

F2L Algorithms (First 2 Layers)

Developed by Feliks Zemdegs
and Andy Klise

Images sourced from Conrad Rider's VisualCube - <http://cube.crider.co.uk/visualcube.php>

Algorithm Presentation Format



Suggested algorithm here

Alternative algorithms here

Set up F2L pair // Solve F2L pair

It is not recommended to learn any of these algorithms before learning intuitive F2L.

The black part of each algorithm sets up the pieces to a basic insertion case, which is then written in blue.

Basic Inserts



U (R U R')

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



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

(R U R')



F2L Case 1



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

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



U' (R U2' R' U) y' (R' U' R)
U' (R U2' R') d (R' U' R)

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



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

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



F2L Case 2



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

y' (U R' U' R) U2' (R' U R)
d (R' U' R) U2' (R' U R)
Note - (y' U) and (d) are interchangeable



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

y' U (R' U2 R) U2' (R' U R)
d (R' U2 R) U2' (R' U R)



F2L Case 3



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

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



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

y' U2 (R' U' R) U' (R' U R)
F' L' U2 L F
Note - The second algorithm is fewer moves, but less intuitive and less finger-friendly.



Incorrectly Connected Pieces



$y' (R' U R) U2' y (R U R')$
 $(R U R') U2 (R U' R' U) (R U' R')$

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



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

$y' (R' U2 R) U (R' U' R)$



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

$y' U' (R' U R U) (R' U R U') (R' U R)$
 $F (U R U' R') F' (R U' R')$



Corner in Place, Edge in U Face



$U' F' (R U R' U') R' F R$
 $R' F' R U (R U' R') F$

$U (R U' R') U' (F' U F)$
 $U (R U' R') (F R' F' R)$



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

$y' (R' U R U') (R' U R)$



$y' (R' U' R U) (R' U' R)$
 $(R' F R F') U (R U' R')$

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



Edge in Place, Corner in U face



$(R U' R' U) y' (R' U R)$
 $U' (R' F R F') (R U' R')$

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



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

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



$(U' R U R') U y' (R' U' R)$

$U (F' U' F) U' (R U R')$



Edge and Corner in Place



Solved Pair

$(R U' R') d (R' U2 R) U2' (R' U R)$



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

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



$(F' U F) U2 (R U R' U) (R U' R')$
 $(R U' R') F (R U R' U') F' (R U' R')$

$(R U R' U') (R U' R') U2 y' (R' U' R)$



Notation



R



R'



R2



r



r'



x



y



U



U'



U2



u



u'



z



M



F



F'



L



L'



B



B'



D

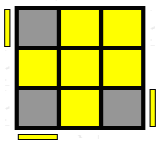


D'

OLL Algorithms (Orientation of Last Layer)

Developed by Feliks Zemdegis
and Andy Klise

Algorithm Presentation Format



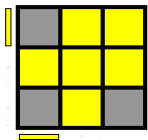
Suggested algorithm here
Alternative algorithms here

OLL Case Name - Probability = 1/x

Round brackets are used to segment algorithms to assist memorisation and group move triggers.

It is recommended to learn the algorithms in the order presented.

All Edges Oriented Correctly

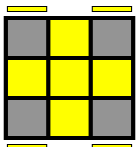
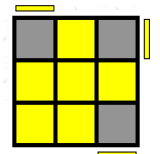


R U2 R' U' R U' R'
y' R' U' R U' R' U2 R

OCLL6 - 26 - Probability = 1/54

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

OCLL7 - 27 - Probability = 1/54

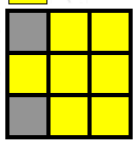
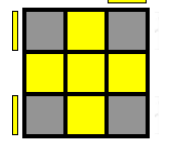


(R U2 R') (U' R U R') (U' R U' R')
y (R U R' U) (R U' R' U) (R U2' R')

OCLL1 - 21 - Probability = 1/108

R U2' R2' U' R2 U' R2' U2' R

OCLL2 - 22 - Probability = 1/54

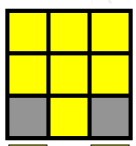
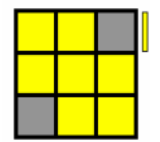


(r U R' U') (r' F R F')
y (R U R D) (R' U' R D') R2'

OCLL4 - 24 - Probability = 1/54

y F' (r U R' U') r' F R
x (R' U R) D' (R' U' R) D x'

