





Update – 10 de Maio de 2021 - 05:36 P.M

Startup – The Erzengell

Texto e essência : Rafael Cinoto e Angell Bälger

Dicionário do “Cubo Mágico” completo no site do Renan Cerpe (Cubo Velocidade)

Todos os Design que contém nesse livro foram criados por Angell.

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Soma dos Algorítmos.

F2Ls = 40

OLLs = 98

PLLs = 40

TOTAL = 178

Autor: Angell Bälger

Angell tem 20 anos, aluno em engenharia mecatrônica Curitiba – PR, ficou em primeiro lugar na prova Equalize, e segundo no geral, dentre os 39 polos espalhados pelo Brasil, em uma competição envolvendo estudantes de engenharia civil, mecânica, elétrica, produção e mecatrônica em 2018, atua como instrutor matemático autônomo, e em alguns casos, por filantropia. É praticante de cardistry e Speed Solving, seu record pessoal no cubo 3³ é de 9.63 segundos.



Coautor: Rafael Cinoto



Rafael Cinoto, um dos protagonistas na propagação do conhecimento de puzzles no Brasil, possui mais de 20 records Sul-Americanos, a maioria deles com os pés, em 2010 obteve o 3^a lugar mundial na resolução com os pés. Atua como pedagogo, e dissemina conhecimento em palestras.

Após aprender o método básico, muitas pessoas ficam perdidas, e não sabem mais o que fazer, eis me aqui! Para propor algo tanto para quem acabou o básico, quanto para quem acabou o avançado, inicialmente esse livro possuía um rótulo numérico referente à versão, no centro inferior da capa, onde agora ocupa o símbolo do “infinito”, o motivo é bem subjetivo não é?! Pois esse método não visa mais um fim específico, pois sempre estará em evolução, Jéssica Fridrich, revolucionou a aprendizagem nessa ramo com o CFOP, e ele continuará evoluindo.

Eu gosto bastante de quebrar paradigmas, talvez seja esse o motivo por qual esse livro exista, e para fazer essa última abordagem e dar ênfase às minhas características supracitadas, repito a frase do Jennette McCurdy: “Não me diga que o céu é o limite enquanto houver pegadas na lua.”

Introdução



O cubo mágico é um cubo convencional de três dimensões, criado pelo húngaro Ernő Rubik em 1974, teve sua origem mediante ao desejo de criar uma peça que fosse perfeita, no que se refere à geometria, para ajudar a ilustrar o conceito da terceira dimensão aos seus alunos de arquitetura. O lançamento do hexaedro despertou a curiosidade de muitas pessoas, tanto é que, o que se cogitava sobre o brinquedo na vertente de negócios, é que seria um fracasso, já que ele era complexo demais para ser resolvido, inclusive o criador, demorou cerca de um mês para resolver seu próprio quebra-cabeça, não obstante, a ideia não procedeu, e o cubo de Rubik tornou-se o brinquedo mais vendido do mundo... e o mais odiado...

Muitas pessoas já tiveram contato com esse objeto, e são poucas as que conseguiram resolver, em uma comparação per capita, para entender o motivo, precisamos analisar seus aspectos físicos. Vejamos:

Há três tipos de peças no cubo mágico:

Centro = As peças são fixas e unidas por um eixo que se localiza no centro do cubo, sendo assim, elas determinam a cor de cada face.

Meio = Duas cores perpendiculares.

Quina = Peças que ficam no vértice do cubo e possuem três cores.

Após uma breve análise, e sabendo da movimentação de cada face, possibilitando movimentos tanto no sentido horário quanto no anti-horário. Podemos calcular a quantidade de casos possíveis. Para isso, partiremos do estudo da análise combinatória.

Para compreender melhor, imagine as lacunas das 8 quinas vazias, e agora podemos pegá-las uma por uma, e permutar, tendo **8!** (oito fatorial), em nossa primeira análise, obtendo como resultado: **40.320** permutações.

Em seguida, temos os meios das arestas, em um total de 12, logo teremos **12!** (doze fatorial), obtendo como resultado: **479.001.600** permutações.

