F2L 1

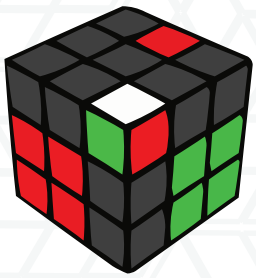
U2 (R U R') U (R U' R')
y F R U2 R' F'

BASIC | BOTH TOP | WHITE UP

F2L 2

y U2 (L' U' L) U' (L' U L)
F' L' U2 L F

BASIC | BOTH TOP | WHITE UP



F2L 3

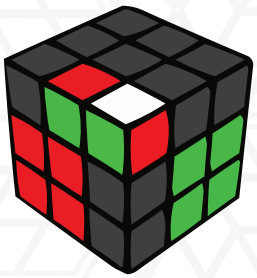
U (R U2 R') U (R U' R')

BASIC | BOTH TOP | WHITE UP

F2L 4

y U' (L' U2 L) U' (L' U L)

BASIC | BOTH TOP | WHITE UP



F2L 5

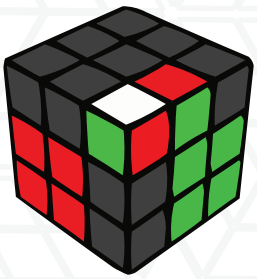
U (R U' R') U' (R U' R' U R U' R')
U (F R' F' R) U (R U R')
U2 (L F' L' F) (R U R')
y U L' U' (L2 F' L' F) (L' U L)
y F' (U' L' U L) F (L' U L)
y' U2 R U' R' U' S R' S'

BASIC | BOTH TOP | WHITE UP

F2L 6

y U' (L' U L) U (L' U L U' L' U L)
y U' (F' L F L') U' (L' U' L)
y U2 (R F' R' F) (L' U' L)
U' R U (R2' F R F') (R U' R')
F (U R U' R') F' (R U' R')
y2 U2 L' U L U S' L S

BASIC | BOTH TOP | WHITE UP



F2L 7

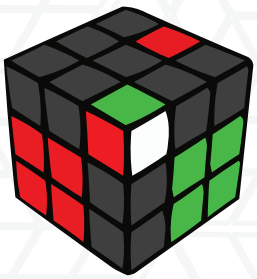
(R U2 R') U' (R U R')

BASIC | BOTH TOP | WHITE UP

F2L 8

y (L' U2 L) U (L' U' L)

BASIC | BOTH TOP | WHITE UP



F2L 9

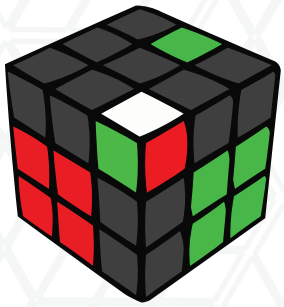
(R U R')

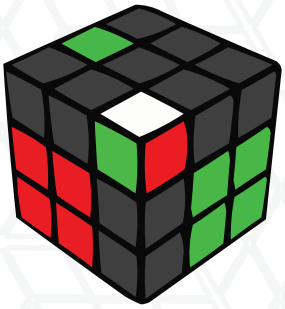
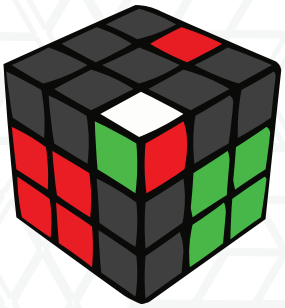
BASIC | BOTH TOP | WHITE SIDE | DIFFER ON U

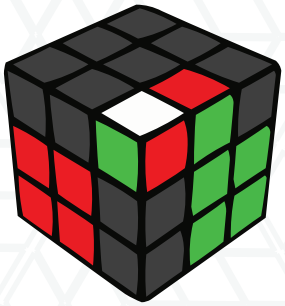
F2L 10

y (L' U' L)

BASIC | BOTH TOP | WHITE SIDE | DIFFER ON U





F2L 11

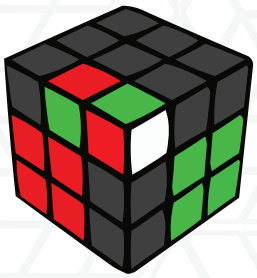
U' (R U R') U (R U R')
U2 (R U' R') U' (R U R')
R' U R2 U R'

BASIC | BOTH TOP | WHITE SIDE | DIFFER ON U

F2L 12

y U (L' U' L) U' (L' U' L)
y U2 (L' U L) U (L' U' L)
y L U' L2' U' L

BASIC | BOTH TOP | WHITE SIDE | DIFFER ON U



F2L 13

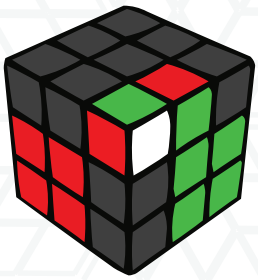
R' U2 R2 U R2' U R
(R U' R') U (R U' R') U2 (R U' R')
R' U2 R2 U R'
y U L' U2 L U' y' R U R'

BASIC | BOTH TOP | WHITE SIDE | DIFFER ON U

F2L 14

y L U2 L2' U' L2 U' L'
y (L' U L) U' (L' U L) U2 (L' U L)
y L U2 L2' U' L
U' (R U2 R') U y (L' U' L)

BASIC | BOTH TOP | WHITE SIDE | DIFFER ON U



F2L 15

U' (R U' R') U (R U R')

BASIC | BOTH TOP | WHITE SIDE | DIFFER ON U

F2L 16

y U (L' U L) U' (L' U' L)

BASIC | BOTH TOP | WHITE SIDE | DIFFER ON U

F2L 17

y U' (L' U L)

BASIC | BOTH TOP | WHITE SIDE | SAME ON U

F2L 18

U (R U' R')

BASIC | BOTH TOP | WHITE SIDE | SAME ON U

F2L 19

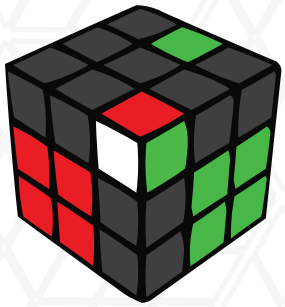
y U (L' U2 L) U2 (L' U L)
r' U2 R2 U R2' U r

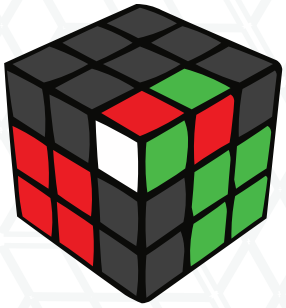
BASIC | BOTH TOP | WHITE SIDE | SAME ON U

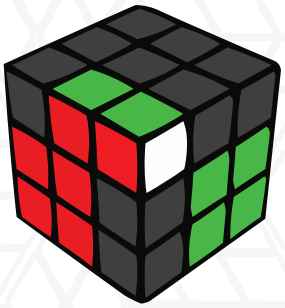
F2L 20

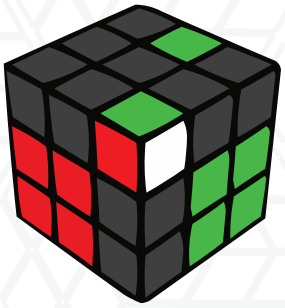
U' (R U2 R') U2 (R U' R')
y l U2 L2' U' L2 U' l'

BASIC | BOTH TOP | WHITE SIDE | SAME ON U









F2L 21

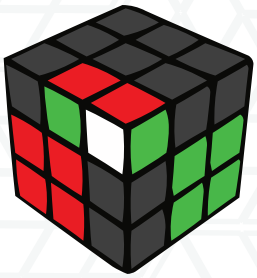
U' (R U R') U2 (R U' R')
y U l' U L U' L' U' l

BASIC | BOTH TOP | WHITE SIDE | SAME ON U

F2L 22

y U (L' U' L) U2 (L' U L)
U' r U' R' U R U r'

BASIC | BOTH TOP | WHITE SIDE | SAME ON U



F2L 23

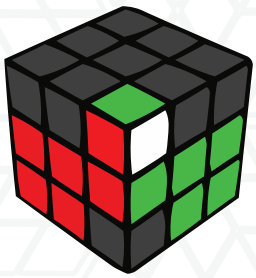
M U (L F' L') U' M'
U' (R' U R) U' (R U R')
y (L' U L) y' U2 (R U R')
y' (R2' F R F' R) U2 (R' U R)
y2 (f' L f) U2 (L U L')

BASIC | BOTH TOP | WHITE SIDE | SAME ON U

F2L 24

y M U' (R' F R) U M'
y U (L U' L') U (L' U' L)
(R U' R') y U2 (L' U' L)
y2 (L2 F' L' F L') U2 (L U' L')
y' (f R' f') U2 R' U' R

BASIC | BOTH TOP | WHITE SIDE | SAME ON U



F2L 25

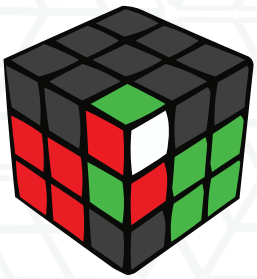
U (R U R') U2 (R U R')
U' (R U2 R') U (R U R')
y U (L' U L) U2 (L' U L)

BASIC | ONE IN SLOT | EDGE

F2L 26

y U' (L' U' L) U2 (L' U' L)
y U (L' U2 L) U' (L' U' L)
U' R U' R' U2 R U' R'

BASIC | ONE IN SLOT | EDGE



y2 U (f' L' f) U' (L U L')

F2L 27

U (F' U' F) U' (R U R')
y U2 (L' U' L) (F' L F L')
y U' M' (U' L' U l) (L' U L)
y U' (L U F' L' F) (L' U L)
y' U2 (R' U' R) y U (R U' R')
y' U2 R' U' M U' R U M'

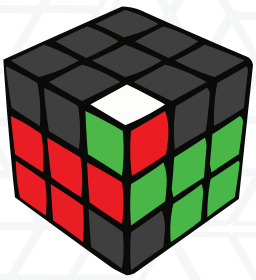
BASIC | ONE IN SLOT | EDGE

y' U' (f R f') U (R' U' R)

F2L 28

y U' (F U F') U (L' U' L)
U2 (R U R') (F R' F' R)
U M' (U R U' r') (R U' R')
U (R' U' F R F') (R U' R')
y2 U2 (L U L') y' U' (L' U L)
y2 U2 L U M U L' U' M'

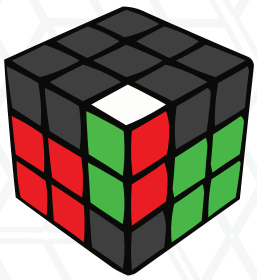
BASIC | ONE IN SLOT | EDGE



F2L 29

(U R U' R')3

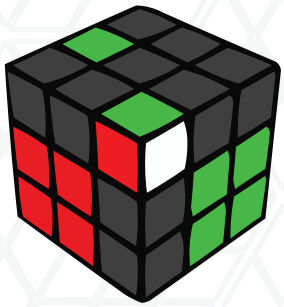
BASIC | ONE IN SLOT | EDGE

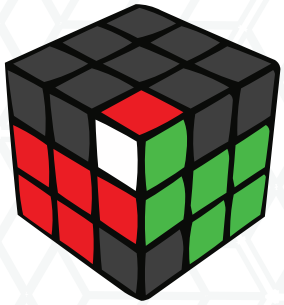


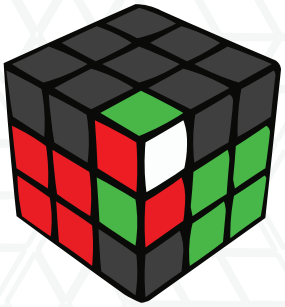
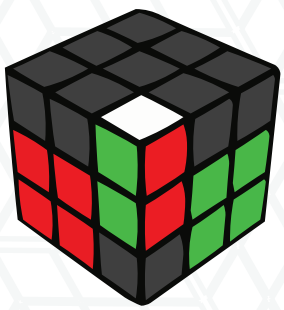
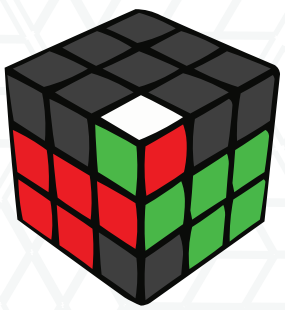
F2L 30

U' (R' F R F') (R U' R')
(R U' R') (F' U2 F)
y' R' U R' F R F' R
y' U' (R' U2 R) (f R f')

BASIC | ONE IN SLOT | EDGE





F2L 31

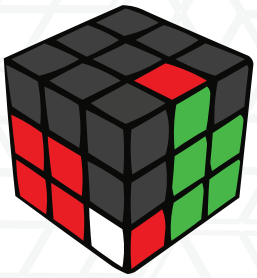
(R U R') U' (R U R')
y M' (U' L' U L) (U' L' U l)
y (L F' L' F)2

BASIC ONE IN SLOT CORNER

F2L 32

y (L' U' L) U (L' U' L)
M' (U R U' R') (U R U' r')
(R' F R F')2

BASIC ONE IN SLOT CORNER



F2L 33

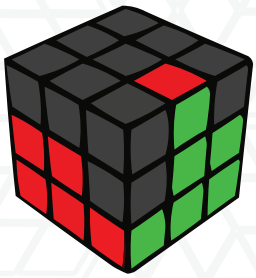
(R U' R') U (R U' R')

BASIC ONE IN SLOT CORNER

F2L 34

y (L' U L) U' (L' U L)

BASIC ONE IN SLOT CORNER



F2L 35

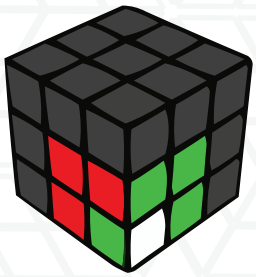
U' (R' F R F') (R U R')
(R' F' R) (U R U' R') F
U' F' (R U R' U') (R' F R)
y U' (L' U L) (F' L F L')
y2 U' M U L U' M' U L'
y' U' R' U M U' R U M'