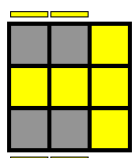
OCLL5 - 25 - Probability = 1/54



R2 D (R' U2 R) D' (R' U2 R')
y2 R2' D' (R U2 R') D (R U2 R)

OCLL3 - 23 - Probability = 1/54

T-Shapes

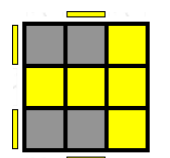


(R U R' U') (R' F R F')

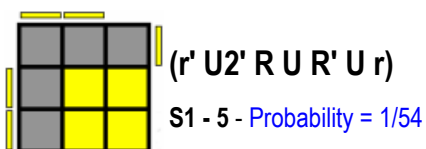
T1 - 33 - Probability = 1/54

F (R U R' U') F'

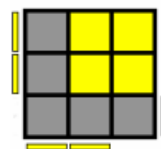
T2 - 45 - Probability = 1/54



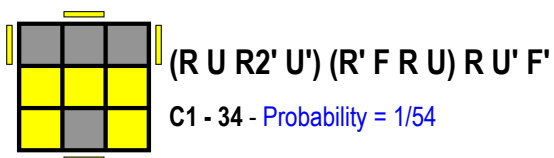
Squares



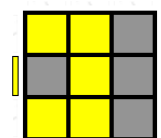
$(r U2 R' U' R U' r')$
S2 - 6 - Probability = 1/54



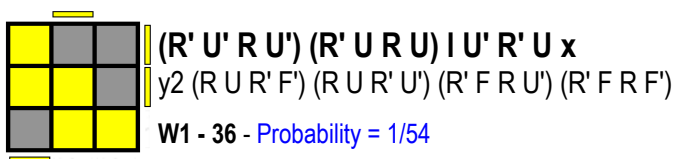
C-Shapes



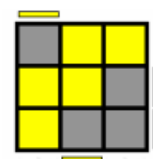
$R' U' (R' F R F') U R$
C2 - 46 - Probability = 1/54



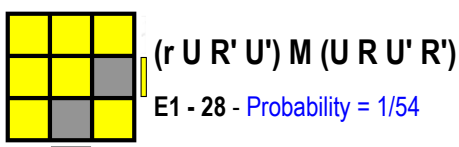
W-Shapes



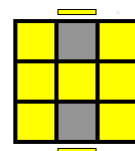
$(R U R' U) (R U' R' U') (R' F R F')$
W2 - 38 - Probability = 1/54



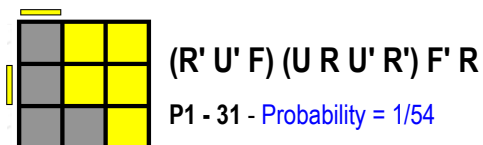
Corners Correct, Edges Flipped



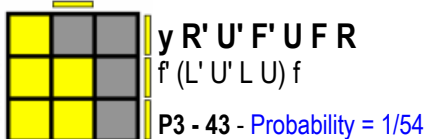
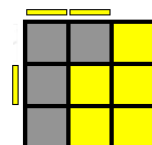
$(R U R' U') M' (U R U' r')$
E2 - 57 - Probability = 1/108



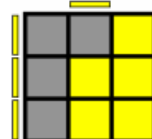
P-Shapes



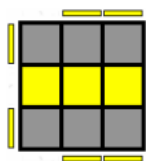
$R U B' (U' R' U) (R B R')$
S $(R U R' U') (R' F R f')$
P2 - 32 - Probability = 1/54



$f (R U R' U') f'$
 $y2 F (U R U' R') F'$
P4 - 44 - Probability = 1/54

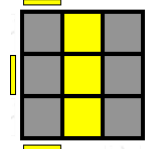


I-Shapes



$f (R U R' U') (R U R' U') f'$
 $y^2 F (U R U' R') (U R U' R') F'$

I1 - 51 - Probability = 1/54

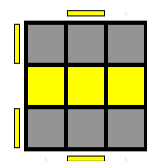


$(R' U' R U' R' U) y' (R' U R) B$
 $(R U R' U R U') y (R U' R') F'$

I2 - 52 - Probability = 1/54

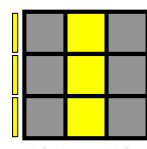
$r' U' r (U' R' U R) (U' R' U R) r' U r$

