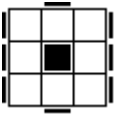
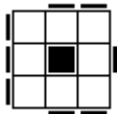
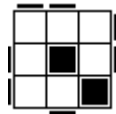
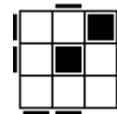
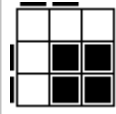
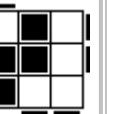
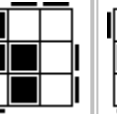
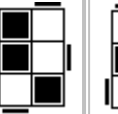
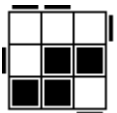
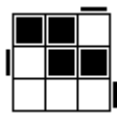
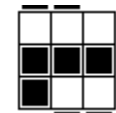
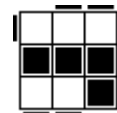
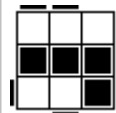
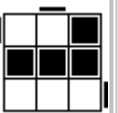
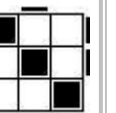
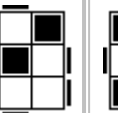
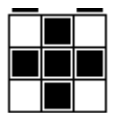
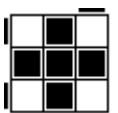
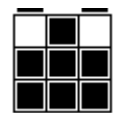
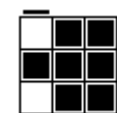
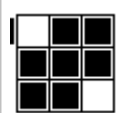
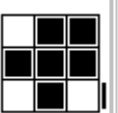
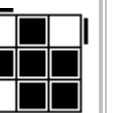
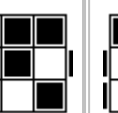
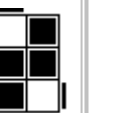
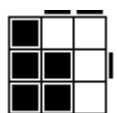
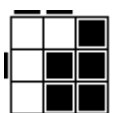
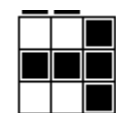
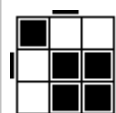
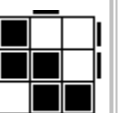
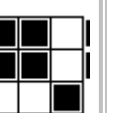
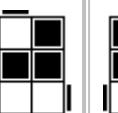
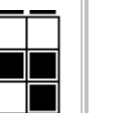
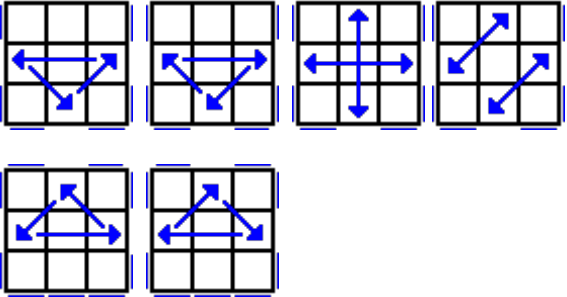
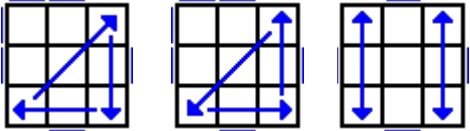
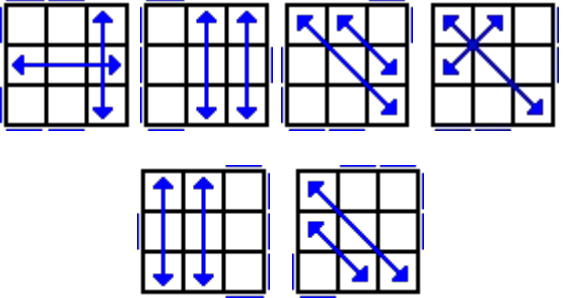
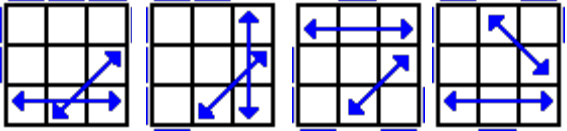
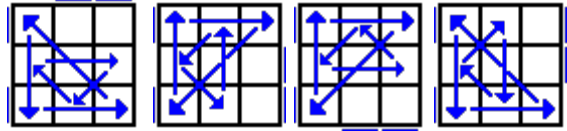