BASIC ONE IN SLOT CORNER

F2L 36

y U (L F' L' F) (L' U' L)
y (L F L') (U' L' U L) F'
y U F (L' U' L U) (L F' L')
U (R U' R') (F R' F' R)
y' U M U' R' U M' U' R
y2 U L U' M U L' U' M'

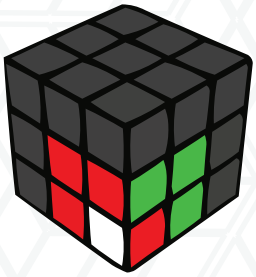
BASIC ONE IN SLOT CORNER



F2L 37

(R U' R') U (R U2 R' U R U' R')
y' (L' U L) U (L' U' L U2' L' U L)

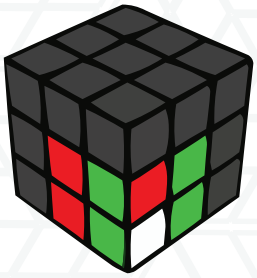
BASIC BOTH IN SLOT



F2L 38

y' (L' U L) U' (L' U2' L U' L' U L)
(R U' R') U' (R U R' U2 R U' R')

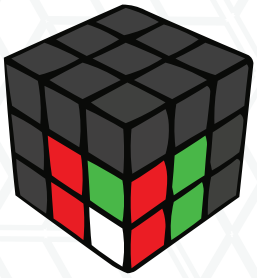
BASIC BOTH IN SLOT



F2L 39

(R U' R') (F' L' U2 L F)
y (F R U2' R' F') (L' U' L)
y2 L2 F U F' U' L' U L'
y' R' U R' U' F' U F R2

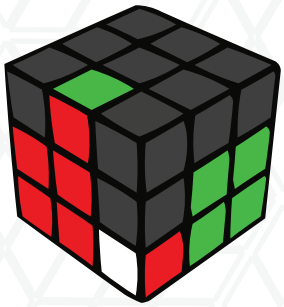
BASIC BOTH IN SLOT

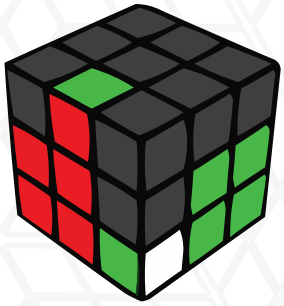


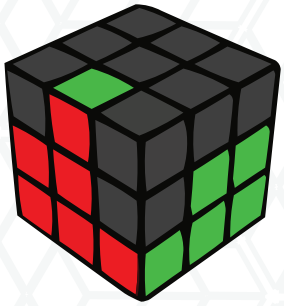
F2L 40

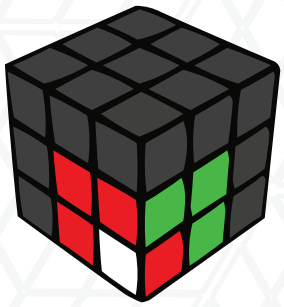
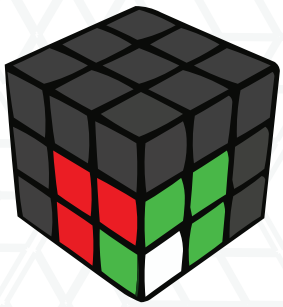
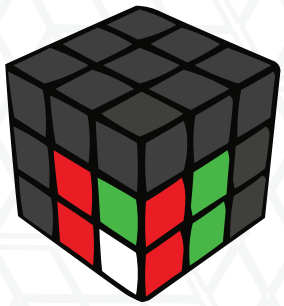
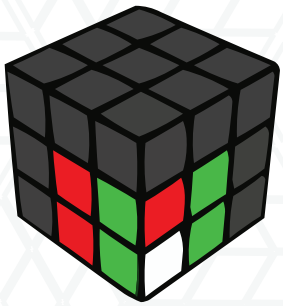
y (L' U L) (F R U2' R' F')
(F' L' U2 L F) (R U R')
y' R2' F' U' F U R U' R
y2 L U' L U F U' F' L2'

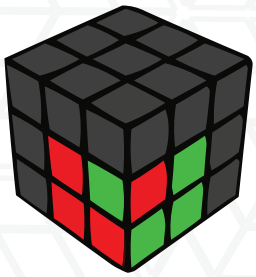
BASIC BOTH IN SLOT







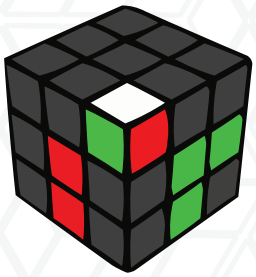







F2L 41

R2' U2' F R2 F' U2' R' U R'
y L2 U2 F' L2' F U2 L U' L
y' (f R' f') U (R' U2' R) U (R' U2' R)
y2 (f' L f) U' (L U2 L') U' (L U2 L')

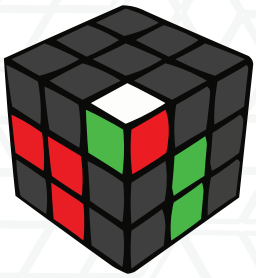
BASIC · BOTH IN SLOT



F2L 42

U' R' U R2 U' R'

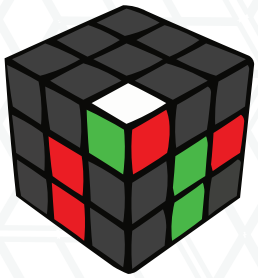
ADV-ANCED · 2 IN WRONG SLOT · WHITE UP



F2L 43

y U L U' L2' U L

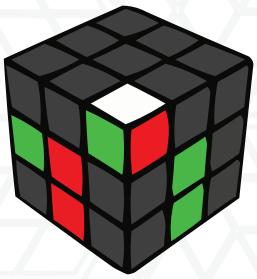
ADV-ANCED · 2 IN WRONG SLOT · WHITE UP



F2L 44

U2 (R' U R) U' (S R S')
y R' F R2 U' R' U2 F'
y2 U2 (L F' L' F) (L U L')

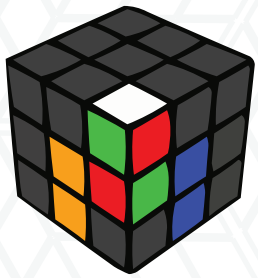
ADV-ANCED · 2 IN WRONG SLOT · WHITE UP



F2L 45

y U2 (L U' L') U (S' L' S)
L F' L2' U L U2' F
y' U2 (R' F R F') (R' U' R)

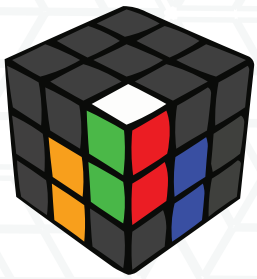
ADV-ANCED · 2 IN WRONG SLOT · WHITE UP



F2L 46

U2 L2' u L2 u' L2'
y U2 R2 u' R2' u R2
y' U2 L2' u' L2 u L2'
y2 U2 R2 u R2' u' R2

ADV-ANCED · 2 IN WRONG SLOT · WHITE UP



F2L 47

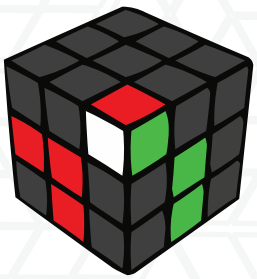
L F' U F L'
y R' F U' F' R
y' (L' u' L) U' (L' u L)
y2 (R u R') U (R u' R')

ADV-ANCED · 2 IN WRONG SLOT · WHITE UP

F2L 48

R' U' R2 U R'

ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE



F2L 49

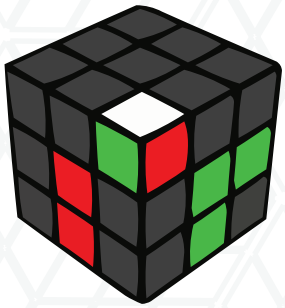
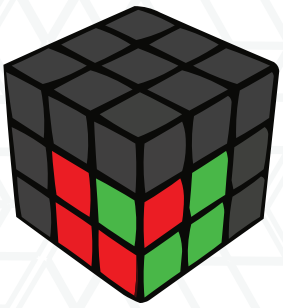
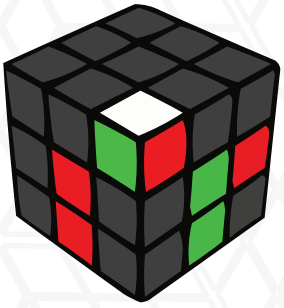
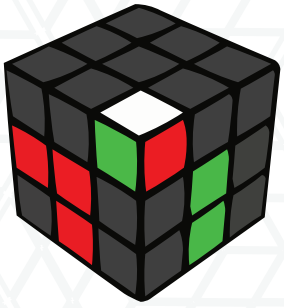
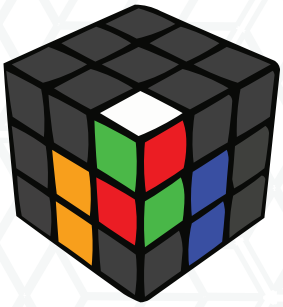
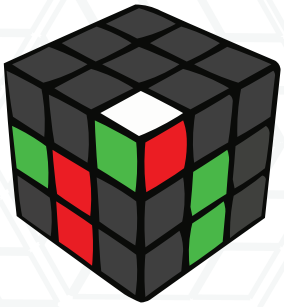
y L U L2' U' L

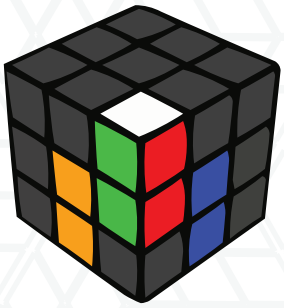
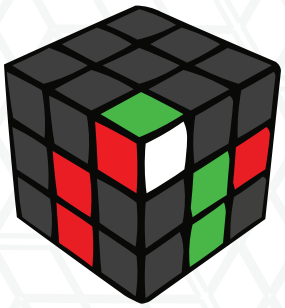
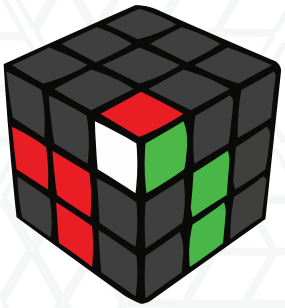
ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE

F2L 50

F D R D' F'
y R (F U F') R'
y2 F (L U L') F'
y' R u R u' R'

ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE

F2L 51

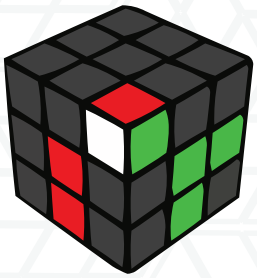
y F' D' L' D F
L' (F' U' F) L
y' F' (R' U' R) F
y2 L' u' L' u L

ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE

F2L 52

U' (L' U' L) (R U' R')
y U2 L' U' L2 U L2' U' L

ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE



F2L 53

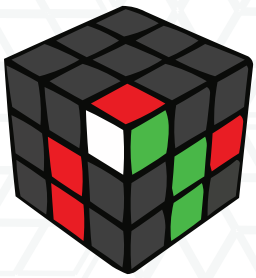
U (R U R') (L' U L)
y' U2' R U R2' U' R2 U R'

ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE

F2L 54

(F U2 F') (R U R')
y L U2 L' F U F'
y' R U2 R' f R f'

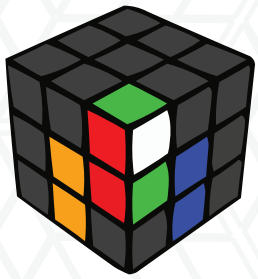
ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE



F2L 55

y (F' U2 F) (L' U' L)
R' U2 R F' U' F
y2 L' U2 L f' L' f

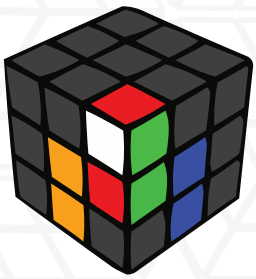
ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE



F2L 56

U (R U R') (L U L')
U' (R U2 R') U' (L U L')
y U (L' U L) (R' U R)

ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE



F2L 57

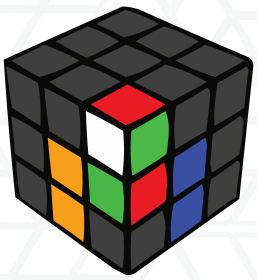
y U' (L' U' L) (R' U' R)
y U (L' U2 L) U (R' U' R)
U' (R U' R') (L U' L')

ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE

F2L 58

U2 F' (L U L') F
y U2 L' (B U B') L
y' U2 R' (F U F') R
y2 f' U L U' f

ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE



F2L 59

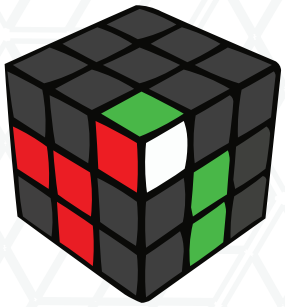
y U2' F (R' U' R) F'
U2' R (B' U' B) R'
y2 U2' L (F' U' F) L'
y' f U' R' U f'

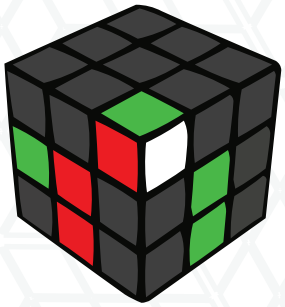
ADV-ANCED · 2 IN WRONG SLOT · WHITE SIDE

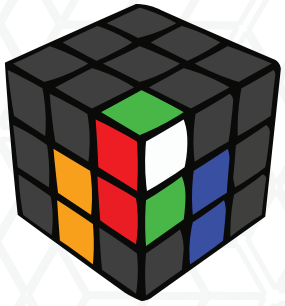
F2L 60

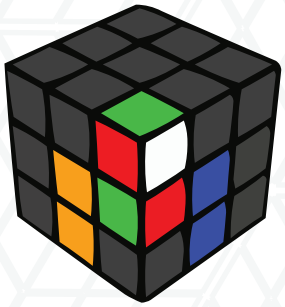
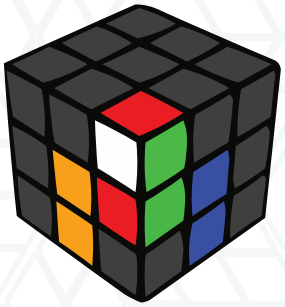
U (R U' R') (L' U L)