I4 - 56 - Probability = 1/108

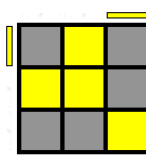


$y (R' F R U) (R U' R^2 F') R^2 U' R' (U R U R')$

I3 - 55 - Probability = 1/108

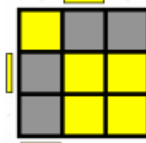


Fish Shapes



$(R U R' U') R' F (R^2 U R' U') F'$
 $(R' U' R) y r U' r' U r U r'$

F1 - 9 - Probability = 1/54

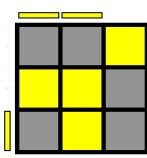


$(R U^2') (R^2 F R F') (R U^2' R')$

F3 - 35 - Probability = 1/54

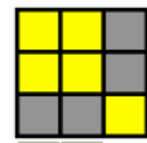
$(R U R' U) (R' F R F') (R U^2' R')$
 $(R U R') y (R' F R U') (R' F' R)$

F2 - 10 - Probability = 1/54

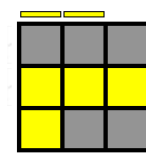


$F (R U' R' U') (R U R' F')$

F4 - 37 - Probability = 1/54

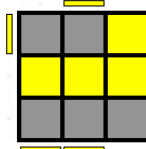


Knight Move Shapes



$(r U' r') (U' r U r') y' (R' U R)$
 $F U R U' R^2 F' R U (R U' R')$

K1 - 13 - Probability = 1/54

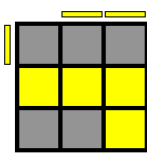


$(r U r') (R U R' U') (r U' r')$

K4 - 16 - Probability = 1/54

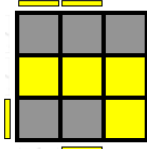
$(R' F R) (U R' F' R) (F U' F')$

K2 - 14 - Probability = 1/54

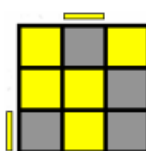


$(r' U' r) (R' U' R U) (r' U r)$

K3 - 15 - Probability = 1/54

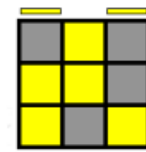


Awkward Shapes



$y (R U R' U') (R U' R') (F' U' F) (R U R')$
 $M U (R U R' U') (R' F R F') M'$

A1 - 29 - Probability = 1/54

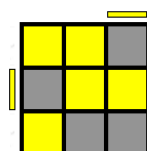


$(R U R' U R U^2 R') F (R U R' U') F'$

A3 - 41 - Probability = 1/54

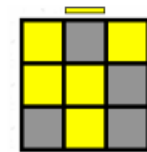
$y' F U (R U^2 R' U') (R U^2 R' U') F'$
 $y' (F R' F) (R^2 U' R' U') (R U R') F^2$

A2 - 30 - Probability = 1/54

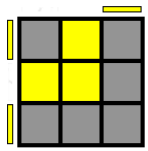


$(R' U' R U' R' U^2 R) F (R U R' U') F'$
 $y (R' F R F') (R' F R F') (R U R' U') (R U R')$

A4 - 42 - Probability = 1/54

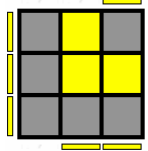


L-Shapes



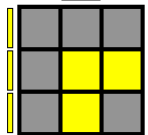
$F (R U R' U') (R U R' U') F'$

L2 - 48 - Probability = 1/54



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

L3 - 49 - Probability = 1/54



$(r' U' R U') (R' U R U') R' U2 r$

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

L5 - 53 - Probability = 1/54

$F' (L' U' L U) (L' U' L U) F$
 $R' U' (R' F R F') (R' F R F') U R$

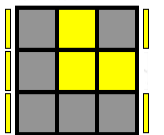
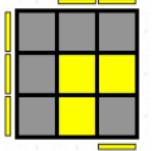
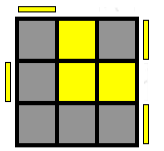
L1 - 47 - Probability = 1/54

$r' U r2 U' r2' U' r2 U r'$
 $y' (R U2 R' U' R U' R') F (R U R' U') F'$

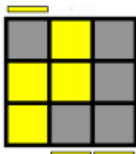
L4 - 50 - Probability = 1/54

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

L6 - 54 - Probability = 1/54

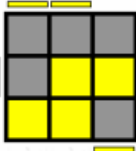


Lightning Bolts



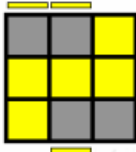
$(r U R' U R U2' r')$

B1 - 7 - Probability = 1/54



$r' (R2 U R' U R U2 R') U M'$

B3 - 11 - Probability = 1/54



$(L F') (L' U' L U) F U' L'$

$F (R U R' U') F' (R' U' R U' R' U2 R)$

B5 - 39 - Probability = 1/54

$(r' U' R U' R' U2 r)$
 $y2 l' U' L U' L' U2 l$

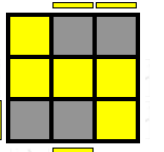
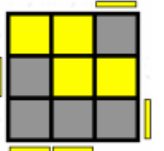
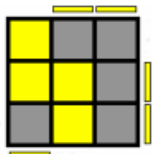
B2 - 8 - Probability = 1/54

