inverted cases

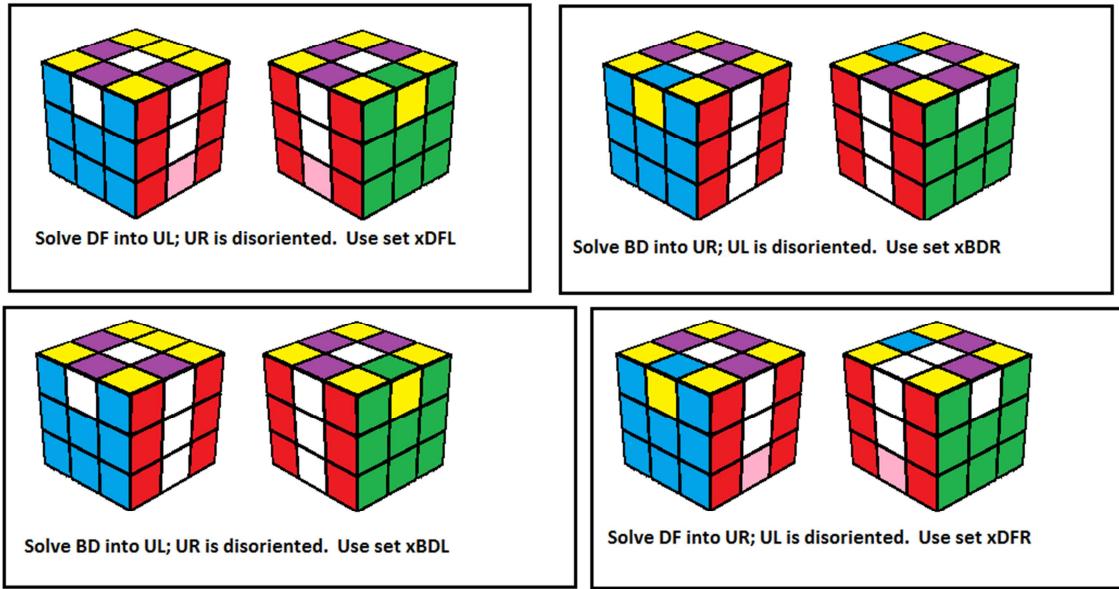


Average move count for this set is 7.87.

Top 3 facelet orientations (black=bad)	<u>rDFR (DF->UR + orient midges)</u>	<u>rBDR (BD->UR + orient midges)</u>
	U' M' U' M U' M' U M' U M2 U [11]	Use reflections
	U2 M' U2 M' U' M U [7]	
	U M2 U' M' U2 M U' M U' [9]	
	U M2 U M' U2 M U M U' [9]	
	U M U' [3]	
	M' U M' U2 M' U M U M' U' [10]	
	M' U2 M' U M U [6]	
	r B [M' R'] U M U' R B' [8]	
	<u>rDFL (DF->UL + orient midges)</u>	<u>rBDL (BD->UL + orient midges)</u>
	Use reflections	Use reflections

The next variant is where UR is flipped:

LMCF L6E inverted cases

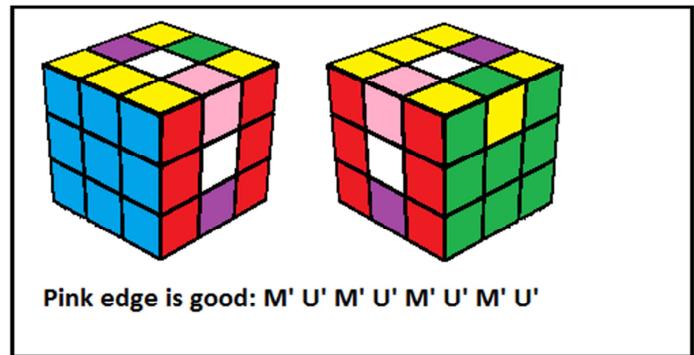
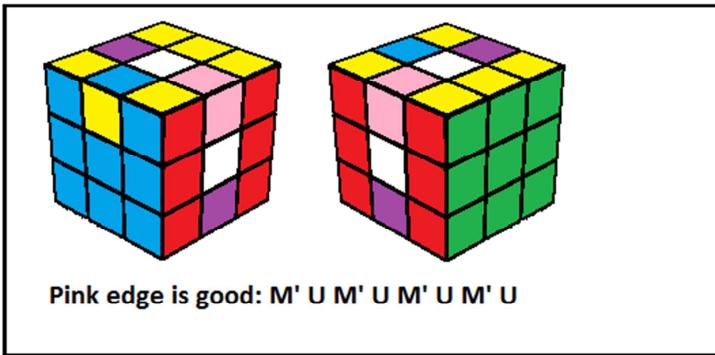
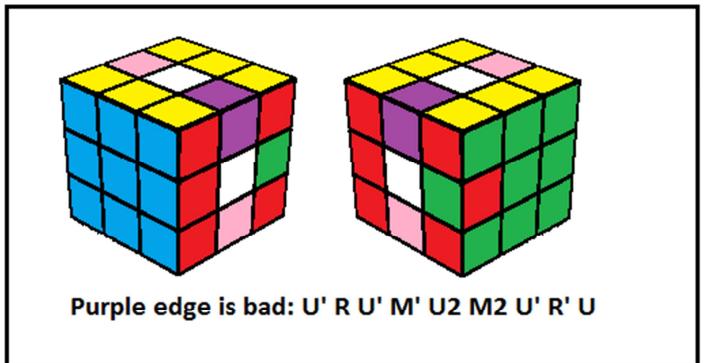
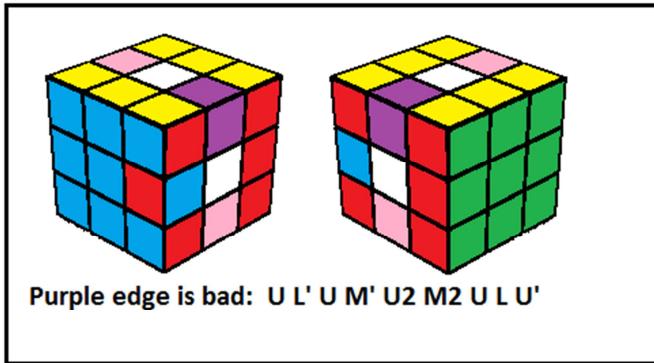


This set has an average move count of 9.00.