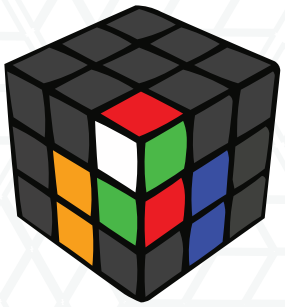
ADV-ANCED · 2 IN WRONG SLOT · IN RIGHT SLOT









F2L 61

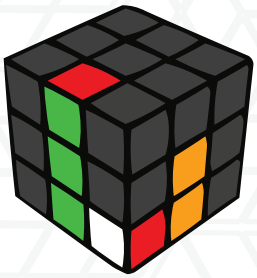
y (L' U2 L) U' (L U L')
y U2 (L' U L) U' (L U2 L')

ADV-ANCED | IN WRONG SLOT | IN RIGHT SLOT

F2L 62

U2 (R U' R') U (L' U' L)
y (F' L F L') U' (L U2 L')

ADV-ANCED | IN WRONG SLOT | IN RIGHT SLOT



F2L 63

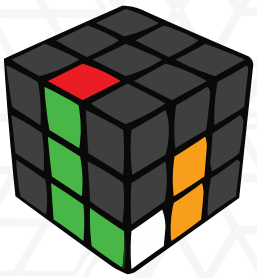
y U' L' U' L2 U2 L'

ADV-ANCED | IN WRONG SLOT | IN RIGHT SLOT

F2L 64

(R U R') U' (L' U L)
y (S' L S)

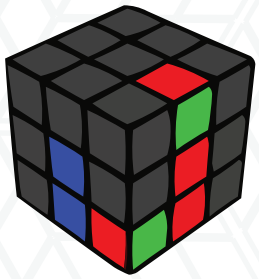
ADV-ANCED | IN WRONG SLOT | IN RIGHT SLOT



F2L 65

U' (R U R') (F U F')
y U (L' U L) U (L U L')
y U' (F U F') (L U L')

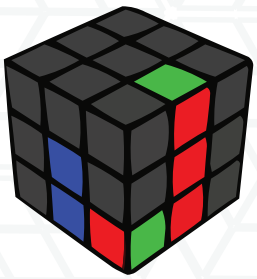
ADV-ANCED | IN WRONG SLOT | IN RIGHT SLOT



F2L 66

y U' (L' U L) (R U' R')

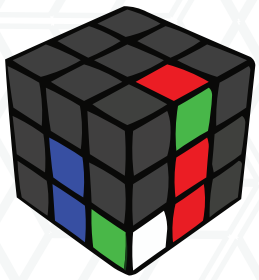
ADV-ANCED | IN WRONG SLOT | IN LEFT SLOT



F2L 67

(R U2 R') U (R' U' R)
U2 (R U' R') U (R' U2 R)

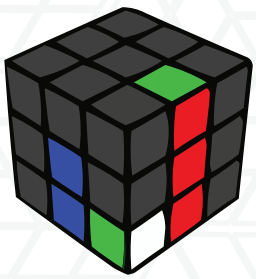
ADV-ANCED | IN WRONG SLOT | IN LEFT SLOT



F2L 68

(F R' F' R) U (R' U2 R)
y U2 (L' U L) U' (R U R')

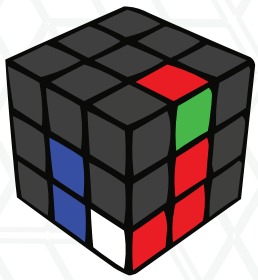
ADV-ANCED | IN WRONG SLOT | IN LEFT SLOT



F2L 69

U R U R2' U2 R

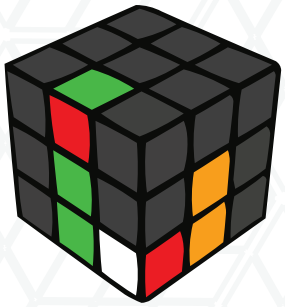
ADV-ANCED | IN WRONG SLOT | IN LEFT SLOT

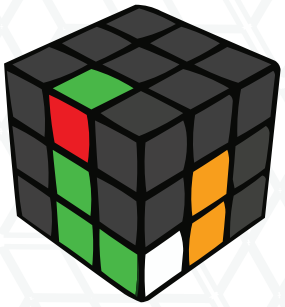


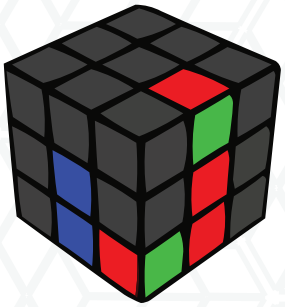
F2L 70

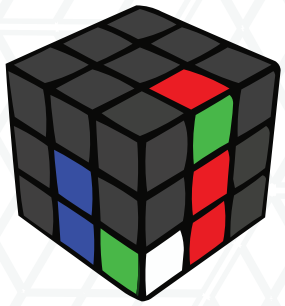
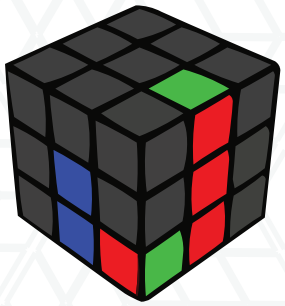
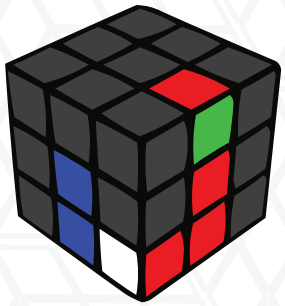
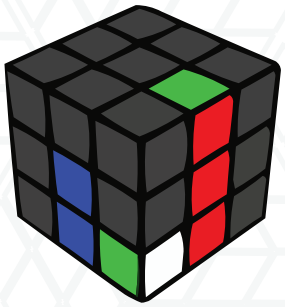
(S R' S')
y (L' U' L) U (R U' R')

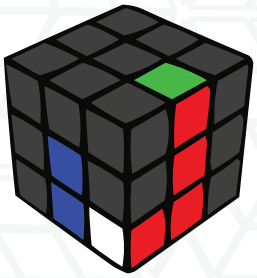
ADV-ANCED | IN WRONG SLOT | IN LEFT SLOT







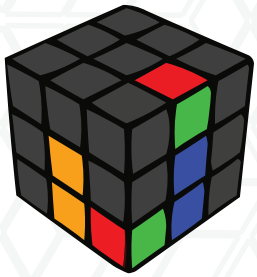







F2L 71

U (F U' F') (R' U' R)
U' (R U' R') U' (R' U R)
y U (L' U' L) (F' U' F)

ADV-ANCED | IN WRONG SLOT | IN LEFT SLOT



F2L 72

U' (F' U F) (L U2 L')
y U' (L' U L) U' (f R' f')

ADV-ANCED | IN WRONG SLOT | IN FAR SLOT

F2L 73

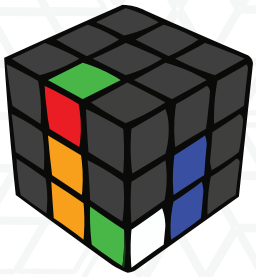
U (R U' R') U (f' L f)
y U (F U' F') (R' U2 R)

ADV-ANCED | IN WRONG SLOT | IN FAR SLOT

F2L 74

(R U' R') (L U2 L')
y (L' U' L) (f R' f')

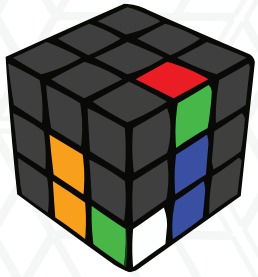
ADV-ANCED | IN WRONG SLOT | IN FAR SLOT



F2L 75

(R U R') (f' L f)
y (L' U L) (R' U2 R)

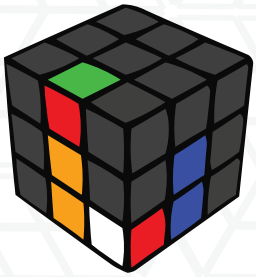
ADV-ANCED | IN WRONG SLOT | IN FAR SLOT



F2L 76

(R U' R') U (L U L')
y (L F' L' F) (R' U2 R)

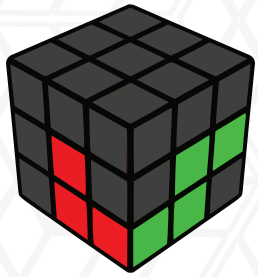
ADV-ANCED | IN WRONG SLOT | IN FAR SLOT



F2L 77

(R' F R F') (L U2 L')
y (L' U' L) U' (R' U' R)

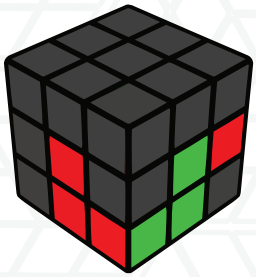
ADV-ANCED | IN WRONG SLOT | IN FAR SLOT



F2L 78

R2 U' R2' U R2
y2 L2' U' L2 U L2'
y F' R' F2 R F

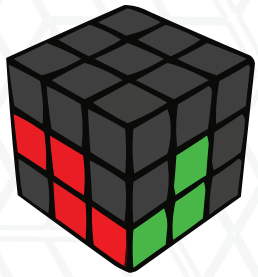
EXPERT | IS SOLVED | IS IN WRONG SLOT



F2L 79

f' R' U R f
y R' u' R u R
y' L' u' L u L
y2 f' D' L D f

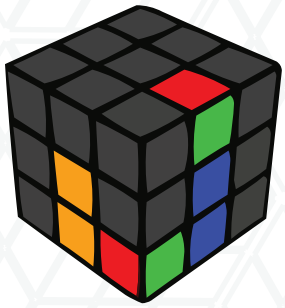
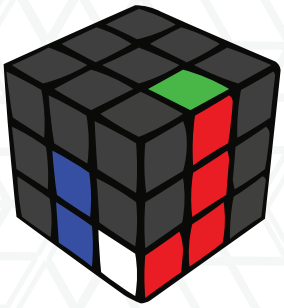
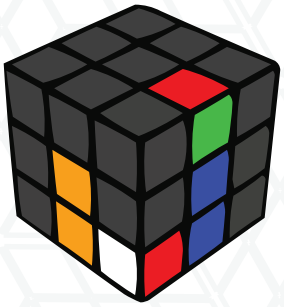
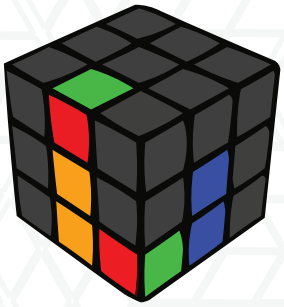
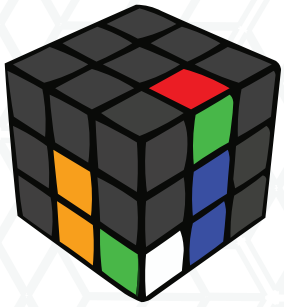
EXPERT | IS SOLVED | IS IN WRONG SLOT

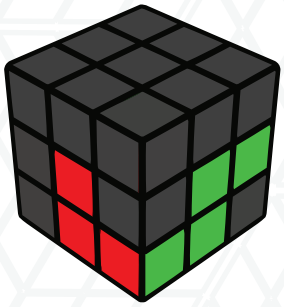
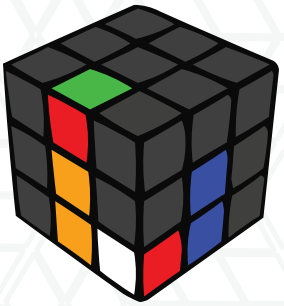
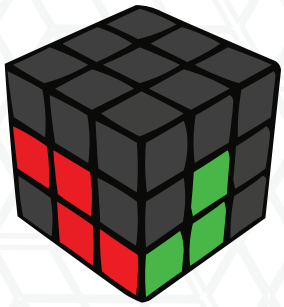
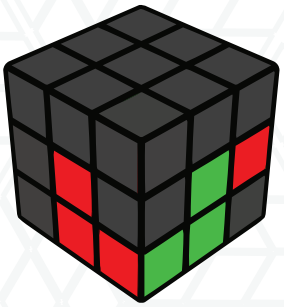


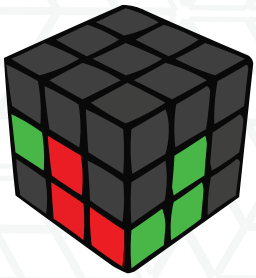
F2L 80

y L2' U L2 U' L2'
y' R2 U R2' U' R2
F L F2' L' F'

EXPERT | IS SOLVED | IS IN WRONG SLOT

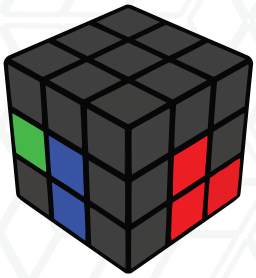







F2L 81

y f L U' L' f'
L u L' u' L'
y2 R u R' u' R'
y' f D R' D' f'

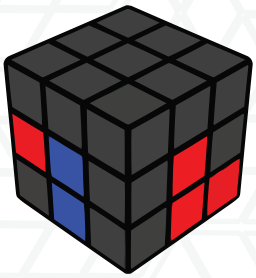
EXPERT · IS SOLVED · IS IN WRONG SLOT



F2L 82

L2' u' L2 u L2'
y' R2 u R2' u' R2
y L2' u L2 u' L2'
y2 R2 u' R2' u R2

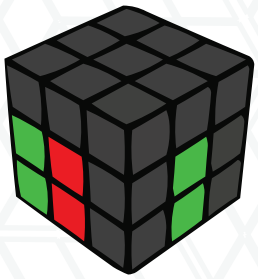
EXPERT · IS SOLVED · IS IN WRONG SLOT



F2L 83

(L' u' L) U (L' u L)
y' (R u R') U' (R u' R')
y (L u L') U' (L u' L')
y2 (R' u' R) U (R' u R)