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

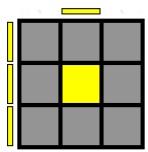
B4 - 12 - Probability = 1/54

$(R' F) (R U R' U') F' U R$

B6 - 40 - Probability = 1/54

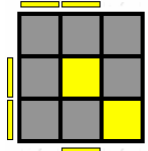


No Edges Flipped Correctly



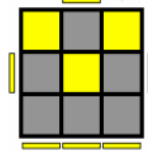
$(R U2') (R2' F R F') U2' (R' F R F')$

O1 - 1 - Probability = 1/108



$f (R U R' U') f' U' F (R U R' U') F'$

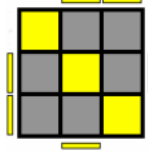
O3 - 3 - Probability = 1/54



$y R U2' (R2' F R F') U2' M' (U R U' r')$

$(r U R' U R U2' r') (r' U' R U' R' U2 r)$

O6 - 18 - Probability = 1/54



$(R U R' U) (R' F R F') U2' (R' F R F')$

O5 - 17 - Probability = 1/54

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

O2 - 2 - Probability = 1/54

$f (R U R' U') f' U F (R U R' U') F'$

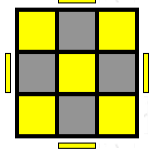
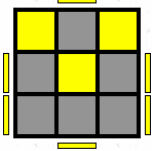
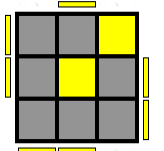
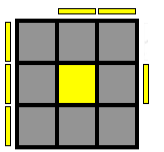
O4 - 4 - Probability = 1/54

$M U (R U R' U') M' (R' F R F')$

O7 - 19 - Probability = 1/54

$M U (R U R' U') M2' (U R U' r')$
 $(r U R' U') M2' (U R U' R') U' M'$

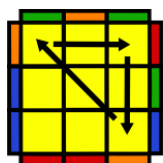
O8 - 20 - Probability = 1/216



PLL Algorithms (Permutation of Last Layer)

Developed by Feliks Zemdegs
and Andy Klise

Algorithm Presentation Format



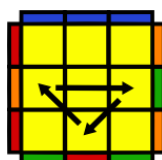
Suggested algorithm here
Alternative algorithms here
PLL Case Name - Probability = $1/x$

Round brackets are used to segment algorithms to assist memorisation and group move triggers.

Moves in square brackets at the end of algorithms denote a U face adjustment necessary to complete the cube from the states specified.

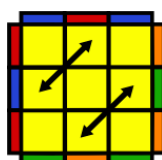
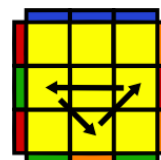
It is recommended to learn the algorithms in the order presented.

Permutations of Edges Only



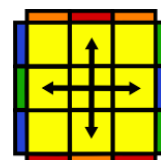
$R^2 U (R U R' U') R' U' (R' U R)$
 $y^2 (R' U R' U') R' U' (R' U R U) R^2$
U_b - Probability = $1/18$

$(R U' R U) R U (R U' R' U') R^2$
 $y^2 (R U R' U) (R' U' R^2 U) R' U R' U R [U^2]$
 $y^2 (R^2 U' R' U') R U R U (R U' R)$
U_a - Probability = $1/18$

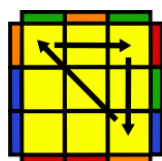


$(M^2 U M^2' U) (M' U^2) (M^2 U^2 M')$ [U²]
 $y' M' U (M^2 U M^2') U (M' U^2 M^2) [U']$
Z - Probability = $1/36$

$(M^2 U M^2') U^2 (M^2 U M^2')$
H - Probability = $1/72$

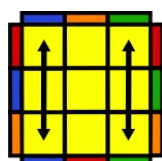
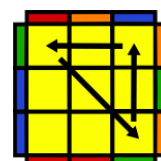