Top 3 facelet orientations (black=bad)	<u>xDFL (DF->UL + orient midges)</u>	<u>xBDL (BD->UL + orient midges)</u>
	U' M U' M' U M2 U M' U M' U' [11]	Use reflections
	U2 M' U2 M' U M2 U2 M U [9]	
	U' M2 U' M' U2 M' U' M U [9]	
	U' M2 U M' U2 M' U M U [9]	
	U M U2 M2 U [5]	
	M U M' U M U M U2 M' U' [10]	
	M' U2 M' U M' U2 M2 U' [8]	
	U' M U r U' r' U M' U' r U [11] U M2 U' M' U' M2 U M U M' U M U M' U [15]	
<u>xBDR (BD->UR + orient midges)</u>		<u>xDFR (DF->UR + orient midges)</u>
	Use reflections	Use reflections

More special cases:

LMCF L6E One edge inverted



UR and UL both solved and disoriented

2 adjacent disoriented midges at top: U M' U2 M U2 M' U' [7] or U M2 F2 M' F2 U' [6]

2 diagonal disoriented midges, UF and BD: U M2 U [M' U M' U M' U] M U' [11]

0 disoriented midges: U M' U M' U M2 U M' U M' U' [11]

4 disoriented midges: R' F R U M' U2 M2 U R' F' [10] (+R)

UR and UL both swapped and oriented:

0 disoriented midges: U M2 U2 M2 U [5]

2 disoriented midges diagonal, DF and UB:

U x' U R U M2 U' R' U' F' or

x' F U R U M2 U' R' U' F' [9] or

2-gen: U M U' M' U2 M' U M' U2 M2 U' [11]

2 disoriented midges adjacent (front): U' M U' M' U2 M' U M' U2 M2 U [11]

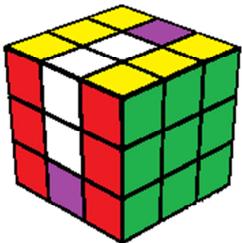
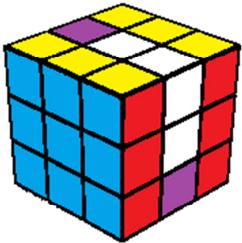
4 disoriented midges:

U M' U2 F2 M2 U M2 U M U2 F2 U [12] or

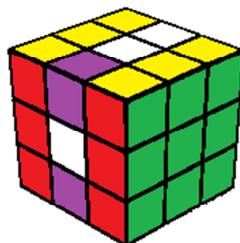
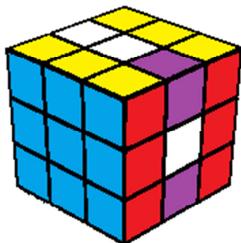
U M U2 M U r U' r' U M' U' r U [13]

(or 2-gen: U M' U' M' U' M2 - U M U M' U M U M' U [15])

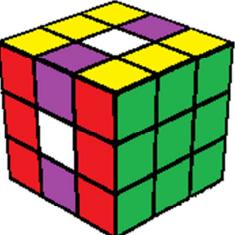
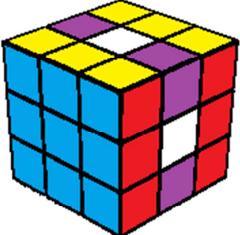
LMCF L6E: UL and UR have been accidentally solved and you must orient the midges:



2 disoriented midges at DF and UB:
 $U' M U M U2 M' U M' U [9]$



2 disoriented midges at UF and DF:
 $U M U M U2 M' U M' U' [9]$

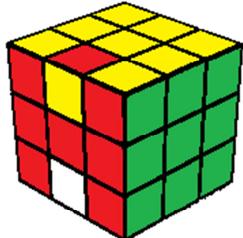


$U r' U M U' M2 R U' R' U M U' [12]$
 $U' M U2 M' U' R' F R U' M' U R' F' [13]$
 $U' M U M U' M' U' M' U M U M' U M U' [15]$

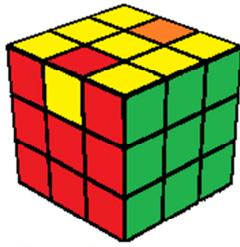
4 disoriented midges
Choose any of these

In the case that the entire cube is accidentally solved and all that is left is to flip edge pieces, these special cases should be mastered.

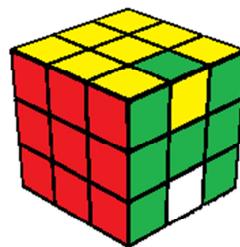
PURE EDGE FLIP CASES:



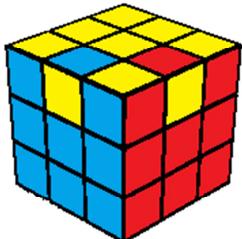
2 edges flipped at UF, DF:
 $U M U M U2 M' U M' U M' U2 M [12]$



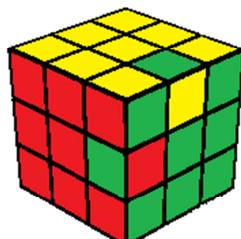
2-edges flipped at UF, UB:
 $M' U M' U M' U M' U2 M' U M' U M' U M' [15]$



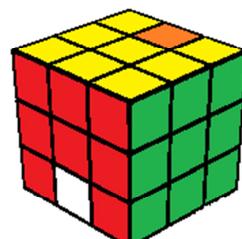
2-edges flipped at UR and DR:
 $U M U2 M2 U R2 U' M2 U2 M' U' R2 [12]$



Adjacent edges flipped at UL, UF:
 $M2 U M U2 M' U M' U M' U2 M U M' [13]$



Adjacent edges flipped at UR, FR:
 $U M U2 M2 U R U' M2 U2 M' U' R' [12]$



Diagonal opposite edges are flipped at UB and DF:
 $U' M U M U2 M' U M' U M' U2 M U2 [13]$

UR and UL both solved (by accident):

This case should only happen by accident, as recognition is slower than standard L6E, but the algorithms are below (exactly as shown in the above graphic):

0 disoriented midges: Skip and go to permute midges!

2 disoriented midges at DF and UB: U' M U M U2 M' U M' U [9]

2 disoriented midges at UF and DF: U M U M U2 M' U M' U' [9]

4 disoriented midges:

U r' U M U' M2 R U' R' U M U' [12]

U' M U2 M' U' R' F R U' M' U R' F' [13]

2 gen: U' M U M U' M' U' M' U M U M' U M U' [15]

If DF is already solved and you have just three edge pieces unsolved, you can solve them in a single algorithm 50% of the time, either of these two:

y' L2 U M' U' L2 U M U' [1-look solve if UF and UB are disoriented]

y' U M' U' L2 U M U' L2 [1-look solve if UF and BD are disoriented]

PURE EDGE FLIPS

If the entire cube ends up solved except for edge flips:

Diagonal opposite edges are flipped:

UB and DF: U' M U M U2 M' U M' U M' U2 M U2 [13]

2 edges are flipped (these are interchangeable based on setup)

UF and DF: U M U M U2 M' U M' U M' U2 M [12]

UF and UB: M' U M' U M' U M' U2 M' U M' U M' U M' [15]

UR and DR: U M U2 M2 U R2 U' M2 U2 M' U' R2 [12]

Adjacent edges are flipped:

UL and UF: M2 U M U2 M' U M' U M' U2 M U M' [13]

UR and FR: U M U2 M2 U R U' M2 U2 M' U' R' [12]

IMPORTANT TIPS FOR BASIC L6E

It is very important to consider the average move count of the main sets:

DFL set: **8.12**

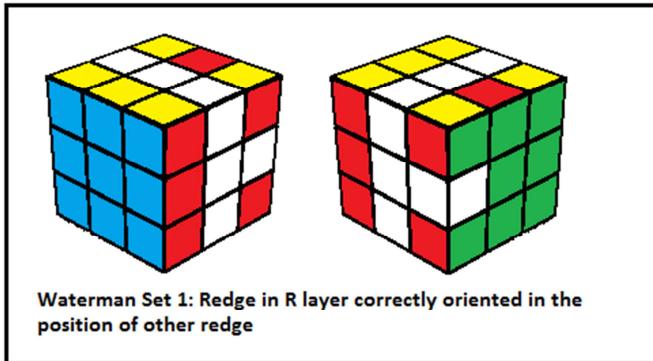
xDFL set: **9.00**

rDFR set: **7.87**

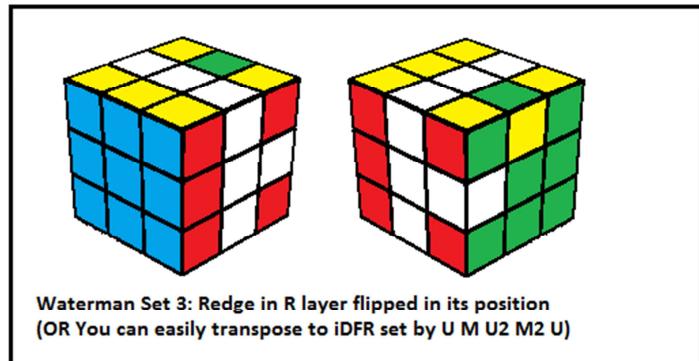
iDFR set: **8.50**

So it is clear that if UR and UL are unsolved, then BY FAR your best choice is to insert one of the two edges in the opposite slot, disoriented, and use the rDFR set which has an average move count of 7.87, including one case with just 3 moves.

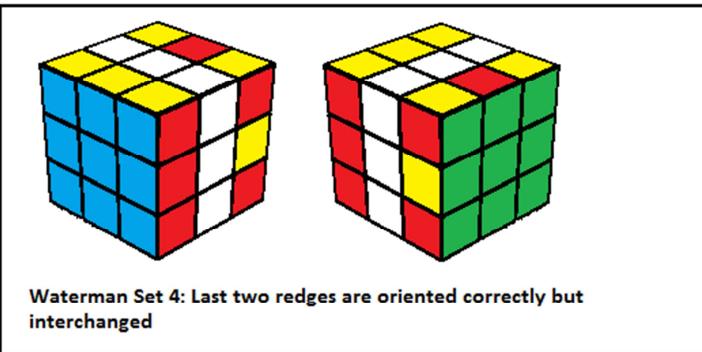
LMCF Advanced L6E: Two edges unsolved on the same side; solve both at once and simultaneously orient the midges



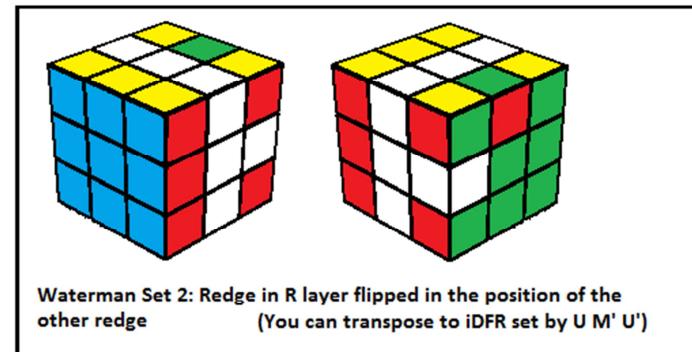
Waterman Set 1: R edge in R layer correctly oriented in the position of other edge



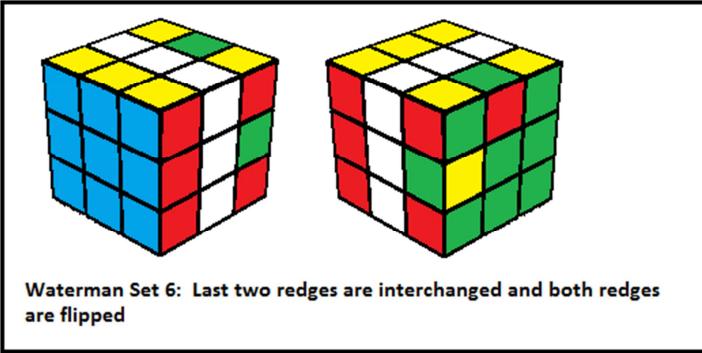
Waterman Set 3: R edge in R layer flipped in its position
(OR You can easily transpose to iDFR set by U M U2 M2 U')



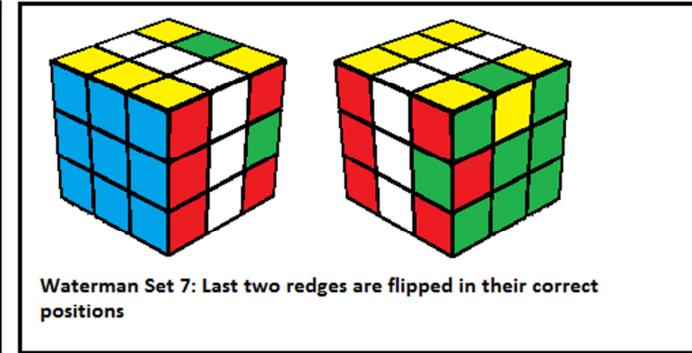
Waterman Set 4: Last two edges are oriented correctly but interchanged



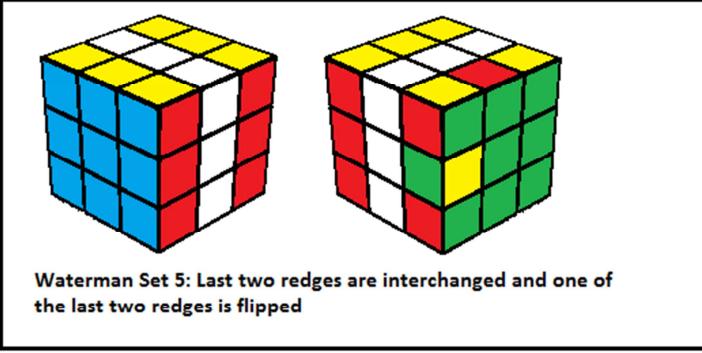
Waterman Set 2: R edge in R layer flipped in the position of the other edge
(You can transpose to iDFR set by U M' U')



Waterman Set 6: Last two edges are interchanged and both edges are flipped



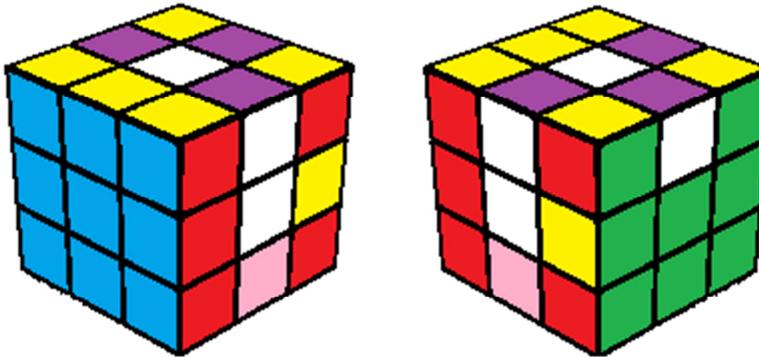
Waterman Set 7: Last two edges are flipped in their correct positions



Waterman Set 5: Last two edges are interchanged and one of the last two edges is flipped

It is important to note that the following tables include the possibility of one of the unsolved edges being at DR or BR. This is primarily because these tables are for LMCF and Waterman which allow DR or BR to be unsolved. If you only allow FR to be unsolved you only need to memorize some of the cases.