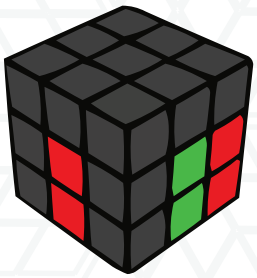
EXPERT · IS SOLVED · IS IN WRONG SLOT



F2L 84

R' F R2 U' R2' F' R
L F' L2' U' L2 F L'
y (f' L' f) U' (L' U L)
y' (R U R') U' (f R' f')
y2 (f R f') (L U2 L')

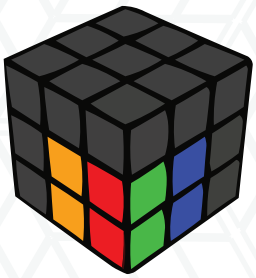
EXPERT · PAIR IS IN WRONG SLOT



F2L 85

y L F' L2' U L2 F L'
y R' F R2 U R2' F' R
(f R f') U (R U' R')
y2 (L' U' L) U (f' L f)
y' (f' L' f) (R' U2' R)

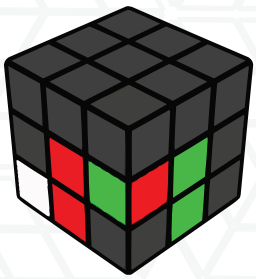
EXPERT · PAIR IS IN WRONG SLOT



F2L 86

R (L U2 L') R'
y L' (R' U2 R) L

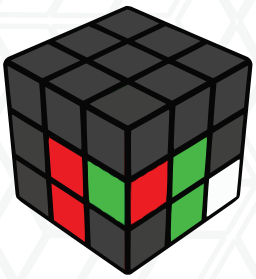
EXPERT · PAIR IS IN WRONG SLOT



F2L 87

L F2' L' F U' F
(L F' L' U' F) U' (R U R')
y (L U' F' L' F) (L' U L)

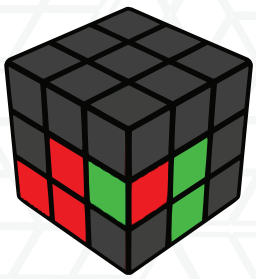
EXPERT · IS FLIPPED · IS IN NEAR SLOT



F2L 88

y R' F2 R F' U F'
y (R' F R U F') U (L' U' L)
(R' U F R F') (R U' R')

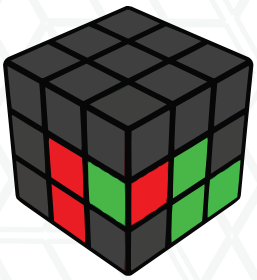
EXPERT · IS FLIPPED · IS IN NEAR SLOT



F2L 89

(R' F R U' F') (R U' R')
y (L' U' L) U (S' L' S)

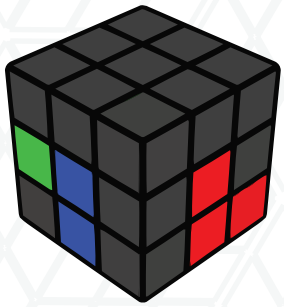
EXPERT · IS FLIPPED · IS IN NEAR SLOT

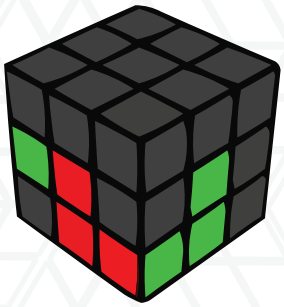


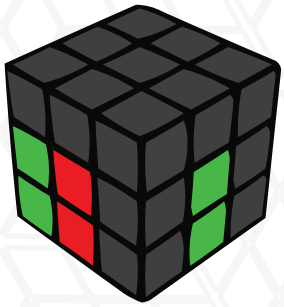
F2L 90

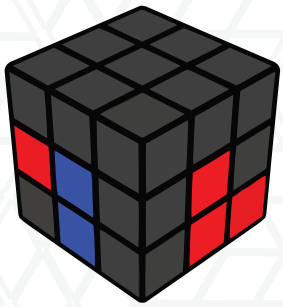
y (L F' L' U F) (L' U L)
(R U R') U' (S R S')

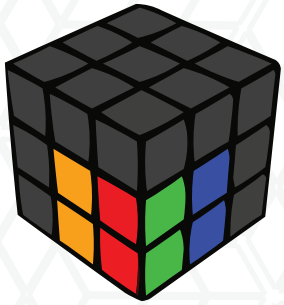
EXPERT · IS FLIPPED · IS IN NEAR SLOT

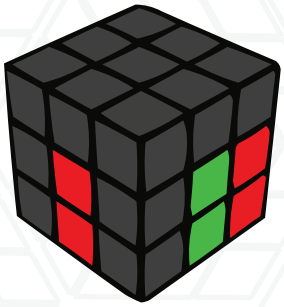


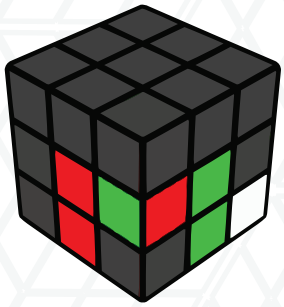


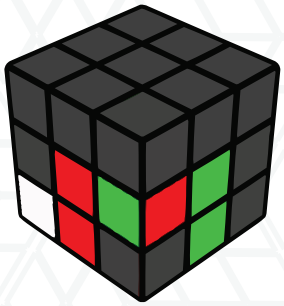


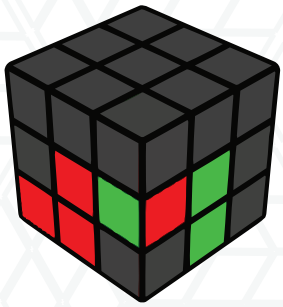


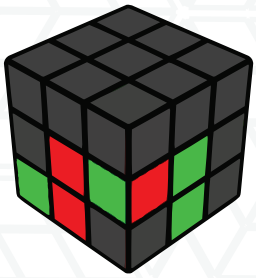












F2L 91

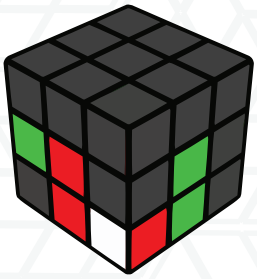
(L' U L) (M' U R U' r') (R U' R')
y (L U F' L' F) U2 (L' U' L)
y (L U L') (F U F') U' (L' U L)

EXPERT · ▽ IS FLIPPED · ▽ IS IN NEAR SLOT

F2L 92

y (R U' R') (M' U' L' U l) (L' U L)
(R' U' F R F') U2 (R U R')
(R' U' R) (F' U' F) U (R U' R')

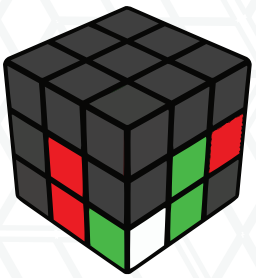
EXPERT · ▽ IS FLIPPED · ▽ IS IN NEAR SLOT



F2L 93

(R' F R U' F') U (R U' R')
R U' R2' u' R' u R
y2 L U' L2' u' L' u L

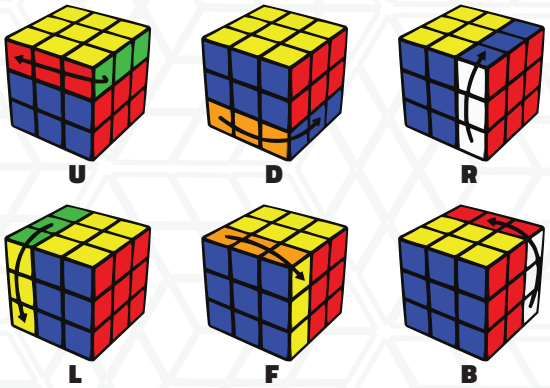
EXPERT · ▽ IS FLIPPED · ▽ IS IN NEAR SLOT

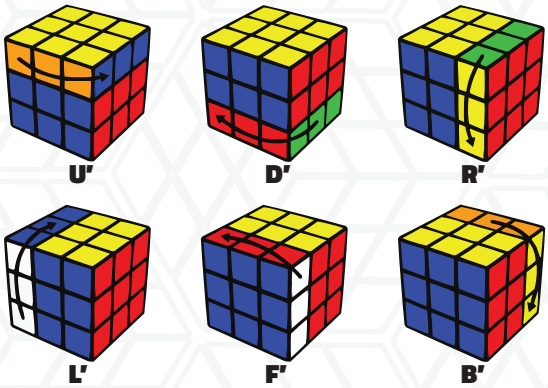


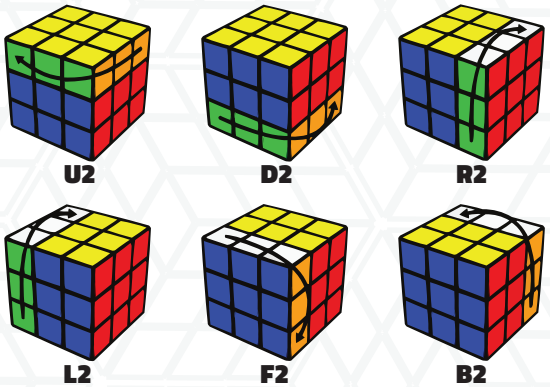
F2L 94

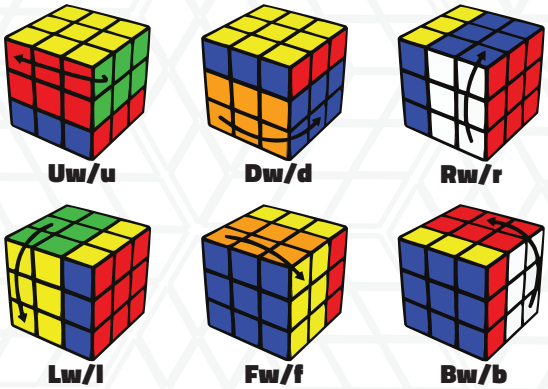
y (L F' L' U F) U' (L' U L)
y L' U L2 u L u' L'
y' R' U R2 u R u' R'

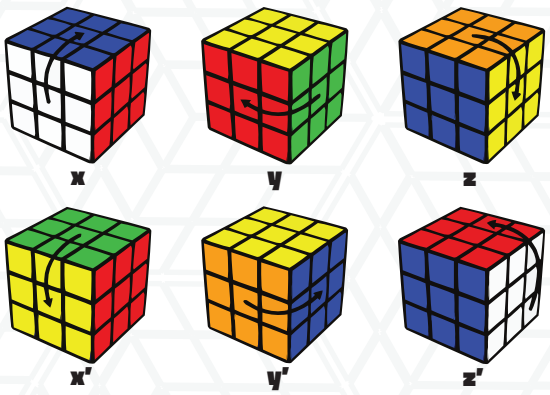
EXPERT · ▽ IS FLIPPED · ▽ IS IN NEAR SLOT