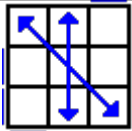
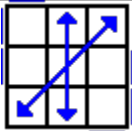
OLL 手法

Gan

1  (R U' <u>U</u>) (R2' F R F') U2 (R' F R F')	2  (F R U R' <u>U</u>' F') (f R U R' <u>U</u>' f')	3  f(R U R' <u>U</u>')f' <u>U</u>' F(R U R' <u>U</u>')F'	4  f(R U R' <u>U</u>')y x(R' F)(R U R' <u>U</u>')F'	5  (r' U2) (R U R'U) r	6  (r U' <u>U</u>) (R' <u>U</u>' R U' r')	7  r U R' U R U' <u>U</u>' r'	8  r' <u>U</u>' R U' R' U2 r	9  (R' U' R) y' x' (R <u>U</u>) (R'F) (R U R')	10  (R U R'U)(R'F R F') (RU' <u>U</u>'R')
11  r'(R2 U R' U)(R U' <u>U</u>' R' U) (r R')	12  (r R'2 <u>U</u>' R U')(R' U2 R U' R)r'	13  (r <u>U</u>' r' <u>U</u>')(r U r') (F' U F)	14  R' F R U R' F'R (F <u>U</u>' F')	15  (r' <u>U</u>' r) (R' <u>U</u>'R U) (r' U r)	16  (r U r') (R U R' <u>U</u>) (r <u>U</u>' r')	17  F(U R' <u>U</u>'F')U (F R2 U R' <u>U</u>'F')	18  F (R U R' d)(R' U2) (R' F R F')	19  (r' R U)(R U R' U' r) (R'2 F R F')	20  r'(R U) (R U R' <u>U</u>' r2)(R2'U) (R <u>U</u>) r'
21  (R U' <u>U</u>) (R' <u>U</u>' R U R' U') (R <u>U</u>' R')	22  R U' <u>U</u>' (R'2 <u>U</u>) (R2 <u>U</u>) R'2 <u>U</u>' <u>U</u>'R	23  (R2 D') (R <u>U</u> <u>U</u>) (R' D) (R <u>U</u> <u>U</u>' R)	24  (r U R' <u>U</u>) (r' F R F)	25  F(r U R' <u>U</u>) (r' F R)	26  R <u>U</u>' <u>U</u>' R' <u>U</u>' R <u>U</u>' R'	27  R' U2 R U R' U R	28  (r U R' <u>U</u>) (r' R U) (R <u>U</u>' R')	29  (r U R' U') (R r'2 F R F') (r R')	30  (R2 U R' B')(RU') (R2' U) (R B R')
31 	32 	33 	34 	35 	36 	37 	38 	39 	40 