Apesar de termos alguns resultados até o momento, o cubo mágico possuem alguns mecanismos que possibilitam a rotação das quinas, cada uma delas possuindo três cores que podem ser giradas em cada canto sozinhas, chegando ao resultado de 3^8 , mas alguns casos são impossíveis de acontecer, se o seu cubo já caiu no chão, e você precisou montar ele (

isso ocorre, pois existe uma relação entre a orientação que cada quina e meios possibilitam. Os cantos devem ser orientados de três em três para o mesmo sentido ou podem ser dois cantos sendo um no sentido horário e outro no sentido anti-horário. “Logo, não é possível movimentar apenas dois cantos no mesmo sentido. Com isso, apenas $\frac{1}{3}$ das 3^8 são possíveis, sendo $\frac{3^8}{3}$, assim resultando a 3^7 , logo temos 2187, permutações rotacionadas. Contudo o mesmo raciocínio deve ser realizado para os meios, poderíamos pensar 2¹², chegamos à mesma contradição, pois os meios são transportados aos pares, não sendo possível orientar um nem três meios sozinhos.

Assim dividindo $\frac{2^{12}}{2^2}$, teremos 2¹⁰ permutações. Após estudar cada um dos casos apresentados, unificaremos todas as permutações”. (referência citada: www.unoste.com.br)

Então, a resolução final fica dessa forma:

$$\frac{8! \times 12! \times 3^7 \times 2^{11}}{2} = 43\,252\,003\,274\,489\,856\,000$$

Atualmente existem diversos métodos para ajudar na resolução do cubo mágico, os mais famosos são, o método “Camadas” e o método “Fridrich”, o método camadas, é nada menos que a simplificação das 119 fórmulas contidas no método

Fridrich, a proporção entre eles seria como o topo do iceberg e sua parte submersa, entretanto, essa analogia também serve para comparar o clássico Fridrich com o “**Sublime Fridrich – Angell**”, pois iremos sobrelevar o método convencional com elegância, com a possibilidade de escolher a fórmula para alguns casos es-



pecíficos onde a fluidez do movimento (finger tricks) fique melhor referente à lateralização hemisférica de cada organismo, (o que determina se uma pessoa é destro ou canhoto).

Não é apenas o número que diferencia esse método dos demais, (apesar de eu poder afirmar com benevolência perante aos meus alunos e para qualquer outro que se submeta, a essa aprendizagem, me permita dizer... tu estás com o maior e

mais completo livro dessa vertente! Congratulations!) Ele possui uma certa originalidade, que possibilita uma aprendizagem mais efetiva, isso graças a tecnologia 4.0, onde além de visualizar o caso de forma abstrata, poderá visualizar clicando na imagem e ver as execuções aos meus moldes.

Com esse livro em vossas mãos, e com a absorção do conhecimento que ele exala, será possível fazer resoluções abaixo de **10** segundos, e aumentar a eficiência geometricamente, como consequência, se aproximando do algarismo de Deus.

O algarismo de Deus, que é apresentado como **“20”**. Ele recebe esse nome, “Número de Deus”, pois um grupo de pesquisadores americanos concluiu que é possível resolver qualquer combinação do puzzle conhecido como "cubo mágico" em apenas 20 movimentos ou menos.

As equações para resolver os enigmas no menor número de movimentos são hiperbólicos e complexos para serem memorizadas por um mero mortal. Via de regra, são necessário supercomputadores para tais objetivos. O "número de Deus" é assim chamado porque os pesquisadores assumem que um ser onisciente usaria este algoritmo para resolver o problema.

Agora podemos iniciar!

Etapas de resoluções:

CROSS HIGHER - Performance Superior;

F2L - Finish Two Layers - Finalizar as 2 camadas;

OLL - Orientation Last Layer - orientar a última camada;

COLL - Algoritmos para orientar e permutar os cantos da última camada sem alterar a orientação dos meios.

PLL - Permutation Last Layer - permutar a última camada;

Cronograma de Estudo:

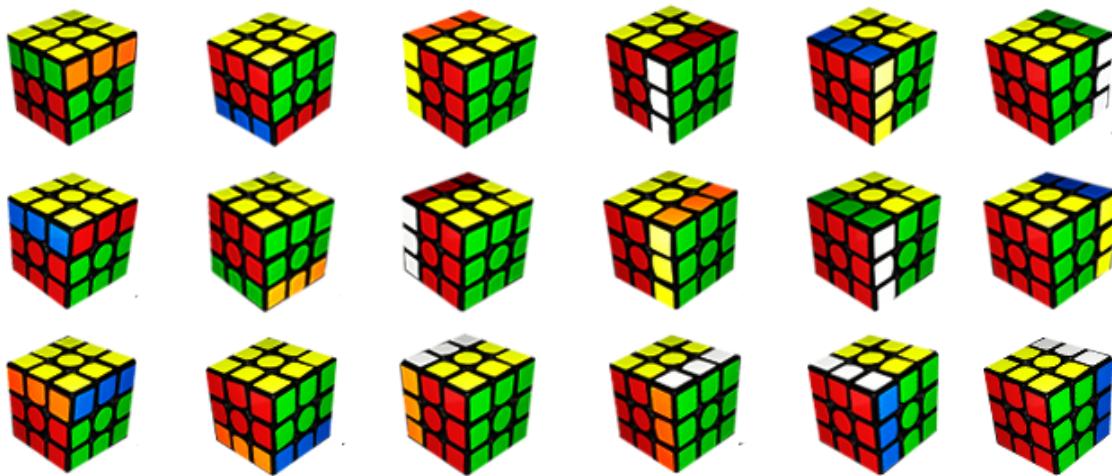
A ordem supracitada, não necessariamente deve ser seguida, e nem é recomendada, já que o **COLL** está incluso na lista. Após aprender a montar o cubo mágico, notará que certos casos cairão com “mais frequência”, e é a partir dessa observação que tu irá dar prioridade, dentro das subsequentes fases: **CROSS**, **F2L**, **OLL**, **PLL**, **COLL**. Ou seja, após treinar o **F2L** intuitivo, os algoritmos do **F2L** farão muito mais sentido, pois a lógica de sua resolução, já estará fragmentada em seu cérebro, e pegar as formulas desse livro para ficar ainda mais rápido é opcional. Em seguida, as últimas etapas poderão seguir sua ordem natural, a aprendizagem de **OLL** poderá ser paralela aos estudos das **PLL** em suas devidas proporções, já que nesse método há uma razão de **2,45** **OLL** para cada caso de **PLL**.

Resumindo, é mais indicado, pegar os casos mais possíveis, dentro de cada uma dessas etapas, exceto O **COLL**, que estará na última abordagem.

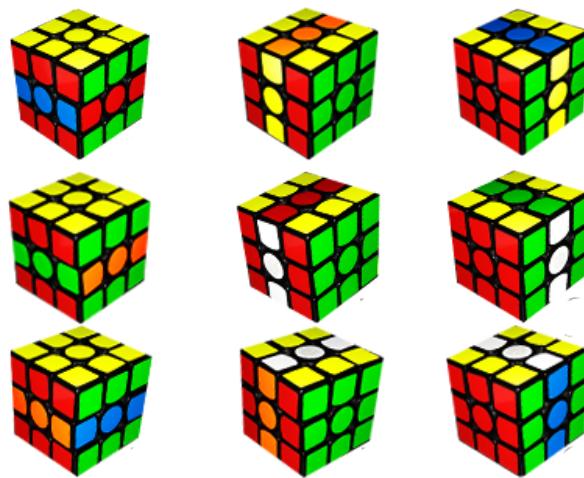
Atenção

Notações

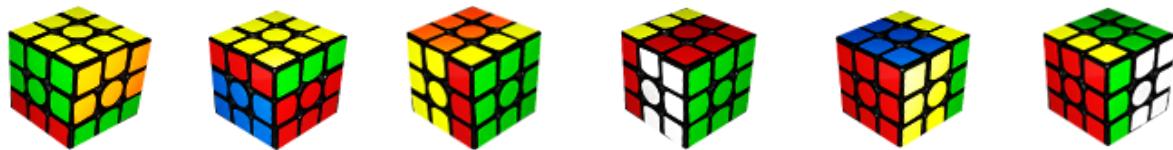
Movimentos de uma face:



Movimento de camadas internas:



Movimentos de camadas duplas:



Movimentos de rotação:



Glossário

CFOP - Abreviação das etapas do Método Fridrich (CROSS, F2L, OLL e PLL).

Corner - Como se traduz, canto (quina).

DIY - Do-It-Yourself (faça você mesmo).

DNF - Did Not Finish (não terminado).

DNS - Did Not Start (não iniciado).

Fridrich - Método Avançado para solução do cubo 3x3x3, também conhecido como CFOP.

Full Step - Resolução onde não acontece o Skip.