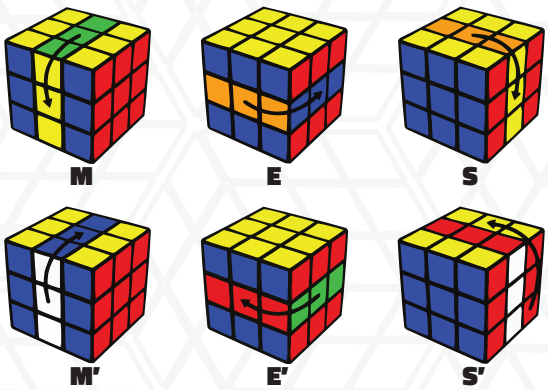


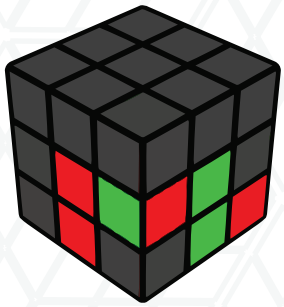


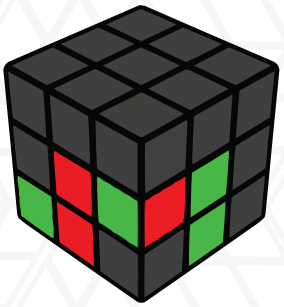


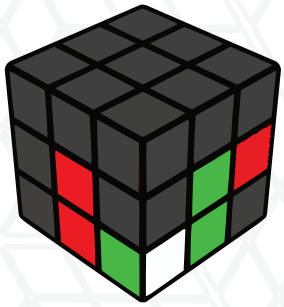


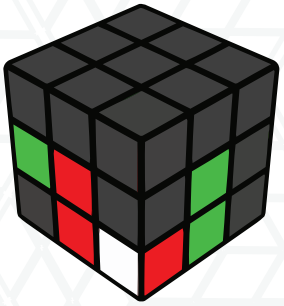


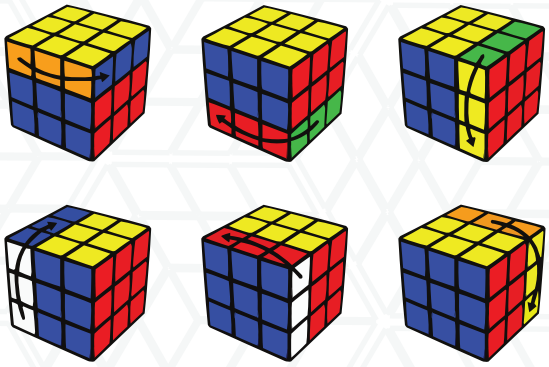


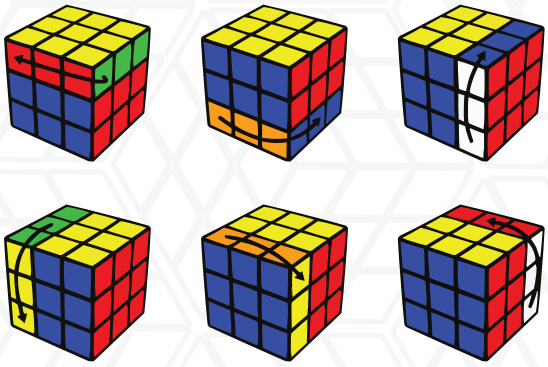


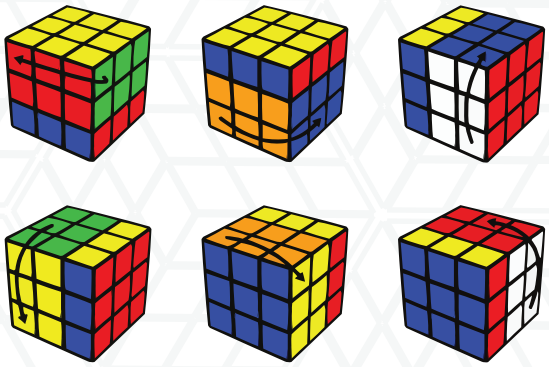


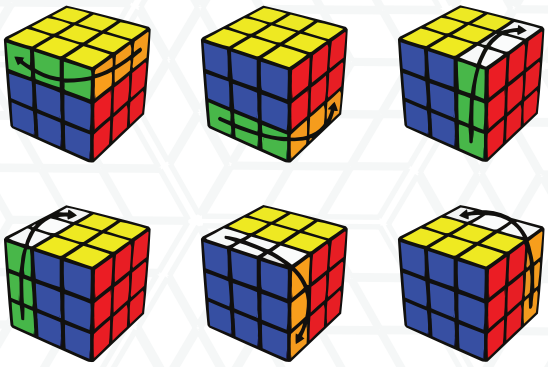


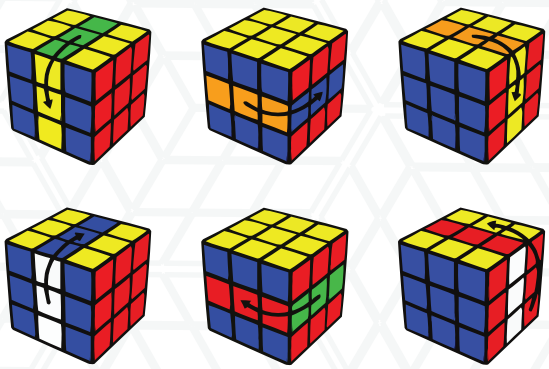


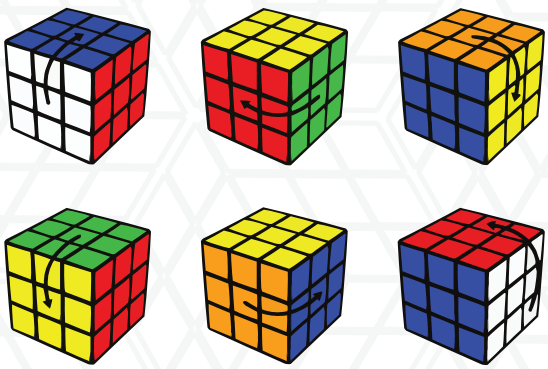


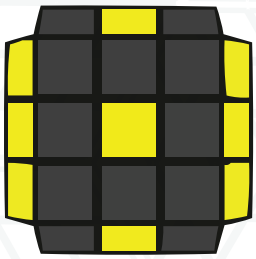






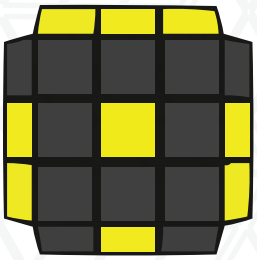






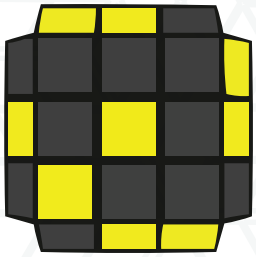
OLL 1

R U2 R2 F R F' U2 R' F R F'



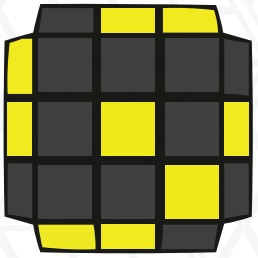
OLL 2

r U r' U2 r U2 R' U2 R U' r'
y' F R U R' U' F' f R U R' U' f'
y' F R U R' U' S R U R' U' f'



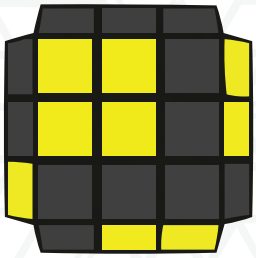
OLL 3

r' R2 U R' U r U2 r' U M'
y F U R U' R' F' U F R U R' U' F'
y' f R U R' U' f' U' F R U R' U' F'



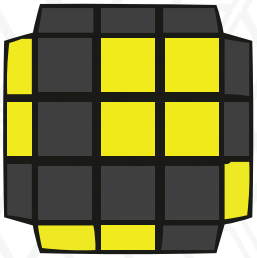
OLL 4

M U' r U2 r' U' R U' R' M'
y F U R U' R' F' U' F R U R' U' F'
y' f R U R' U' f' U F R U R' U' F'



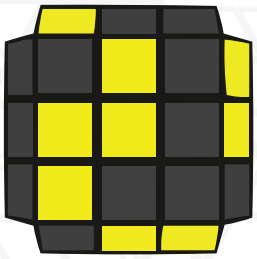
OLL 5

l' U2 L U L' U l
y2 r' U2 R U R' U r



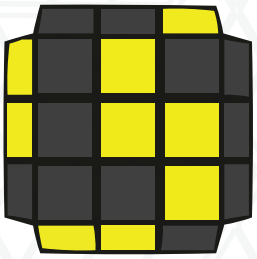
OLL 6

r U2 R' U' R U' r'



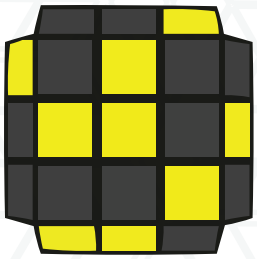
OLL 7

r U R' U R U2 r'



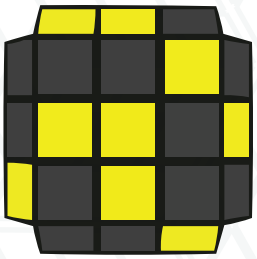
OLL 8

l' U' L U' L' U2 l
R U2 R' U2 R' F R F'
y2 r' U' R U' R' U2 r



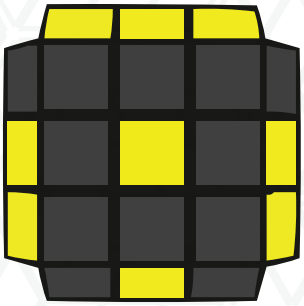
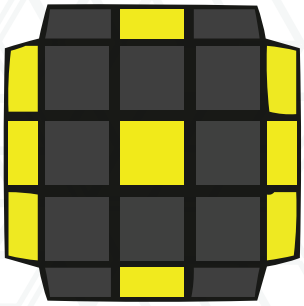
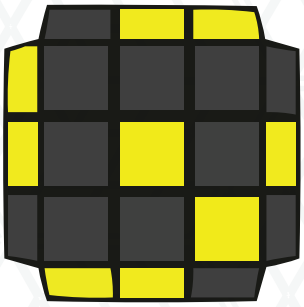
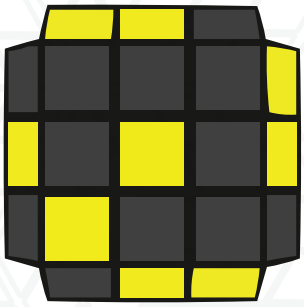
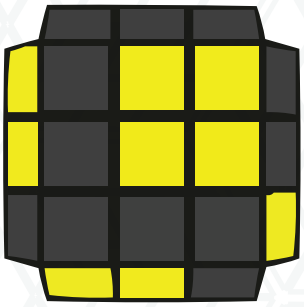
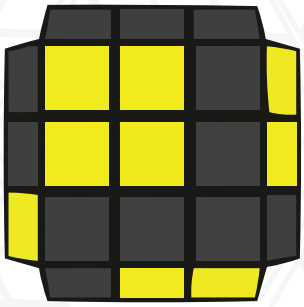
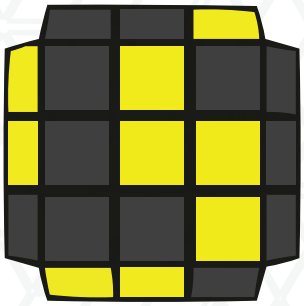
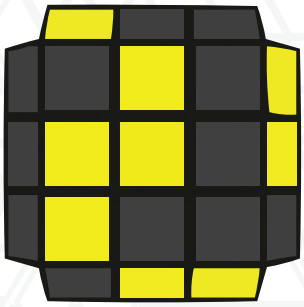
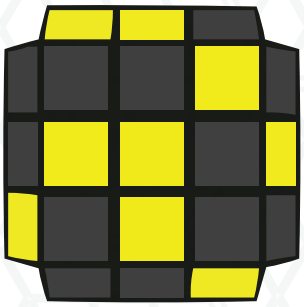
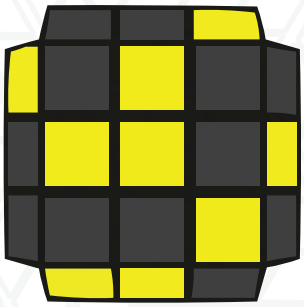
OLL 9

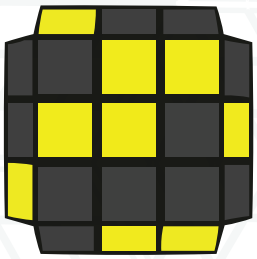
R U R' U' R' F R2 U R' U' F'



OLL 10

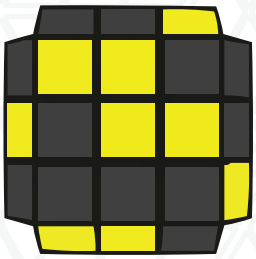
R U R' U R' F R F' R U2 R'
y2 r U R' U R U' R' U' r' R U R U' R'



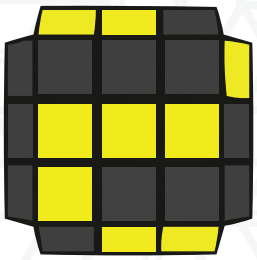
OLL 11

r U R' U R' F R F' R U2 r'
y2 r' R2 U R' U R U2 R' U M'



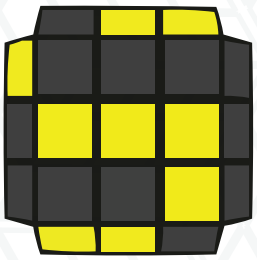
OLL 12

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



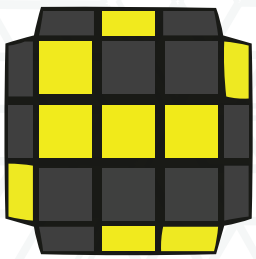
OLL 13

F U R U' R2 F' R U R U' R'
r U' r' U' r U r' y' R' U R



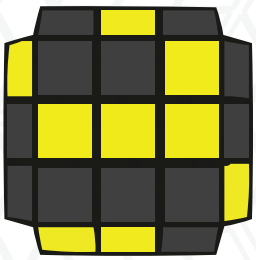
OLL 14

R' F R U R' F' R F U' F'



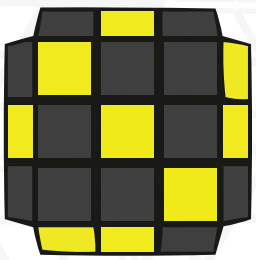
OLL 15

l' U' l L' U' L U l' U l
y2 r' U' r R' U' R U r' U r



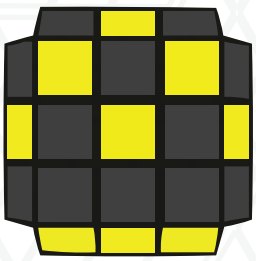
OLL 16

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



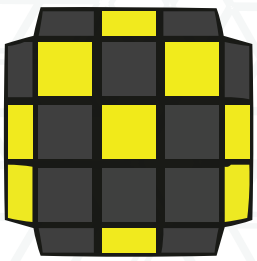
OLL 17

F R' F' R2 r' U R U' R' U' M'
y2 R U R' U R' F R F' U2 R' F R F'



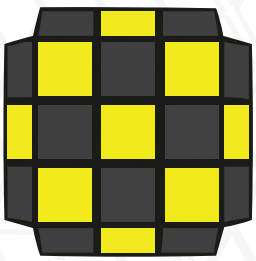
OLL 18

r U R' U R U2 r2 U' R U' R' U2 r
y R U2 R2 F R F' U2 M' U R U' r'