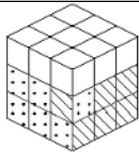
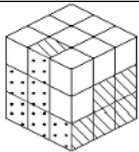
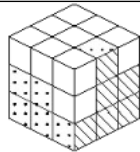
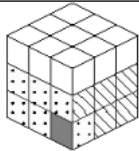
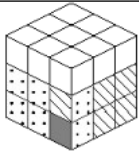
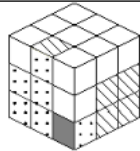
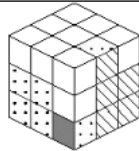
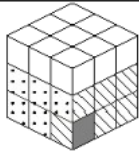
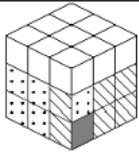
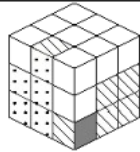
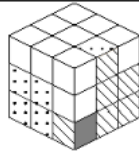
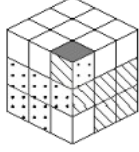
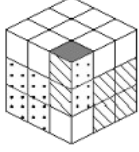
$(r' F U F)$ $(L F'$ $L' U' r)$	$(R U)(B' U')$ $(R' U R B$ $R')$	$(R U R' \underline{U}')$ $(R' F R F')$ 	$(R' \underline{U}' R U)$ $y(r U R'$ $\underline{U}')r' R$	$R U' \underline{U}' R 2'$ $F R F'(R$ $U' \underline{U}' R')$	$R' \underline{U}' R U'$ $R' U R U$ $I \underline{U}' R' U$	$F (R \underline{U}'$ $R' \underline{U}' R U)$ $(R' F')$	$(R U R' U)$ $(R \underline{U}' R' \underline{U}')$ $(R' F R F')$	$(r \underline{U}' r' \underline{U}'$ $r)y(R U R'$ $f)$	$(R' F R U$ $R' \underline{U}')$ $(F U R)$
41 $R U' R' U 2$ $R U y R \underline{U}'$ $R' \underline{U}' F'$	42 $(R' U R$ $U' \underline{U}' R' \underline{U}')$ $(F' U)(F U$ $R)$	43 $(B' \underline{U}')$ $(R' U R B)$	44 $f (R U$ $R' \underline{U}')f'$	45 $F (R U R'$ $\underline{U}') F'$	46 $(R' \underline{U}')$ $R' F R F'$ $(U R)$	47 $B'(R' \underline{U}'$ $R U) 2 B$	48 $F (R U R'$ $\underline{U}') 2 F'$	49 $R B'(R 2 F)$ $(R 2 B)$ $R 2 F' R$	50 $L' B (L 2 \underline{F}')$ $(L 2 \underline{B}')$ $L 2 F L'$
51 $f (R U R'$ $\underline{U}') 2 f'$	52 $R' \underline{U}' R \underline{U}'$ $R' d$ $R' U I U$	53 $(r' U 2)$ $(R U R' \underline{U}')$ $(R U R' U)$ r	54 $(r U' \underline{U}')$ $(R' \underline{U}' R U$ $R' \underline{U}')$ $(R U' r')$	55 $(R U' \underline{U}')$ $(R' 2 \underline{U}')$ $R U' R' U 2$ $(F R F')$	56 $F (R U$ $R' \underline{U}')(R$ $F')(r U$ $R' \underline{U}')r'$	57 $(R U R' \underline{U}'$ $r)(R' U)$ $(R U' r')$	对标记有 问题请到 最后页去 看标记说 明。		
42' $(r' R 2)y$ $(R U R' \underline{U}')$ $y' (R' U$ $R')r$	47' $b' \underline{U}'$ $(R' U R \underline{U}'$ $R' U R)b$	10' $(L U L')$ y' $(R' F R \underline{U}')$ $(R' F' R)$	5' $(I' U 2)$ $(L U L' U I)$	6' $I U 2$ $L' U' L U'$ I'	3' $(r' R 2 U$ $R' U)(r$ $U 2)(r' U$ $r R')$	12' $F (R U R'$ $U') y L' F$ $(R U R'$ $U') F'$	13' $I \underline{U}' R' F'$ $R U I'$ $y R' U R$		