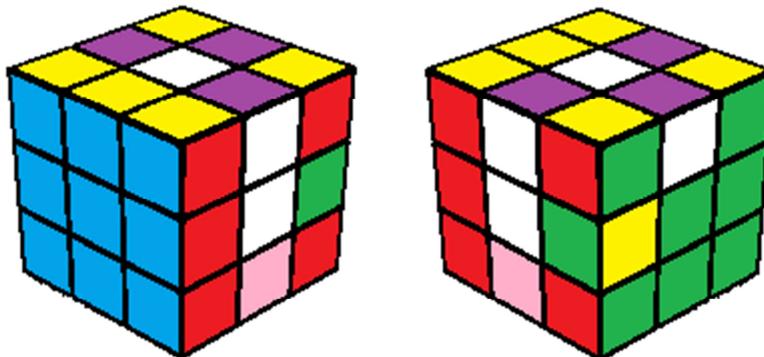
Waterman Set 1: R edge in R layer correctly oriented in the position of the other edge
(48 cases):



Waterman Set 1: One edge is oriented but in the wrong position.
The green-red edge is in the M-slice, at either DF or BD, with its green facelet on the D-face. Examine the three purple facelets to determine the orientation case, with respect to the U center piece.
There are 24 cases for green-red at DF, and 24 cases for green-red at BD, 48 cases total. The colors are just for example & clarity.

	Algorithm for Green-Red at DF position	Redge @	Algorithm for Green-Red at BD position
	U' M2 U' R' U M U' R U' M' U' [11] U' M2 U' R U M U' R' U' M' U' [11] U' M2 U' R2 U M U' R2 U' M' U' [11]	BR FR DR	Reflections coming soon!
	M' R' U M U' M U r U M' U' R' U' [13] or B' L U' M U R' U M' U M' U' [12] r U M U' M U M' R' U M' U' R U' [14] or M' U' M' U M2 F U M' U' F' [10] or U R U M' U' R' U M' U M' U2 M' U' [13] r2 U M' U' M' U r2 U M' U' R2 U' [12] or R' U R U R U2 R2 L F' R' F' [11]	BR FR DR	
	x' U' M' U' R U' M U R' U' M2 U' [11] R M U' M' U' R' U' M U R U' M2 U' [13] or M U' M' U M F U M' U' F' [10] or x M2 U' M' U' R' U' M U R U' M2 U' [12] R2 M U' M' U' R2 U' M U R2 U' M2 U' [13]	BR FR DR	
	R' U M' U' R U M U' [8] R U M' U' R' U M U' [8] R2 U M' U' R2 U M U' [8]	BR FR DR	
	R' U M' U M' U2 M R U M U' [11] R U M' U M' U2 r' U M U' [10] R2 U M' U M' U2 r' R' U M U' [11]	BR FR DR	
	R' U M' U' M R U2 M U M' U [11] R U M' U' r' U2 M U M' U [10] R2 U M' U' r' R' U2 M U M' U [11]	BR FR DR	
	R' U M R U M' U' M' R' U'[10] R U r' U M' U' r U' [8] R2 U r' R' U M' U' r R U' [10]	BR FR DR	
	M' R' U M R U M' U' R' U2 M U [12] x U r' U M' U' R U2 M U [9] M' R2 U r' R' U M' U' R2 U2 M U [12]	BR FR DR	

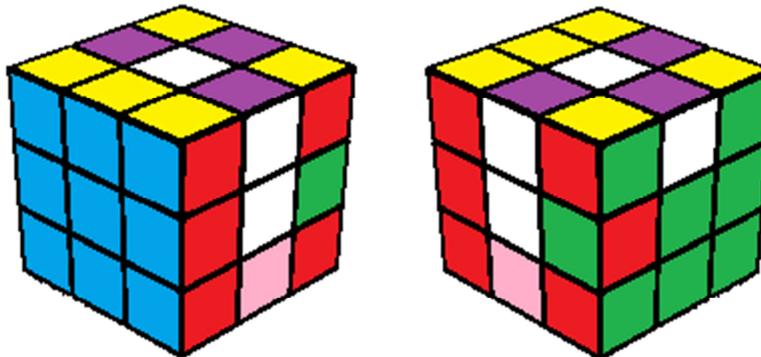
Waterman Set 2: R edge in R layer flipped in the position of the other edge (48 cases):



Waterman Set 2: One edge is flipped and in the wrong position. The other edge (green-red) is in the M-slice at either DF or BD, with the green facelet on the D-face. Examine the three purple facelets to determine the orientation case with respect to the U-center. There are 24 cases for green-red at DF, and 24 cases for green-red at BD, 48 cases total. The colors are just examples.

	Algorithm for Green-Red at DF position	Redge @	Algorithm for Green-Red at BD position
	R' U M2 U R U' M U R' U' M U' [12] R U M2 U R' U' M U R U' M U' [12] R2 U M2 U R2 U' M U R2 U' M U' [12]	BR FR DR	Reflections coming soon!
	R' U2 M R U2 M' U M' U R' U2 [11] R U2 r' U2 M' U M' U R U2 [10] R2 U2 r' R' U2 M' U M' U R2 U2 [11]	BR FR DR	
	M' R' U2 r U M U' R' U2 [9] r U2 M' R' U M U' R U2 [9] M' U2 r R U M U' R2 U2 [9]	BR FR DR	
	R' U R' r2 U' M U r' U' [9] R U M2 R' U' M U R M U' [10] R2 U r2 U' M U r' R' U' [9]	BR FR DR	
	M2 R' U' R U2 M U M2 U r' U [11] M2 R U' R' U2 M U M2 U M R U [12] r2 U' R2 U2 M U M2 U r' R' U [11]	BR FR DR	
	R M2 U' r' U M U' r2 R' U [10] M2 U' M R U M U' M2 R' U [10] M2 U' r' R' U M U' r2 U [9]	BR FR DR	
	R' U2 R U' M' U R' U2 [8] R U2 R' U' M' U R U2 [8] R2 U2 R2 U' M' U R2 U2 [8]	BR FR DR	
	R' U M2 U M' U' M U' r U' M2 U [12] R U M2 U M' U' M U' M' R' U' M2 U [13] or M U r U M U M' U' M' U' r' U' [12] M' U M U M D U M U M' D' [12]	BR FR DR	