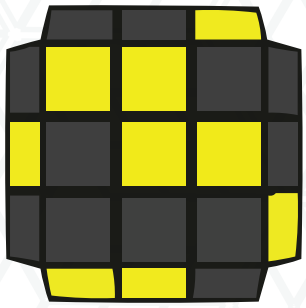
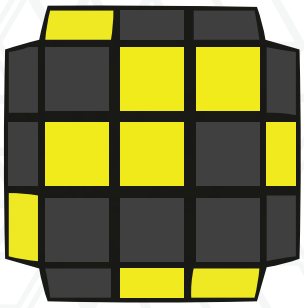
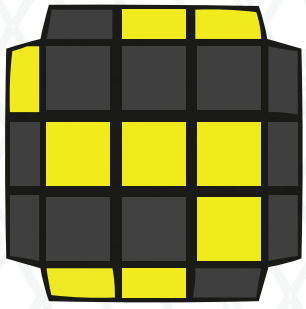
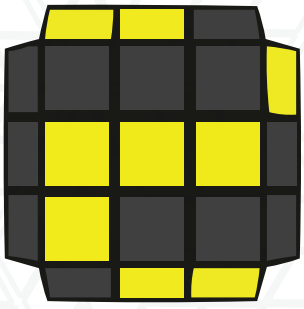
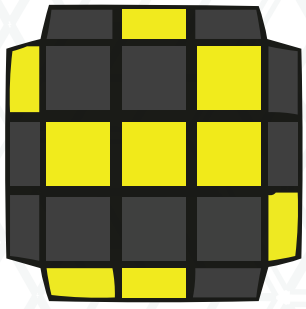
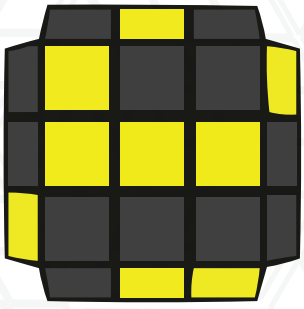
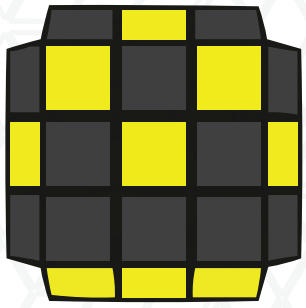
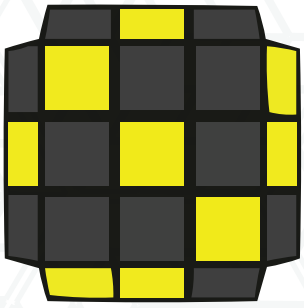
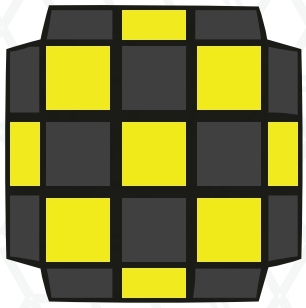
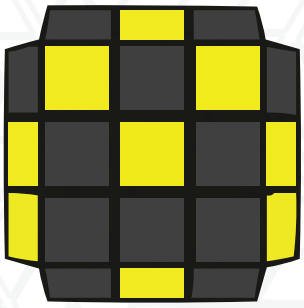
OLL 19

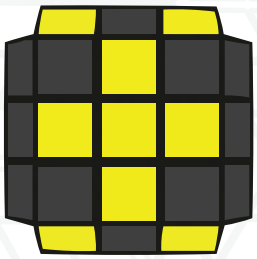
r' R U R U R' U' M' R' F R F'



OLL 20

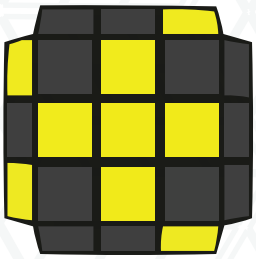
r U R' U' M2 U R U' R' U' M'
r' R U R U R' U' M2 U R U' r'



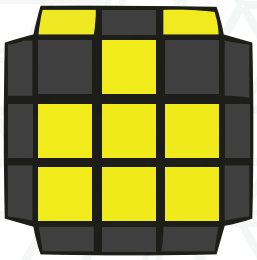
OLL 21

R U2 R' U' R U R' U' R U' R'
y R U R' U R U' R' U R U2 R'



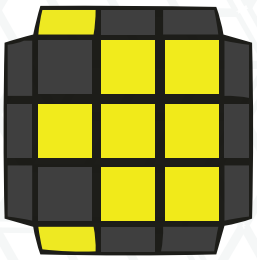
OLL 22

R U2 R2 U' R2 U' R2 U2 R



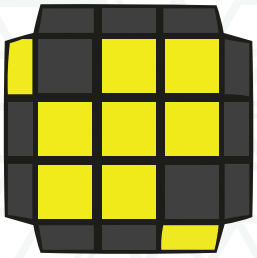
OLL 23

R2 D' R U2 R' D R U2 R
y2 R2 D R' U2 R D' R' U2 R'



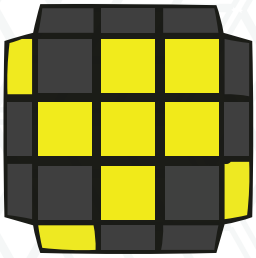
OLL 24

r U R' U' r' F R F'
y R U R D R' U' R D' R2



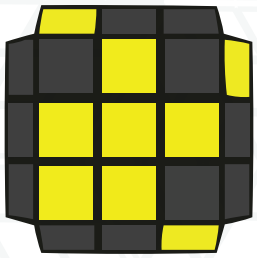
OLL 25

F' r U R' U' r' F R
y' R' F R B' R' F' R B



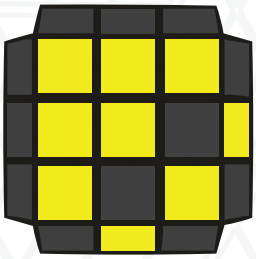
OLL 26

R U2 R' U' R U' R'
y' R' U' R U' R' U2 R



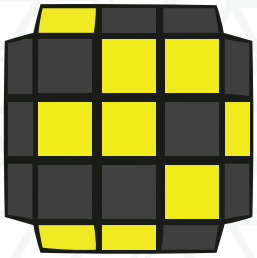
OLL 27

R U R' U R U2 R'
y' R' U2 R U R' U R



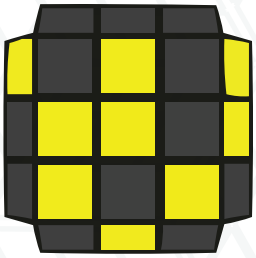
OLL 28

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



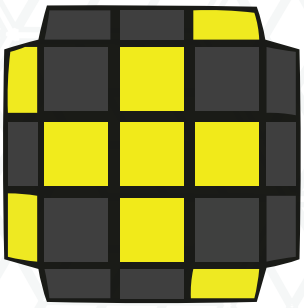
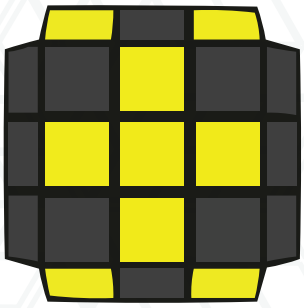
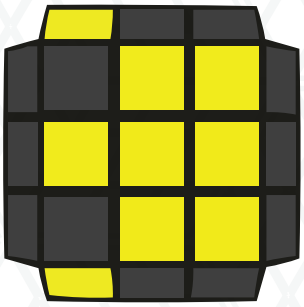
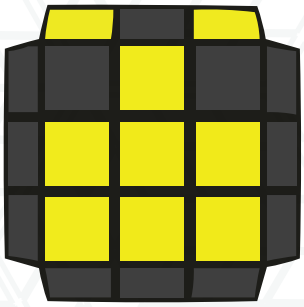
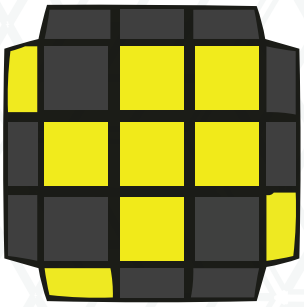
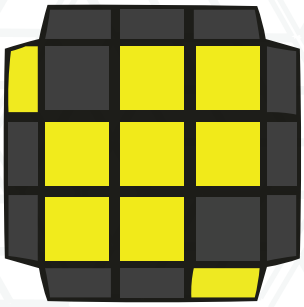
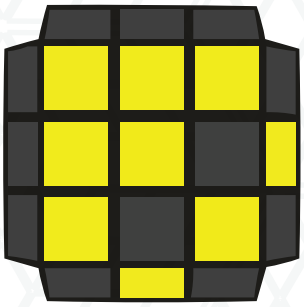
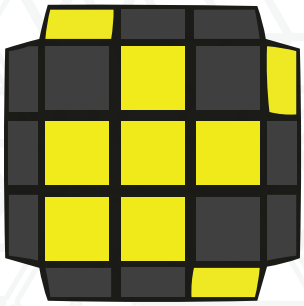
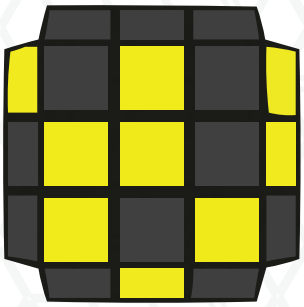
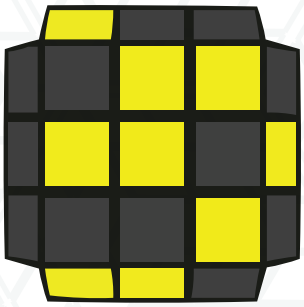
OLL 29

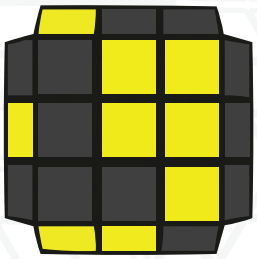
R U R' U' R U' R' F' U' F R U R'



OLL 30

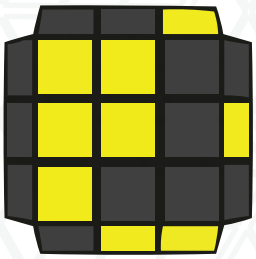
F R' F R2 U' R' U' R U R' F2
F U R U2 R' U' R U2 R' U' F'



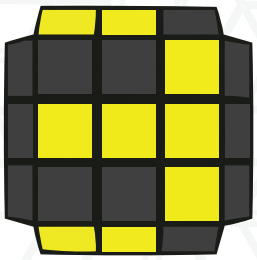
OLL 31

R' U' F U R U' R' F' R



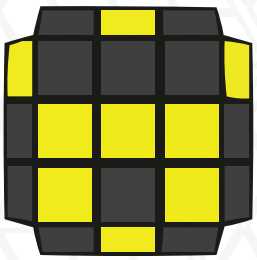
OLL 32

L U F' U' L' U L F L'
y2 S R U R' U' R' F R f'



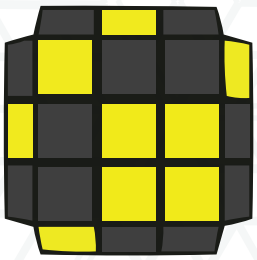
OLL 33

R U R' U' R' F R F'



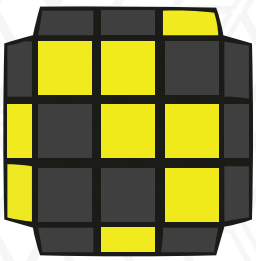
OLL 34

R U R2 U' R' F R U R U' F'
R U R' U' B' R' F R F' B



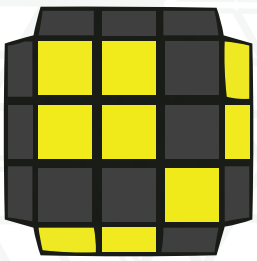
OLL 35

R U2 R2 F R F' R U2 R'



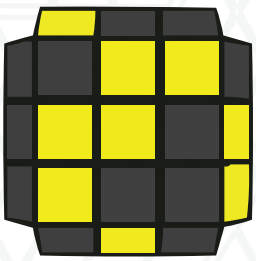
OLL 36

L' U' L U' L' U L U L F' L' F
y2 R' U' R U' R' U R U R B' R' B



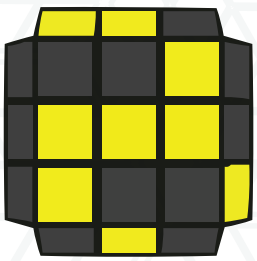
OLL 37

F R' F' R U R U' R'
F R U' R' U' R U R' F'



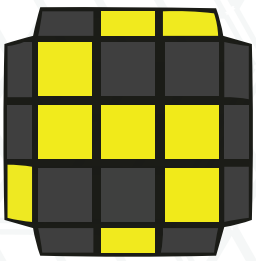
OLL 38

R U R' U R U' R' U' R' F R F'



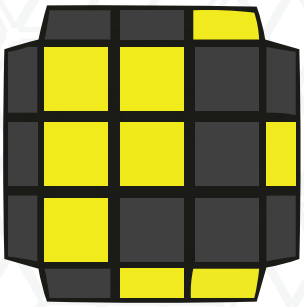
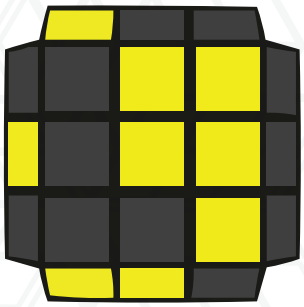
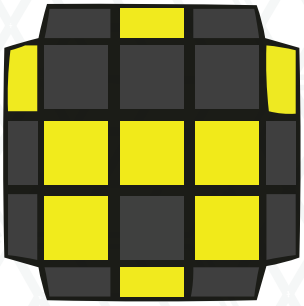
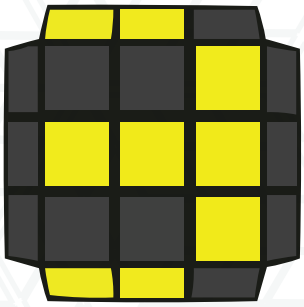
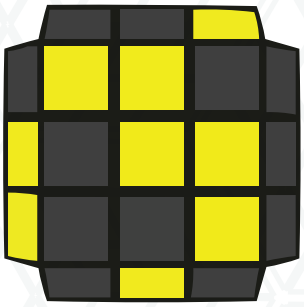
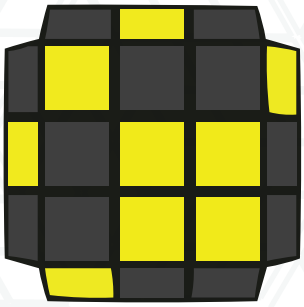
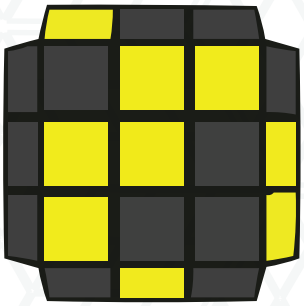
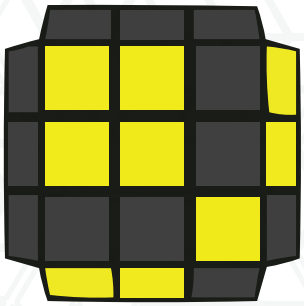
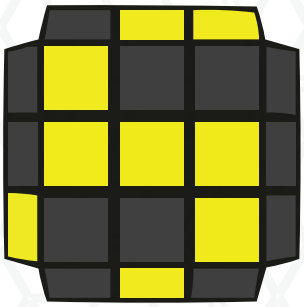
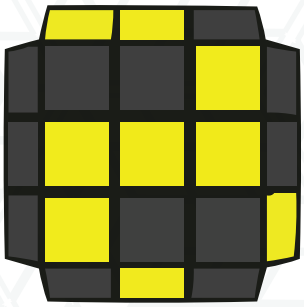
OLL 39