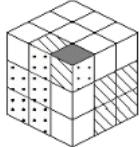
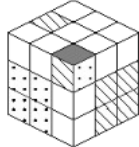
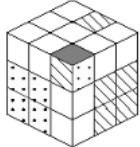
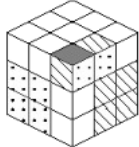
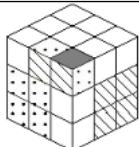
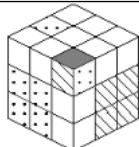
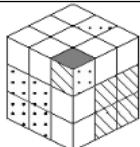
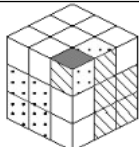
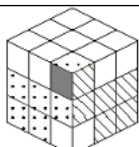
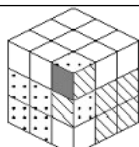
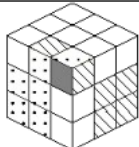
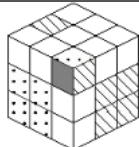
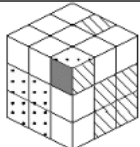
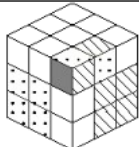
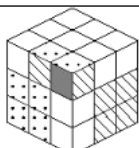
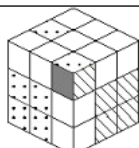
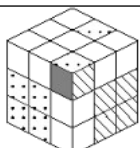
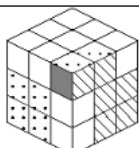
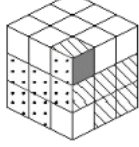
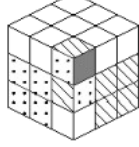
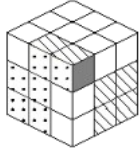
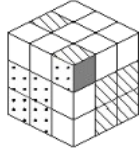
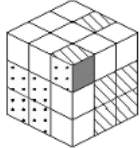
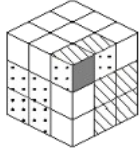
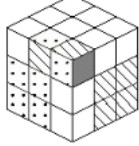
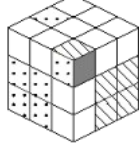
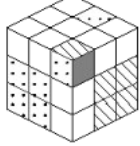
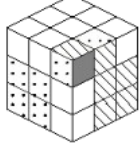
棱换		01. $(R\ U'\ R)(U\ R\ U\ R)(\underline{U}'\ R'\ \underline{U}'\ R^2)$ 02. $(R^2'\ U)(R\ U\ R'\ \underline{U}')(R'\ \underline{U}')(R'\ U\ R')$ 03. $M^2\ U\ M^2\ U^2\ M^2\ U\ M^2$ 04. $(U\ R'\underline{U}')(R\ \underline{U}'R)(U\ R\ \underline{U}')(R'\underline{U}\ R\ U)(R^2\ \underline{U}')(R'\underline{U})$ 01'. $(R^2\ \mathcal{U})(R'\ \underline{U}'\ R\ U\ R\ U)(R\ \mathcal{U}'R)$ 02'. $(R'\ U\ R'\ \underline{U}')(R'\ \underline{U}')(R'\ U)(R\ U\ R'^2)$
角换		05. $x'\ R^2\ D^2(R'\ \underline{U}'\ R)D^2(R'\ U\ R')$ 06. $x'(R\ U'\ R)z'(R'^2\ \underline{U}'\ L\ U\ R^2\ x\ y\ R^2)$ 上式中的 $R^2\ x\ y$ 是同时进行的 07. $x'(R\ U'\ R'\ D)(R\ U\ R')u^2'(R'\ U\ R)D(R'\ \underline{U}'\ R)$
邻角 对棱 对角 邻棱		08. $(R\ U\ R'\ \underline{U}')(R'\ F)(R^2\ \underline{U}'\ R'\ \underline{U}')(R\ U\ R'\ F')$ 09. $\underline{U}'(R'\underline{U}\ R\ \underline{U}'\ R'^2\ b')x(R'\underline{U}\ R)y'(R\ U\ R'\ \underline{U}'\ R^2)$ 10. $(R'\ U\ R'\ \underline{U}')yx^2(R'\ U\ R'\ \underline{U}'R^2)xz'(R'\underline{U}'R\ U\ R)$ 11. $F(R\ \underline{U}'R'\ \underline{U}')(R\ U\ R'\ F')(R\ U\ R'\ \underline{U}')(R'\ F\ R\ F')$ 09'. $z(R\ U\ R'\ \underline{U}'\ R\ \mathcal{U}'\ \underline{U}')(x'\ z')(R\ U\ R'\underline{U}')$ $x(\underline{U}'R'\underline{U}\ R\ \mathcal{U}'\underline{U}')$ 10'. $z(U'\ R\ U'\ I')z(R'\ U\ R'U')(I\ R)$ $(U'\ R'\ U\ R\ U)$
邻角 邻棱 换		12. $z(\underline{U}'\ R\ D')(R^2\ U\ R'\ \underline{U}'\ R^2\ U)z'(R\ U')$ 13. $(R\ U\ R'F')(R\ U\ R'\underline{U}')(R'F\ R^2\ \underline{U}'R'U')$ 14. $(R'\ U^2)(R\ U'\underline{U}')(R'\ F\ R\ U\ R'\ \underline{U}')(R'F'\ R^2\ \underline{U}')$ 15. $(R\ U'\underline{U}')(R'\ U^2)(R\ \mathcal{B}'\ R'\ \underline{U}')(R\ U\ R\ \mathcal{B}\ R^2'\ U)$
三角 三棱 换		16. $(R^2'\ \underline{u}'\ R\ U'\ R)(U\ R'\ u)(R^2\ fR'\ f)$ 17. $(R\ U\ R')y'(R^2'\ u'\ R\ U')(R'\ U\ R'\ u\ R^2)$