Look ahead - Capacidade de durante um movimento se prever qual será o próximo.

Lucky Case - Resolução em que uma ou mais etapas não são necessárias.

Notação - Letras e sinais utilizados para representar movimentos do puzzle.

Paridade - Permutação entre apenas 2 meios ou 2 quinas, presente apenas em cubos pares (exemplo: 4x4).

Permutação - A movimentação de uma peça para completar determinada tarefa.

POP - É o termo usado quando o cubo "explode" (todas ou algumas peças saem dele).

Setup - Deixar o cubo em uma determinada configuração desejada.

Scramble - Embaralhamento do cubo.

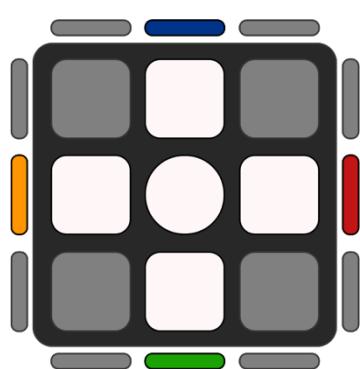
Skip - Significa pular uma das etapas da solução.

Speedsolving - Ato de resolver o cubo através do Speedcubing.

Tps - Turns Per Second (giros por segundo).

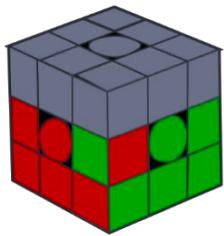
WCA - World Cube Association (associação mundial do cubo).

Higher Cross (Performance Superior)

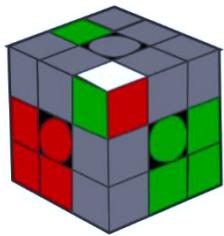


No método avançado, teremos uma execução diferente, referente ao Finger Tricks e análise, como o primeiro passo para a resolução da montagem é bem intuitiva, não haverá fórmula. Esse método é um passo fundamental para entrar, posteriormente, no X-cross.

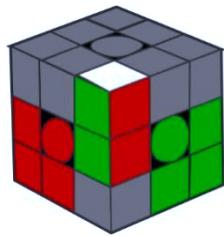
F2L
Finish Two
Layer



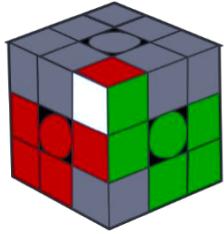
D3: R U2 R' U R U2 R' d R' U'
R



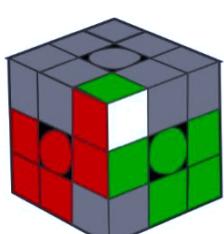
2,2: d' L' U' L U' L' U L



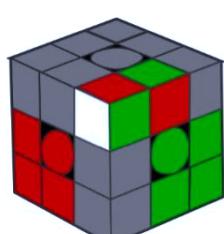
C3: R U' I U' R' U I'



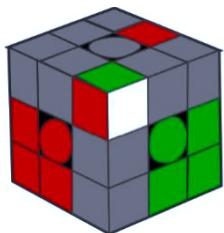
2: U' R U' R' U2 R U' R'



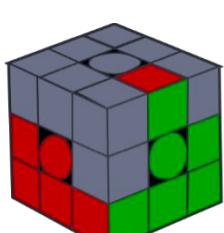
A1: U' R U2' R' U R U R'



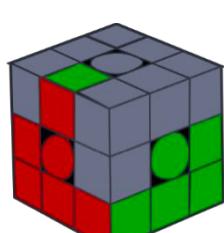
J2: U' R U2' R' d R' U' R



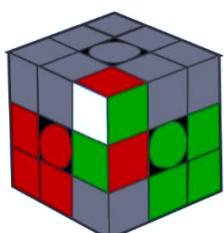
Fish Right: R U R'



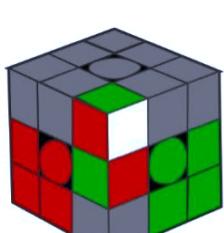
E3: y U' L' U' L d R U R'