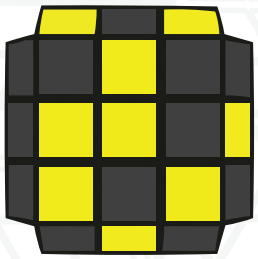
L F' L' U' L U F U' L'
y2 R B' R' U' R U B U' R'



OLL 40

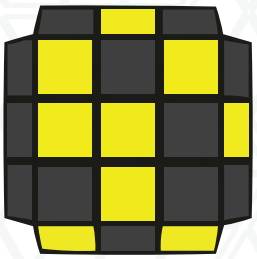
R' F R U R' U' F' U R



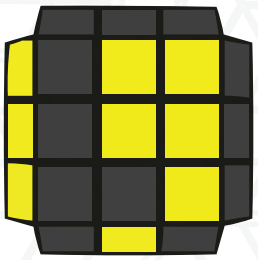
OLL 41

R U R' U R U2 R' F R U R' U' F'



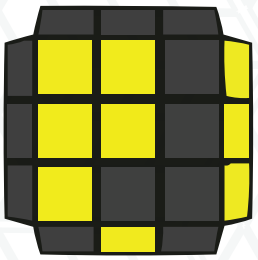
OLL 42

R' U' R U' R' U2 R F R U R' U' F'



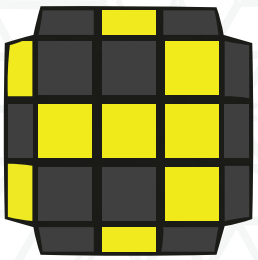
OLL 43

F' U' L' U L F
R' U' F R' F' R U R



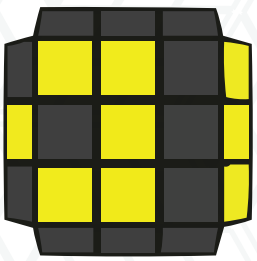
OLL 44

F U R U' R' F'
y2 f R U R' U' f'



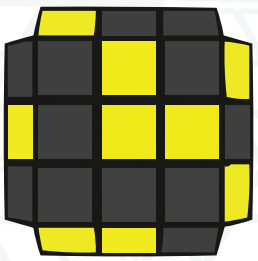
OLL 45

F R U R' U' F'



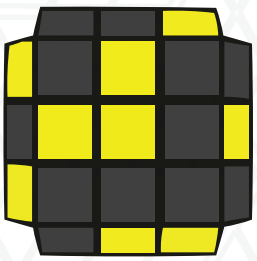
OLL 46

R' U' R' F R F' U R



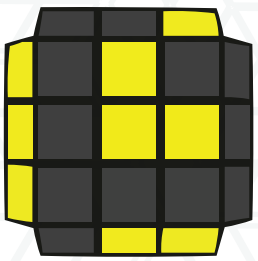
OLL 47

R' U' R' F R F' R' F R F' U R
F' L' U' L U L' U' L U F
y' F U R U' R' F' R U R' U R U2 R'



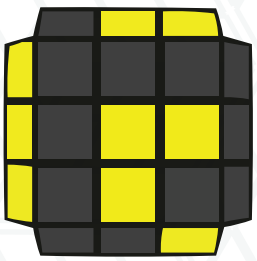
OLL 48

F R U R' U' R U R' U' F'



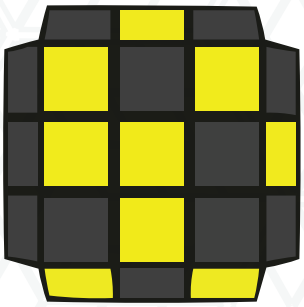
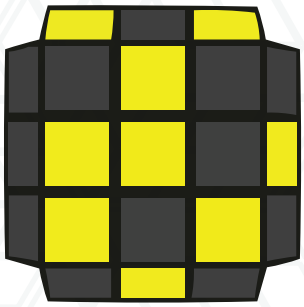
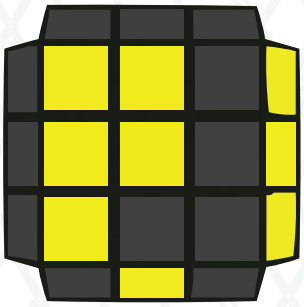
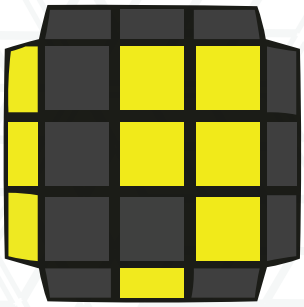
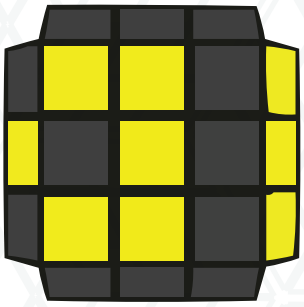
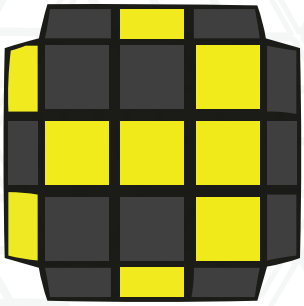
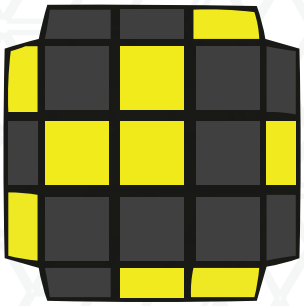
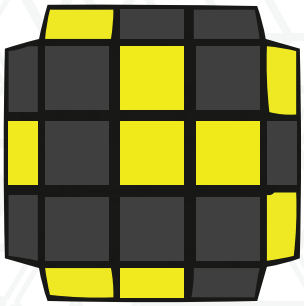
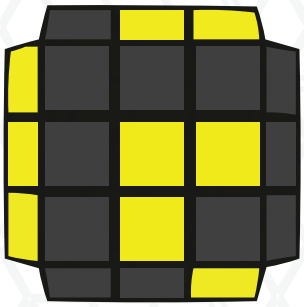
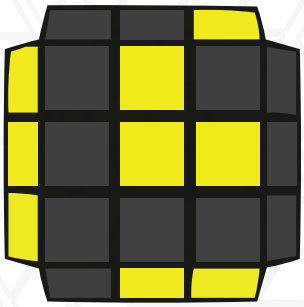
OLL 49

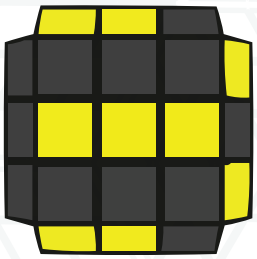
r U' r2 U r2 U r2 U' r



OLL 50

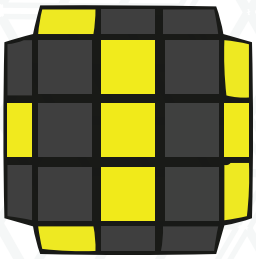
r' U r2 U' r2 U' r2 U r'



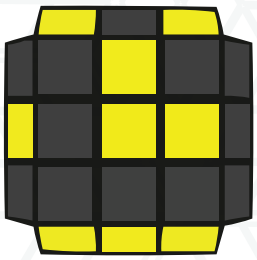
OLL 51

F U R U' R' U R U' R' F'
y2 f R U R' U' R U R' U' f'



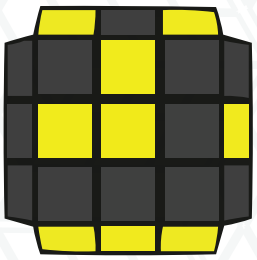
OLL 52

R U R' U R U' B U' B' R'
y2 R' F' U' F U' R U R' U R
R U R' U R U' y R U' R' F'



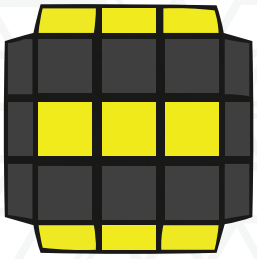
OLL 53

l' U2 L U L' U' L U L' U l
y2 r' U2 R U R' U' R U R' U r
y r' U' R U' R' U R U' R' U2 r



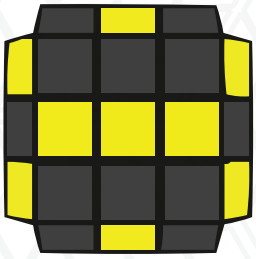
OLL 54

r U2 R' U' R U R' U' R U' r'
y r U R' U R U' R' U R U2 r'



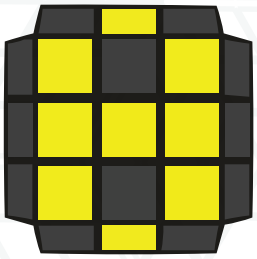
OLL 55

R' F R U R U' R2 F' R2 U' R' U R U R'
y R U2 R2 U' R U' R' U2 F R F'



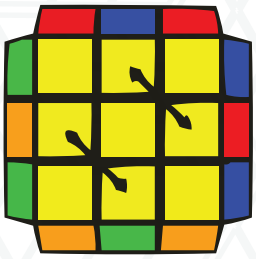
OLL 56

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



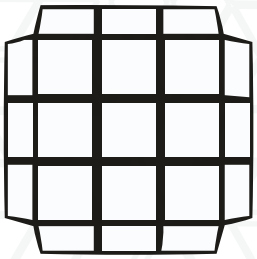
OLL 57

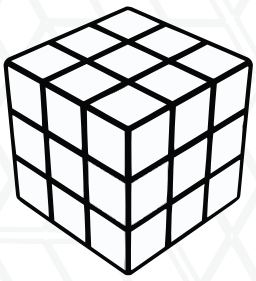
R U R' U' M' U R U' r'

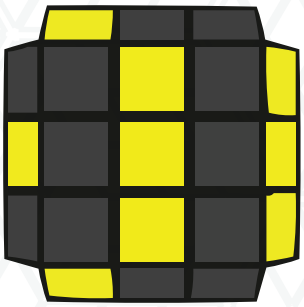
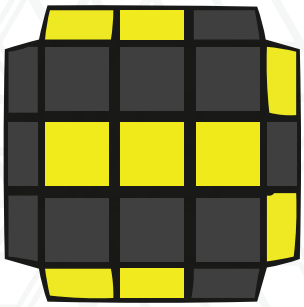
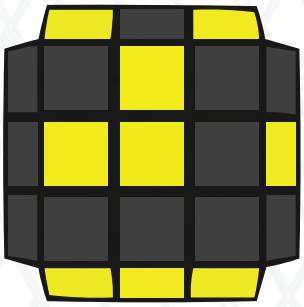
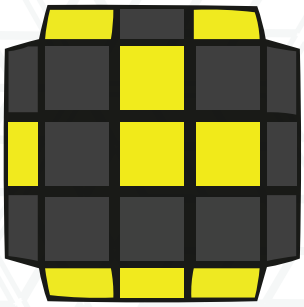
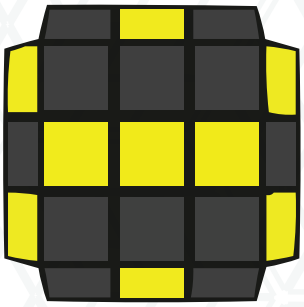
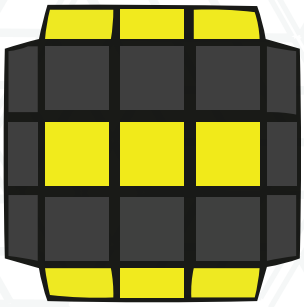
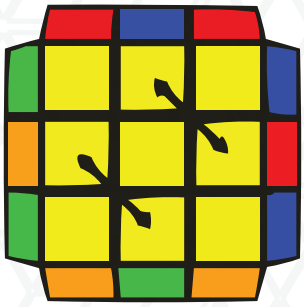
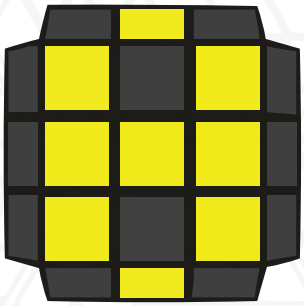
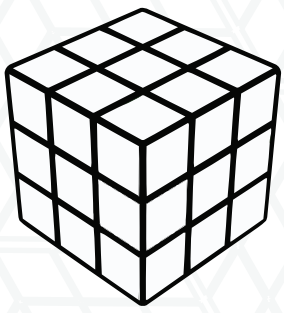
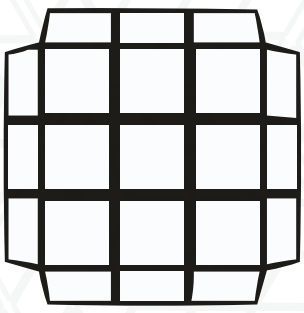


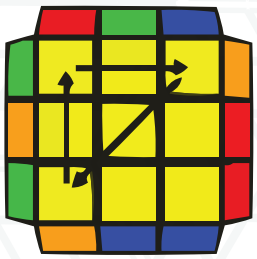
PLL Z

M' U M2 U M2 U M' U2 M2
y M' U' M2 U' M2 U' M' U2 M2
y M2 U M2 U M' U2 M2 U2 M'
M2 U' M2 U' M' U2 M2 U2 M'



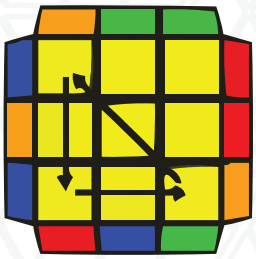




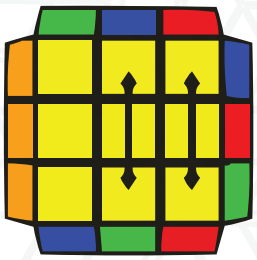
PLL Aa

x L2 D2 (L' U' L) D2 (L' U L')
y' x' (L' U L') D2 (L U' L') D2 L2
y x (R' U R') D2 (R U' R') D2 R2
y2 x' R2 D2 (R' U' R) D2 (R' U R')