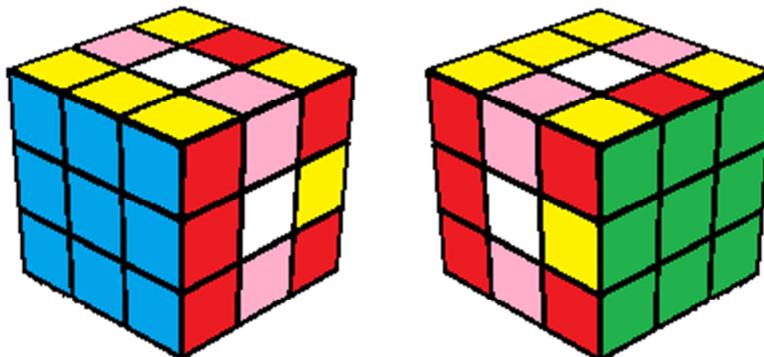
Waterman Set 3: R edge in R layer flipped in its position (48 cases):



Waterman Set 3: One edge is flipped in its position and the UR slot is empty. The green-yellow edge is in the M-slice at either DF or BD position, with the green facelet on the D-face. Examine the three purple facelets to determine the orientation case with respect to the U-center. There are 24 cases for green-yellow at DF, and 24 cases for green-yellow at BD, 48 cases total.

	Algorithm for Green-Yellow at DF position	Ridge@	Algorithm for Green-Yellow at BD position
	$U M' U' R' U' M' U2 M2 U'$ [9] $U M' U' R U' M' U2 M2 U'$ [9] $U M' U' R2 U' M' U2 M2 U'$ [9]	BR FR DR	Reflections coming soon!
	$R' U M U2 r U M' U' M' R' U$ [11] $R U M U2 M' R' U M' U' r U$ [11] $R2 U M U2 r R U M' U' M' R2 U$ [12]	BR FR DR	
	$M2 R' U' R U' M U' M U M U r' U$ [12] $M U' r U2 M' U M2 U2 M' U' R' U$ [12] $r2 U' R2 U' M U' M U M U r' R' U$ [13] or $M R2 U M U' R2 U2 M' S' U' S U'$ [11]	BR FR DR	
	$M2 R' U' M R U M U' r' U2 M' U'$ [12] $r M' U' r' U M U' M R U2 M' U'$ [12] $r2 U' r' R' U M U' r' R' U2 M' U'$ [12]	BR FR DR	
	$M2 R' U' R U2 M U' M U' r' U$ [11] $r M' U' R' U2 M U' M U' M R U$ [12] $r2 U' R2 U2 M U' M U' r' R' U$ [11]	BR FR DR	
	$R' U2 R U' M U2 M2 U' R' U2$ [10] $R U2 R' U' M U2 M2 U' R U2$ [10] $R2 U2 R2 U' M U2 M2 U' R2 U2$ [10]	BR FR DR	
	$M2 R' U M U2 M2 U R U2 M U M2 U$ [13] $r M' U M U2 M2 U R' U2 M U M2 U$ [13] or $R U B' U2 M' U M' U M' B U'$ [11] $M2 R2 U M U2 M2 U R2 U2 M U M2 U$ [13] or $M S' U M2 U2 M U M S$ [9]	BR FR DR	
	$M2 R' U M2 U2 M U r U M2 U'$ [12] $r M' U M2 U2 M U M' R' U M2 U'$ [12] $r2 U M2 U2 M U r R U M2 U'$ [11]	BR FR DR	

Waterman Set 4: Last two edges are oriented correctly but interchanged (12 cases):



Waterman Set 4: The last two edges are oriented correctly but interchanged. There are 12 cases. First you choose the location of the two unsolved edges (adjacent on the R layer, or opposite on the R layer). Then you observe the orientation of the four midges. Use the table below.

No disoriented midges:

U2 R' U M2 U2 M2 U R U2	[edges at UR and BR] [9]
U2 R U M2 U2 M2 U R' U2	[edges at UR and FR] [9]
U2 R2 U M2 U2 M2 U R2 U2	[edges at UR and DR] [9]

2 disoriented midges at UB and DB:

U r' U M2 U2 M' U r U'	[edges at UR and BR] [9]
R U r' U M2 U2 M' U r U'	[edges at UR and FR] [9]
U r' R' U M2 U2 M' U r R U'	[edges at UR and DR] [11]

2 disoriented midges at DF and UB:

U' M' U M2 U R' U M U' r U'	[edges at UR and BR] [11]
R U' M' U M2 U R' U M U' r U'	[edges at UR and FR] [12]
U' M' U M2 U R2 U M U' r R U'	[edges at UR and DR] [12]

4 disoriented midges:

R' U M U2 R U' F2 M' F2 U r' U (or U M U M' U2 M U R' U M U' r U')	[edges at UR and BR][12]
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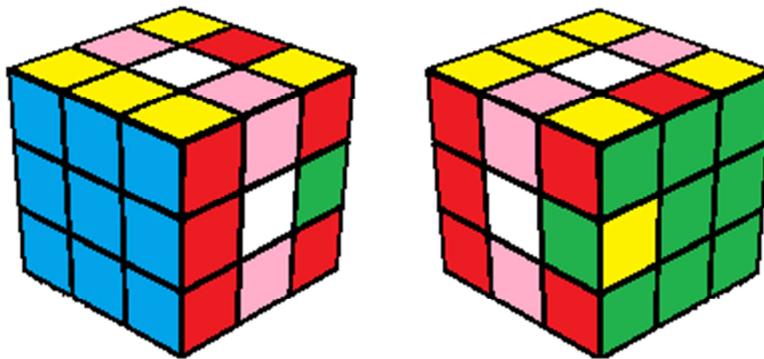
U M U2 R U' F2 M' F2 U r' U (or R U M U M' U2 M U R' U M U' r U')	[edges at UR and FR][11]
--	--------------------------

U' [M' R2] U F2 M' F2 U' R2 U2 M' U'	[edges at UR and DR][11]
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12 cases, 10.33 move average.

Waterman Set 5: Last two edges are interchanged and one of the last two edges is flipped

(6 cases):



Waterman Set 5: The last two edges are exchanged, one is oriented the other is disoriented. Place the oriented edge at UR. Select the algorithm based on the location of the disoriented edge, and the orientation of the 4 midges. Use the table below. There are 6 cases.