		18. $(R^2 u)(R' U R' \underline{U})(R u')(R^2' F U A)$ 19. $(R' d' F)(R^2 u)(R' U)(R U' R \underline{u} R^2)$
对角 对棱 换	 	20. $z(R' U R')z'(R U^2 \underline{L}' U R')$ $z(U R')z'(R U^2 \underline{L}' U R')$ 21. $z(\underline{U}' R D')(R^2 U R' \underline{U})z'(R U R')$ $z(R^2 U R')z'(R U')$
说明	符号系统：RLUDBF, rludfb(转两层) 如 u 就是上两层顺时针转 90 度 x(整个魔方以 R 的方向转动), y(整个魔方以 U 的方向转动), z(整个魔方以 F 的方向转动), 斜体是用右拇指 下划线用左食指	

-*F2l 手法

Gan

 $(R U \underline{U}' R' U)^2 y'(R' \underline{U}' R)$	 $(U R \underline{U}' R' \underline{U}) y'(R' U R)$	 $(R' F R U)(R U' R' F)$ $U'(F' R U R' U')(R' F R)$	
 $(R U R' U')(R U \underline{U}' R' U')(R U R')$	 $(R U' R U) y(R U' R' F^2)$	 $y'(R' \underline{U}' R U)(R' \underline{U}' R)$	 $(R U' R' U)(R U' R')$
 $(R U' R' U)(R U \underline{U}' R' U)(R U' R')$	 $R^2 y(R U R' \underline{U}) y'(R' U R')$	 $y'(R' U)(R \underline{U}')(R' U R)$	 $(R U R' \underline{U}')(R U R')$
 $(R U R' \underline{U})^2 (R U R')$	 $(R \underline{U}' R') y'(R' U^2 R)$		

			
$y' (R' U2)(R U R' \underline{U})R$	$y' \underline{U}'(R' U2)(R \underline{U}' R' U)R$	$y'(R' U R \underline{U}'\underline{U}')(R' \underline{U}' R)$	$y' (U2 R2' U2)(R U R' U R2)$ $(R U R' U)(R \underline{U}'\underline{U}' R'd)(R' U R)$
			
$(R U R')U2(R U R' \underline{U}')(R U R')$	$(R U' R' U2)(R U R')$	$U(R \underline{U}'\underline{U}')(R' U R U')R'$	$(R \underline{U}'\underline{U}')(R' \underline{U}' R U)R'$
			
$\underline{U}'(R \underline{U}')(R' U2)(R U' R')$	$\underline{U}' (R U R') d (R' \underline{U}' R)$		
			
$d (R' U R U')(R' \underline{U}' R)$	$y' (R' \underline{U}' R)$	$(d R' \underline{U}' R U')(R' \underline{U}' R)$	$y' (R \underline{U}'\underline{U}')R'2 \underline{U}' R2 \underline{U}' R'$ $U'(R \underline{U}'\underline{U}' R' d)(R' U R)$
			
$y' (R' U)(R d' \underline{U}')(R U R')$	$U' (R \underline{U}'\underline{U}')(R' U2)(R U' R')$	$U'(R U R' U')(R \underline{U}'\underline{U}' R')$	$U R U' R'$
			
$\underline{U}' (R \underline{U}'\underline{U}' R' U)(R U R')$	$d (R' U' R) d' (R U R')$		
			
$y' \underline{U}' (R' U R)$	$(d R' \underline{U}' R \underline{U}'\underline{U}')(R' U R)$	$d (R' U2)(R \underline{U}'\underline{U}')(R' U R)$	$(R U' R' U)(d R' \underline{U}' R)$
			