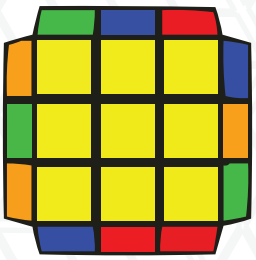
PLL Ab

x' L2 D2 (L U L') D2 (L U' L)
y x (L U' L) D2 (L' U L) D2 L2
y2 x R2 D2 (R U R') D2 (R U' R)
y' x' (R U' R) D2 (R' U R) D2 R2



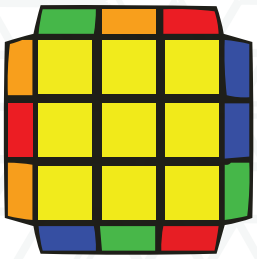
PLL F

R' U' F' (R U R' U') R' F -->
--> (R2 U' R' U') (R U R' U) R



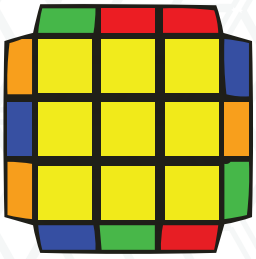
PLL Ga

(R2 U R' U) (R' U' R U') R2 -->
--> (U' D) (R' U R) D'
R2 u (R' U R' U') R u' R2 y' (R' U R)



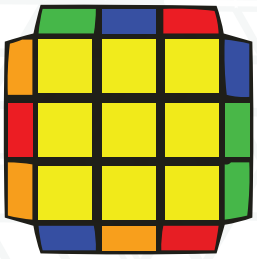
PLL Gb

(R' U' R) (U D') (R2 U R' U) -->
--> (R U' R U') R2 D
y F' U' F R2 u (R' U R U') R u' R2



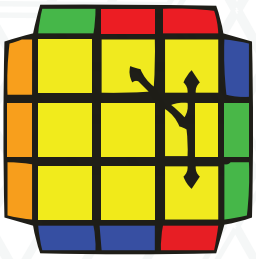
PLL Gc

(R2 U' R U') (R U R' U) R2 -->
--> (U D') (R U' R') D
y2 R2 F2 (R U2 R U2) R' F -->
--> (R U R' U') R' F R2
R2 u' (R U' R U) R' u R2 y (R U' R')



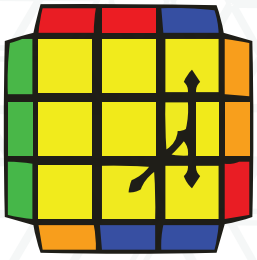
PLL Gd

(R U R') (U' D) (R2 U' R U') -->
--> (R' U R' U) R2 D'
(R U R') y' R2 u' (R U' R' U) R' u R2



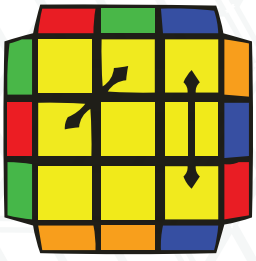
PLL Ja

x R2 F R F' (R U2 r' U) r U2
y2 (L' U' L) F (L' U' L U) L F' (L2 U L)
y' (R' U L' U2) (R U' R' U2) R L



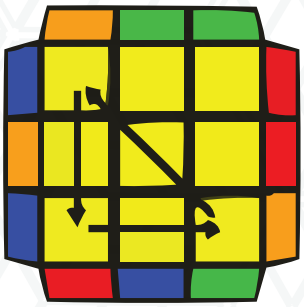
PLL Jb

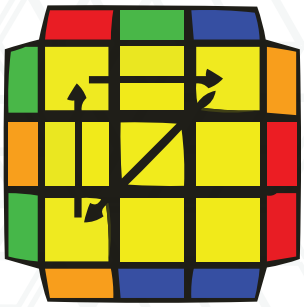
(R U R') F' (R U R' U') R' F (R2 U' R')

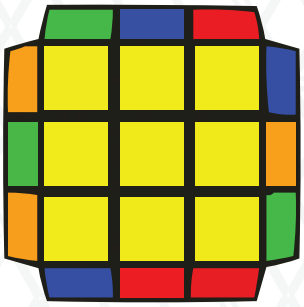


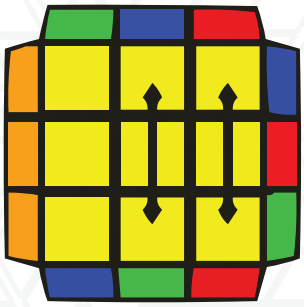
PLL Ra

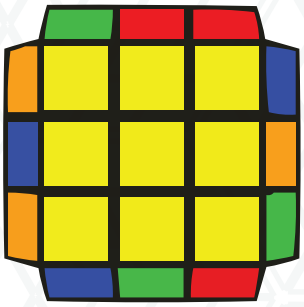
(R U' R' U') (R U R) D (R' U' R) -->
--> D' (R' U2 R')
(R U R') F' (R U2 R' U2) R' F -->
--> (R U R U2) R'
y' (L U2 L' U2) L F' (L' U' L U) L F L2

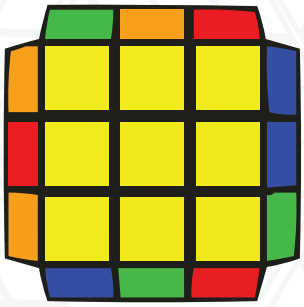


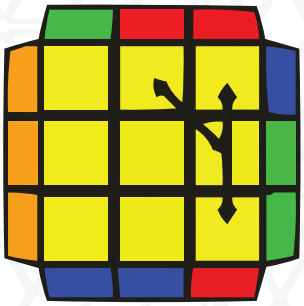


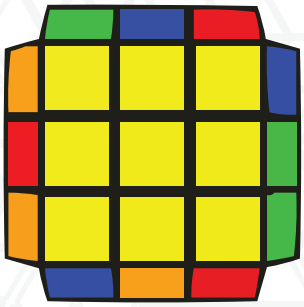


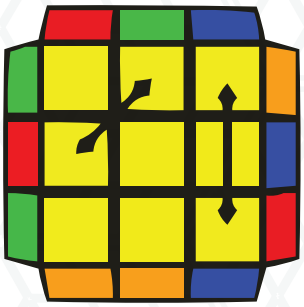


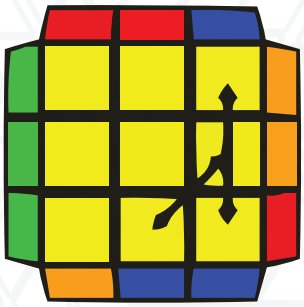


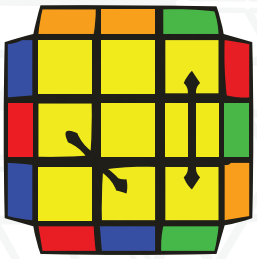






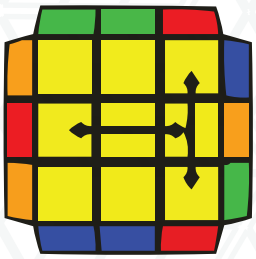






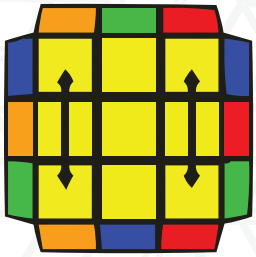
PLL Rb

R2 F (R U R U') R' F' (R U2 R' U2) R
y' (R' U2 R U2) R' F -->
--> (R U R' U') R' F' R2
(R' U2 R') D' (R U' R') D -->
--> (R U R U') (R' U' R)



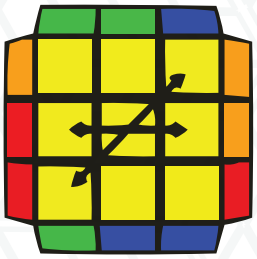
PLL T

(R U R' U') R' F (R2 U' R' U') -->
--> (R U R') F'



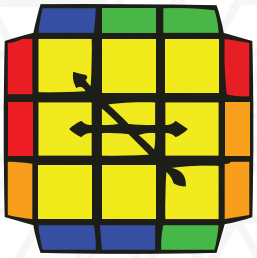
PLL E

x' (L' U L) D' (L' U' L) D (L' U' L) -->
--> D' (L' U L) D
x' (R U' R') D (R U R') D' (R U R') -->
--> D (R U' R') D'



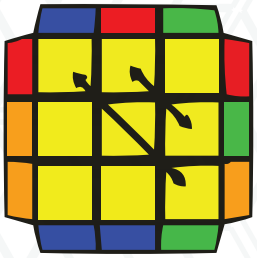
PLL Na

(R U R' U) (R U R') F' (R U R' U') -->
--> R' F (R2 U' R' U2) (R U' R')
z U R' D (R2 U' R) D' U R' D -->
--> (R2 U' R) D'



PLL Nb

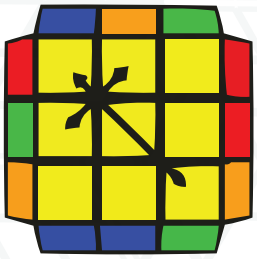
R' (U R U' R') F' U' F (R U R') -->
--> (F R' F' R) U' R
z D' R U' R2 D R' U D' R U' R2 D R' U



(R U2 R') D (R U' R U') R U R2 D -->
--> (R' U' R) D2
x' (R' F R F') (U R U2 R') -->
--> (U' R U' R') (U2 R U R') U'

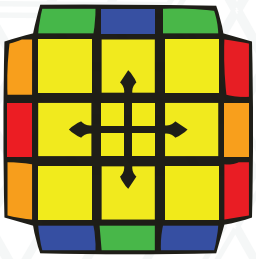
PLL V

(R' U R' U') y R' F' (R2 U' R' U) -->
--> R' F R F
(R' U R' U') R D' R' D R' U D' -->
--> R2 U' R2 D R2
z D' R2 D (R2 U R') D' (R U' R U) -->
--> R' D R U' z'



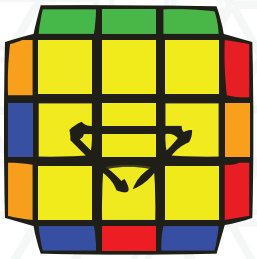
PLL Y

F (R U' R' U') (R U R') F' -->
--> (R U R' U') (R' F R F')
F R' F (R2 U' R' U') (R U R') -->
--> F' (R U R' U') F'



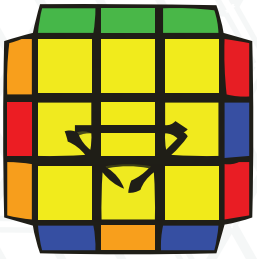
PLL H

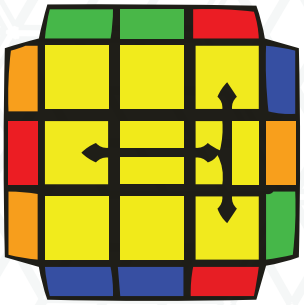
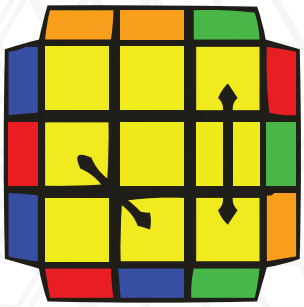
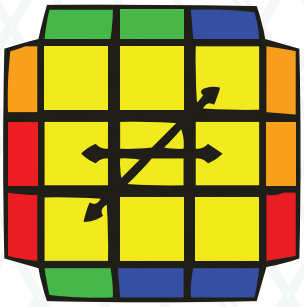
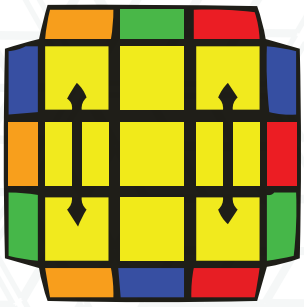
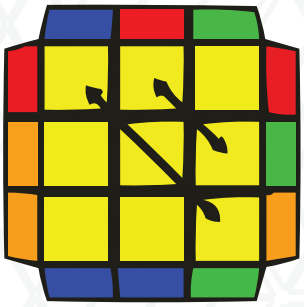
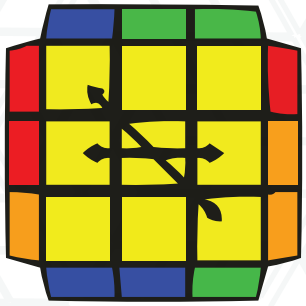
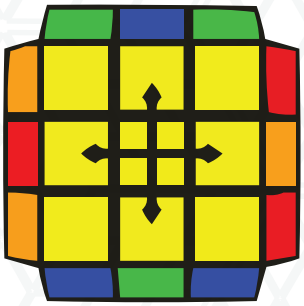
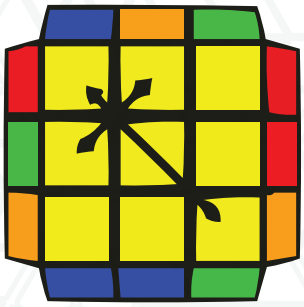
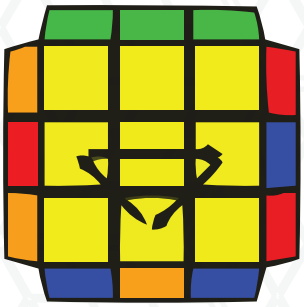
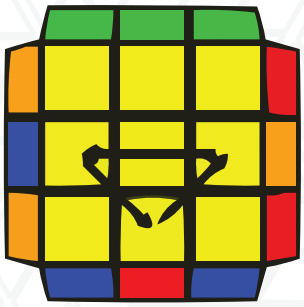
M2 U M2 U2 M2 U M2
M2 U' M2 U2 M2 U' M2



PLL Ua

M2 U M U2 M' U M2
(R U' R U) (R U R U') R' U' R2
y2 (R2 U' R' U') (R U R U) (R U' R)



PLL Ub

M2 U' M U2 M' U' M2
R2 U (R U R' U') (R' U' R' U) R'
y2 (R' U R' U') R' U' (R' U R U) R2
y2 (R' U R' U') R3 U' (R' U R U) R2