Permutations of Corners Only



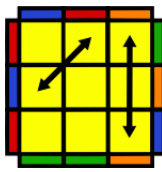
$x (R' U R') D^2 (R U' R') D^2 R^2 x'$
 $y x' R^2 D^2 (R' U' R) D^2 (R' U R') x$
A_a - Probability = $1/18$

$x R^2 D^2 (R U R') D^2 (R U' R) x'$
 $y x' (R U' R) D^2 (R' U R) D^2 R^2 x$
A_b - Probability = $1/18$



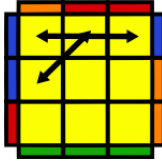
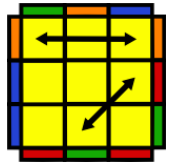
$x' (R U' R' D) (R U R' D') (R U R' D) (R U' R' D') x$
E - Probability = $1/36$

Swap One Set of Adjacent Corners



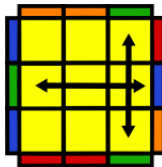
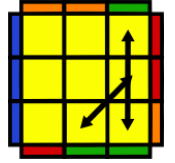
$(R' U' R' U') (R U R D) (R' U' R D') (R' U2 R') [U']$
 $y' (L U2 L' U2) L F' (L' U' L U) L F L2' [U]$
 $(R U R' F') (R U2' R' U2') (R' F R U) (R U2' R') [U']$
Ra - Probability = 1/18

$(R' U2 R U2') R' F (R U R' U') R' F' R2 [U']$
 $(R' U2 R' D') (R U' R' D) (R U R U') (R' U' R) [U']$
Rb - Probability = 1/18



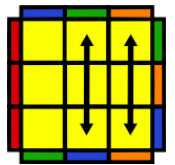
$(R' U L' U2) (R U' R' U2 R) L [U']$
 $y' (L' U' L F) (L' U' L U) L F' L2' U L [U]$
Ja - Probability = 1/18

$(R U R' F') (R U R' U') R' F R2 U' R' [U']$
Jb - Probability = 1/18

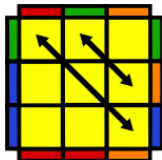


$(R U R' U') (R' F R2 U') R' U' (R U R' F')$
T - Probability = 1/18

$(R' U' F')(R U R' U')(R' F R2 U')(R' U' R U)(R' U R)$
 $y (R' U2 R' U') y (R' F' R2 U') (R' U R' F) R U' F$
F - Probability = 1/18

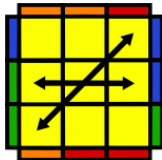
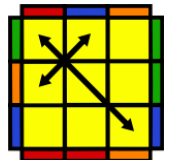


Swap One Set of Diagonal Corners



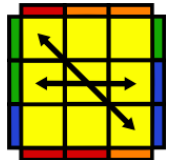
$(R' U R' U') y (R' F' R2 U') (R' U R' F) R F$
V - Probability = 1/18

$F (R' U' R' U') (R U R' F') (R U R' U') (R' F R F')$
Y - Probability = 1/18



$(R U R' U')(R U R' F')(R U R' U')(R' F R2 U') R' U2 (R U' R')$
 $z (U R' D) (R2 U' R D') (U R' D) (R2 U' R D') [R'] z'$
Na - Probability = 1/72

$(R' U R U') (R' F' U' F) (R U R' F) R' F' (R U' R)$
 $(R' U L' U2 R U' L) (R' U L' U2 R U' L) [U]$
Nb - Probability = 1/72

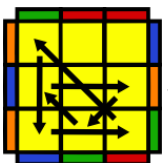
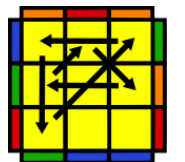


G Permutations (Double cycles)



$R2 U (R' U R' U') (R U' R2) D U' (R' U R D') [U]$
 $R2 u (R' U R' U') R u' R2 y' (R' U R)$
Ga - Probability = 1/18

$(F' U' F) (R2 u R' U) (R U' R u') R2'$
 $y' R' U' y F (R2 u R' U) (R U' R u') R2'$
 $y' D (R' U' R U) D' (R2 U R' U) (R U' R U) R2' [U']$
Gb - Probability = 1/18



$R2 U' (R U' R U) (R' U R2 D') (U R U' R') D [U']$
 $y2 R2' F2 (R U2' R U2') R' F (R U R' U') R' F R2$
Gc - Probability = 1/18

$D' (R U R' U') D (R2 U' R U') (R' U R' U) R2 [U]$
 $(R U R') y' (R2 u' R U') (R' U R' u) R2$
Gd - Probability = 1/18