One disoriented midege at DF:

U M' U' R U' M' U R' U M2 U'
U M' U' R' U' M' U R U M2 U'
U M' U' R2 U' M' U R2 U M2 U'

[11] [oriented edge at UR, disoriented edge at FR]
[11] [oriented edge at UR, disoriented edge at BR]
[11] [oriented edge at UR, disoriented edge at DR]

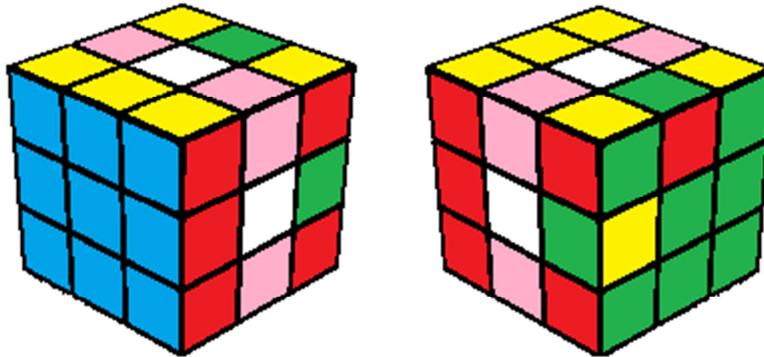
3 disoriented midges (oriented midege at UB):

U M U' R U' M2 U r' U' M U
U M U' R' U' M2 U M R U' M U
U M U' R2 U' M2 U r' R' U' M U

[11] [disoriented edge at UR, oriented edge at FR]
[12] [disoriented edge at UR, oriented edge at BR]
[12] [disoriented edge at UR, oriented edge at DR]

6 cases, 11.33 move average.

Waterman Set 6: Last two redges are interchanged and both redges are flipped (12 cases):



Waterman Set 6: The last two redges are interchanged and both disoriented. First choose your algorithm based on whether the two redges are adjacent or opposite on the R layer. Then observe the orientations of the 4 midges and select the algorithm from the table below.

No midges disoriented:

U M U' R U' M2 U R' U M' U'

[redges at UR and FR] [11]

U M U' R' U' M2 U R U M' U'

[redges at UR and BR] [11]

U M U' R2 U' M2 U R2 U M' U'

[redges at UR and DR] [11]

2 midges disoriented at UF and DF:

U r' U' M2 U r U'

[redges at UR and BR] [7]

R U r' U' M2 U r U'

[redges at UR and FR] [8]

U r' R' U' M2 U r R U'

[redges at UR and DR] [9]

2 midges disoriented at DF and UB:

U M U2 R U' M2 U R' U2 M' U'

[redges at UR and FR] [11]

U M U2 R' U' M2 U R U2 M' U'

[redges at UR and BR] [11]

U M U2 R2 U' M2 U R2 U2 M' U'

[redges at UR and DR] [11]

4 disoriented midges:

U2 R' U M' U' r U' R' U M' U' R U'

[redges at UR and BR] [13]

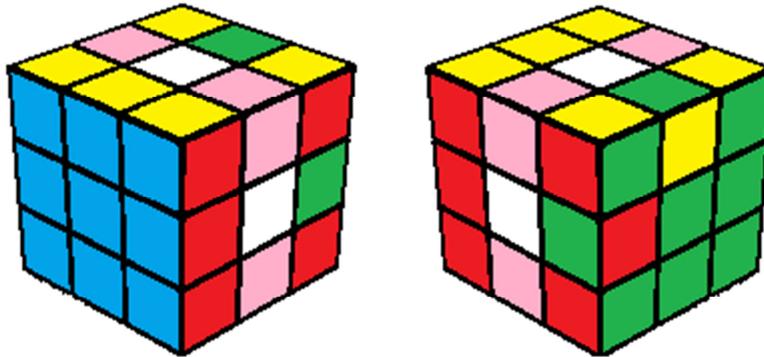
R U2 R' U M' U' r U' R' U M' U' R U'

[redges at UR and FR] [14]

U2 R2 U M' U' M' R2 U' R2 U M' U' R2 U'

[redges at UR and DR] [14]

Waterman Set 7: Last two edges are flipped in their correct positions (12 cases):



Waterman Set 7: The last two edges are both in their correct position but disoriented. First select your algorithm based on whether the edges are adjacent or opposite on the R layer; then observe the orientation of the 4 midges and select your algorithm from the table below. 12 cases.

No disoriented midges:

U M U2 M2 U R' U' M2 U2 M' U'
[edges at UR and BR] [11]
U M U2 M2 U R U' M2 U2 M' U'
[edges at UR and FR] [11]
U M U2 M2 U R2 U' M2 U2 M' U'
[edges at UR and BR] [11]

2 disoriented midges at UF and UB:

U2 R' U M U2 M' U2 M U' R U2
[edges at UR and BR] [11]
U2 R U M U2 M' U2 M U' R' U2
[edges at UR and FR] [11]
U2 R2 U M U2 M' U2 M U' R2 U2
[edges at UR and DR] [11]

2 disoriented midges at DF and UB:

U2 r U M U2 M' U2 M U' R' U2
[edges at UR and FR] [11]
R' U2 r U M U2 M' U2 M U' R' U2
[edges at UR and BR] [12]
U2 r R U M U2 M' U2 M U' R2 U2
[edges at UR and DR] [12]

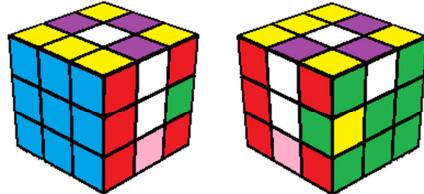
4 disoriented midges

U r' U M2 U2 M U r U'
[edges at UR and BR] [9]
R U r' U M2 U2 M U r U'
[edges at UR and FR] [10]
U r' R' U M2 U2 M U r R U'
[edges at UR and DR] [11]

12 cases, 10.91 move average.

Examples

Scramble: M2 U2 M2 U' M' R' U' M' U R M2 U' R'



If you know Waterman Set 2, the solve becomes:

R U M2 R' U' M U R M U' [10] // Waterman Set 2

U2 M2 U2 M2 [5] // Permute midges

Total: 15 moves

If you only basic L5E, the solve could be done like this:

R U M' U' R' U M U' M2 R' [10] // intuitive solve & setup

Now orient midges with special case:

U' R U' M' U2 M2 U' R' U [9] // orient midges

R2 M' U2 M U2 M [6] // permute midges

Total: 25 moves

But if you know the iDFR L5E set, then you can transpose the solve quickly into the iDFR set as follows:

R U M' U' R' y2 [5] // intuitive set up to iDFR set

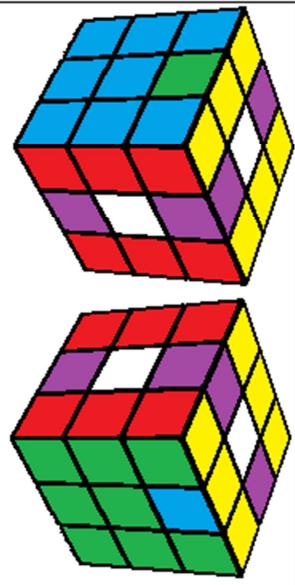
r F R U' M' U R' F' [8] // iDFR L5E algorithm