$(R U')(R' U)(R U')(R' U2)(R U' R')$	$\underline{U}'(R U R' U)(R U R')$	$(R U R')$	$\underline{U}' (R \underline{U}' R' U)(R U R')$

加下划线的是用左食指完成，斜体是用右拇指

浅蓝色的是最少步数版本

红色是新增的多解

新修正

对标记有问题的朋友
请看下页的标记说明

魔方的某个面

	U 上层作顺时针 90 度转(即转一下)		R 右面作顺时针 90 度转(即转一下)		F 前面作顺时针 90 度转(即转一下)
	U' 上层作逆时针 90 度转(即转一下)		R' 右面作逆时针 90 度转(即转一下)		F' 前面作逆时针 90 度转(即转一下)
	U2 上层作顺时针 180 度转而逆时针 180 度实际结果与顺时针是一样的!		R2 右面作顺时针 180 度转而逆时针 180 度实际结果与顺时针是一样的!		F2 前面作顺时针 180 度转而逆时针 180 度实际结果与顺时针是一样的!
	D 底层作顺时针 90 度转(即转一下)		L 左面作顺时针 90 度转(即转一下)		B 后面作顺时针 90 度转(即转一下)
	D' 底层作逆时针 90 度转(即转一下)		L' 左面作逆时针 90 度转(即转一下)		B' 后面作逆时针 90 度转(即转一下)
	D2 底层作顺时针 180 度转而逆时针 180 度实际结果与顺时针是一样的!		L2 左面作顺时针 180 度转而逆时针 180 度实际结果与顺时针是一样的!		B2 后面作顺时针 180 度转而逆时针 180 度实际结果与顺时针是一样的!

(图 5)

整个魔方

	x 整个魔方作一个 R 方向 90 度转		y 整个魔方作一个 U 方向 90 度转		z 整个魔方作一个 F 方向 90 度转
	x' 整个魔方作一个 R' 方向 90 度转		y' 整个魔方作一个 U' 方向 90 度转		z' 整个魔方作一个 F' 方向 90 度转
	x2 整个魔方作一个 R 方向 180 度转		y2 整个魔方作一个 U' 方向 180 度转		z2 整个魔方作一个 F 方向 180 度转

(图 6)

魔方双层转

	u 上面两层作顺时针90度转(即转一下)		r 右面两层作顺时针90度转(即转一下)		f 前面两层作顺时针90度转(即转一下)
	u' 上面两层作逆时针90度转(即转一下)		r' 右面两层作逆时针90度转(即转一下)		f' 前面两层作逆时针90度转(即转一下)
	u2 上面两层作顺时针180度转而逆时针180度实际结果与顺时针是一样的!		r2 右面两层作顺时针180度转而逆时针180度实际结果与顺时针是一样的!		f2 前面两层作顺时针180度转而逆时针180度实际结果与顺时针是一样的!
	d 底面两层作顺时针90度转(即转一下)		l 左面两层作顺时针90度转(即转一下)		b 后面两层作顺时针90度转(即转一下)
	d' 底面两层作逆时针90度转(即转一下)		l' 左面两层作逆时针90度转(即转一下)		b' 后面两层作逆时针90度转(即转一下)
	d2 底面两层作顺时针180度转而逆时针180度实际结果与顺时针是一样的!		l2 左面两层作顺时针180度转而逆时针180度实际结果与顺时针是一样的!		b2 后面两层作顺时针180度转而逆时针180度实际结果与顺时针是一样的!

(图7)

中间层

	E 中层作顺时针90度转(即转一下)		M 中层作顺时针90度转(即转一下)		S 中层向F作顺时针90度转(即转一下)
	E' 中层作逆时针90度转(即转一下)		M' 中层作逆时针90度转(即转一下)		S' 中层作逆时针90度转(即转一下)
	E2 中层作顺时针180度转而逆时针180度实际结果与顺时针是一样的!		M2 中层作顺时针180度转而逆时针180度实际结果与顺时针是一样的!		S2 中层作顺时针180度转而逆时针180度实际结果与顺时针是一样的!

(图8)