L2 M' U2 M2 U2 M' [6] // permute midges

Total: 19 moves

LMCF L6E Special Cases - Sheet 1

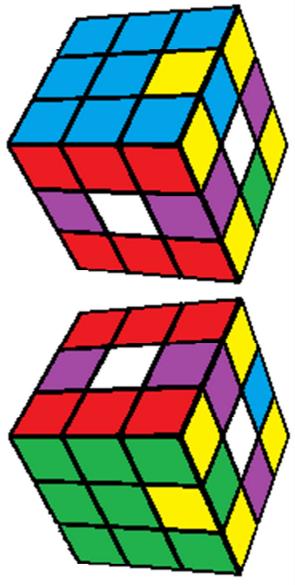
UL, UR swapped and oriented



$U' M' U' M' U2 M' U M' U2 M2 U$

$x' F U R U M2 U' R' U' F'$

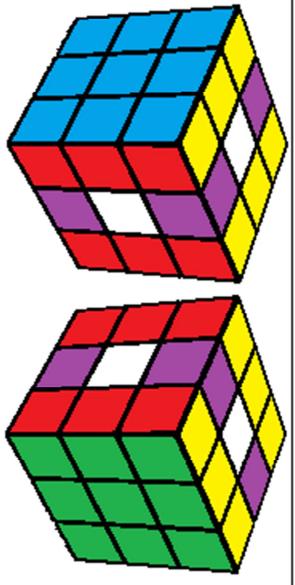
UL, UR solved and disoriented



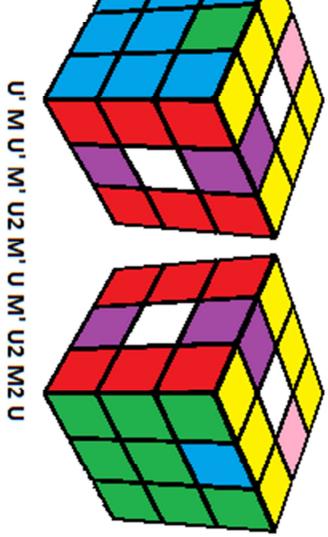
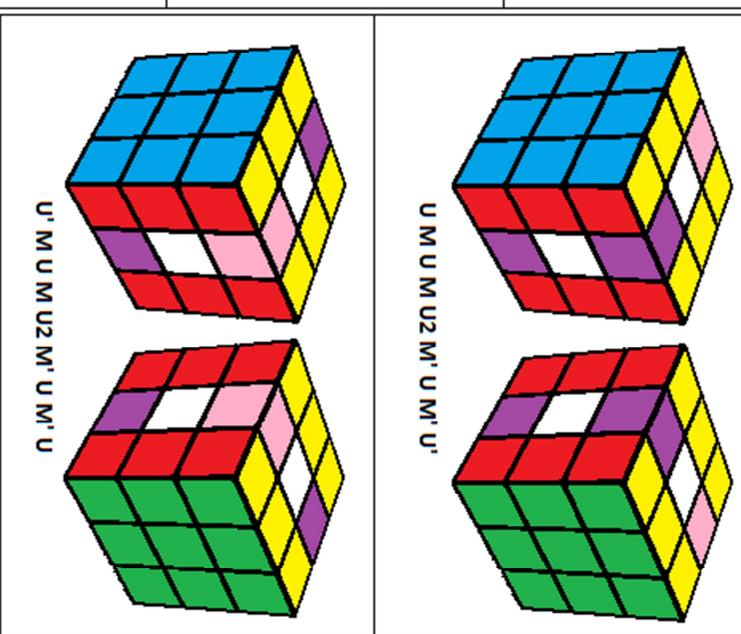
$U' M2 U [M' U M' U M' U] M' U'$

$R' F R U M' U2 M2 U R' F' [R]$

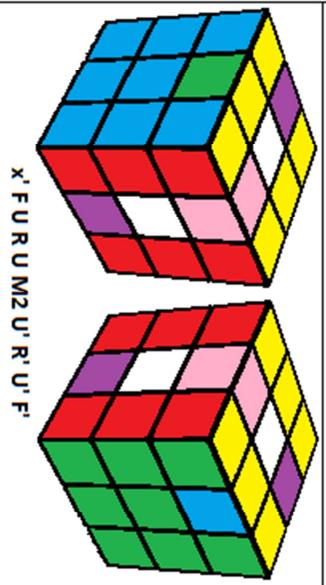
UL and UR both solved



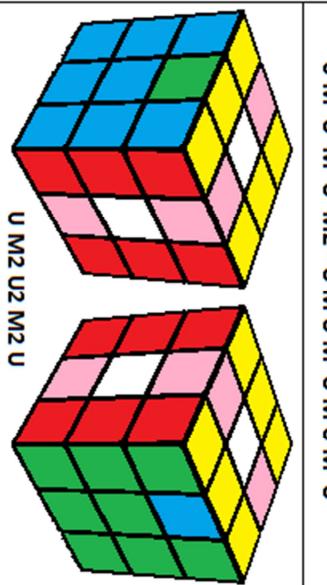
$U' r' U M' U' M2 R' U' R' U M' U' [12]$
 $U' M U2 M' U' M' r' F R U' M' U R' F' [14]$
 $U' M U M' U' M' U' M' U M' U M' U M' U' [15]$



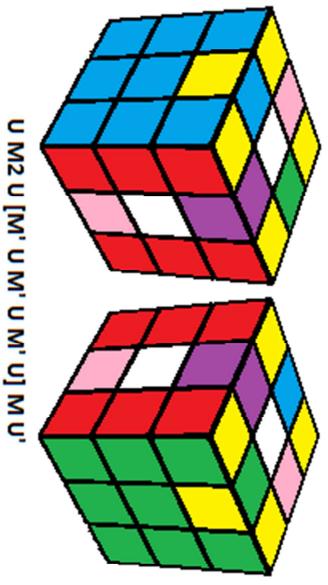
$U' M' U' M' U2 M' U M' U2 M2 U$



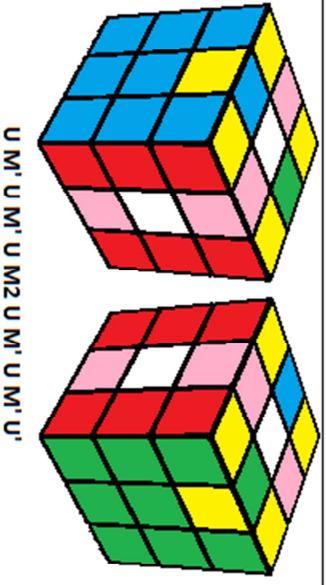
$x' F U R U M2 U' R' U' F'$



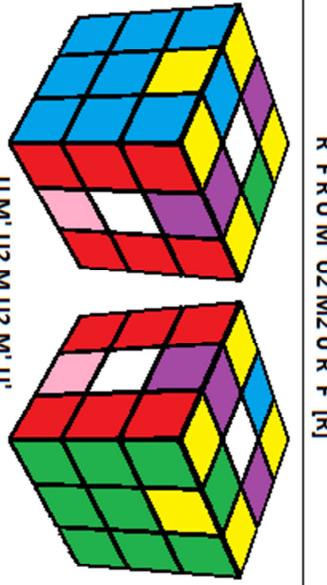
$U M2 U2 M2 U$



$U' M2 U [M' U M' U M' U] M' U'$



$U' M' U M' U M2 U M' U' M' U'$



$U M U M U2 M' U M' U'$

Waterman Set 5: One oriented edge, one disoriented edge

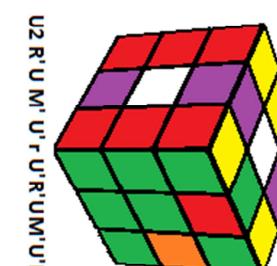
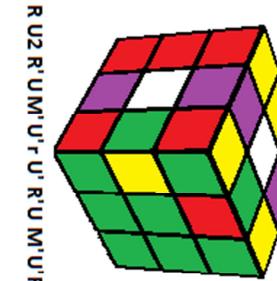
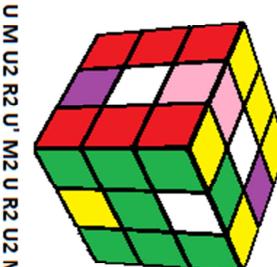
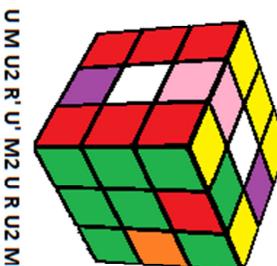
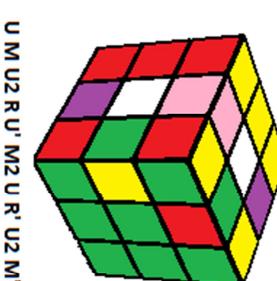
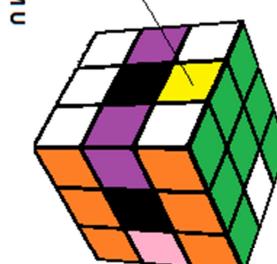
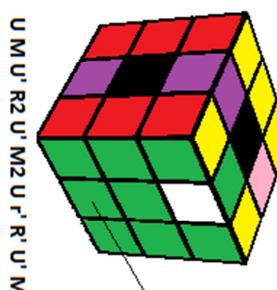
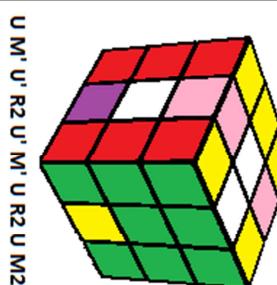
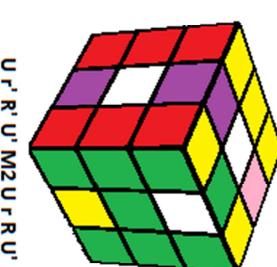
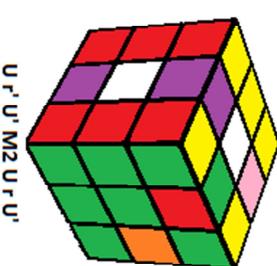
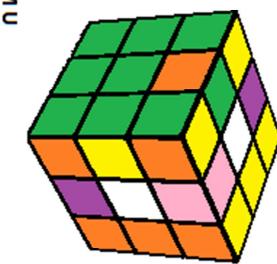
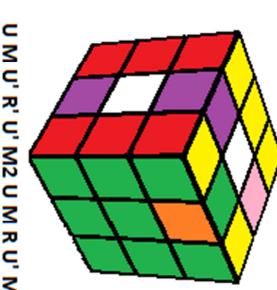
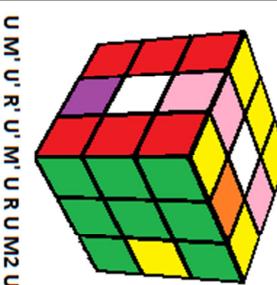
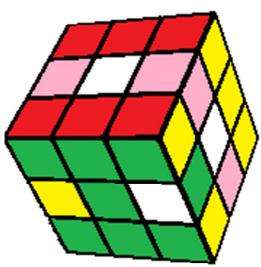
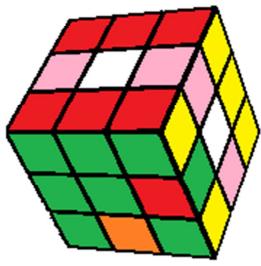
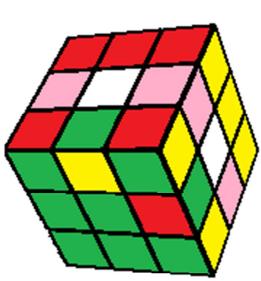
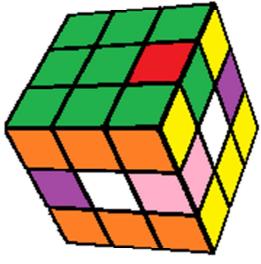
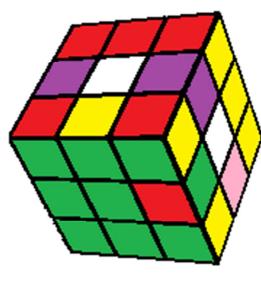
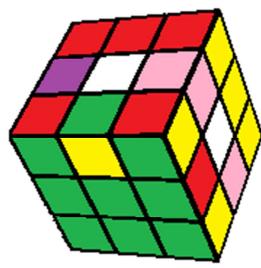
Three disoriented midges

Redges at UR, FR

Waterman Set 6: Two disoriented edges interchanged

Redges at UR, BR

Redges at UR, DR



$U M' U' R' U' M' U R' U M2 U'$

$U M' U' R2 U' M' U R2 U M2 U'$

$U2 R' U M' U' r' U' R' U M' U' R' U'$

$U M' U' R2 U' M' U R2 U M2 U'$

$U M' U' R' U' M2 U M' U R' U M' U$

$U2 R2 U M' U' M' R2 U' R2 U M' U' R' U'$

$U M' U' R' U' M' U R' U M2 U'$

$U M' U2 R' U' M2 U R' U2 M' U'$

$U r' U' M2 U r' U'$

$U M' U' R' U' M' U R' U M2 U'$

$U M' U2 R' U' M2 U R' U2 M' U'$

$U r' R' U' M2 U r' U'$

$U M' U' R' U' M' U R' U M2 U'$

$U M' U' R' U' M2 U r' U' M U$

$U M' U' R' U' M2 U r' U'$

$U M' U' R' U' M2 U R' U M' U$

$U M' U2 R' U' M2 U R' U2 M' U'$

$U M' U2 R' U' M2 U R' U2 M' U'$