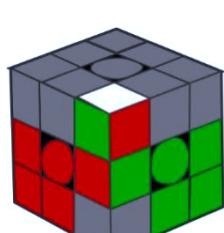
F3: U R U R' d' L' U' L



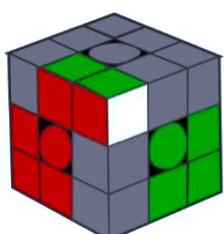
C2: U' R U R' d R' U' R



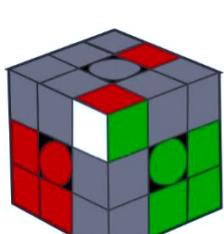
C1: d R' U' R d' R U R'



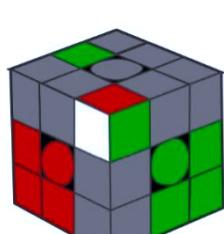
A3: R U R' U' R U R' U' R U R'



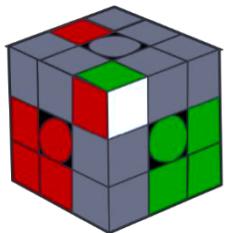
I1: d' L' U L



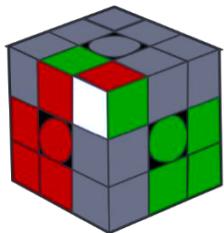
Q2: U' R U R' U2 R U' R'



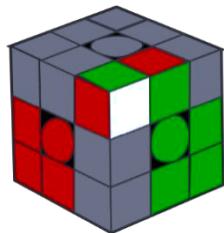
Fish Left: y L' U' L



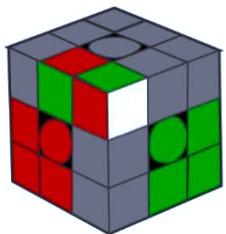
R1: $U' R U R' U R U R'$



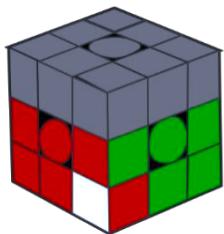
K2: $d R' U R U' R' U' R$



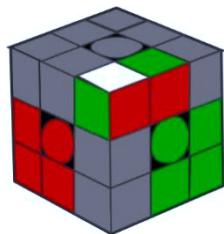
K1: $U' R U' R' U R U R'$



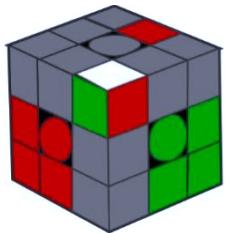
J1: $R' U2 R2 U R2 U R$



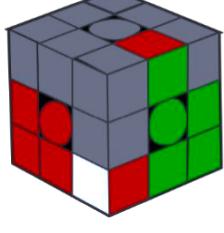
B2: $R U R' U' R U2 R' U' R U R'$



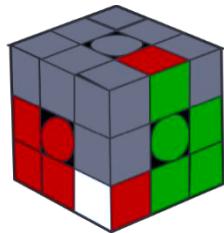
N1: $y U2 L2 U2 L U L' U L2$



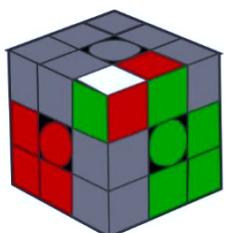
1,2: $U R U2 R' U R U' R'$



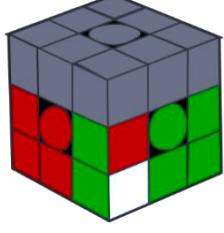
F1: $y U L' U' L U L' U' L$



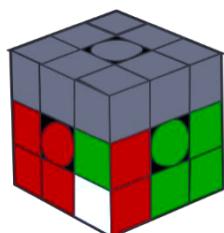
E2: $R U' R' U R U' R'$



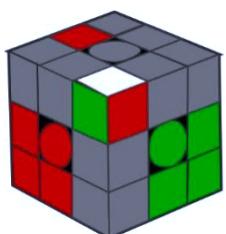
M1: $R U2 R' U' R U R'$



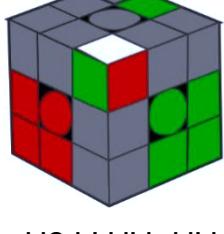
D1: $R U R' U' R U' R' U d R' U' R$



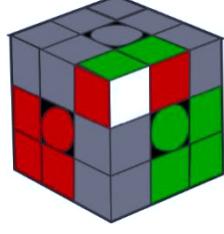
D2: $R U' R' U' R U' R' d R' U' R$



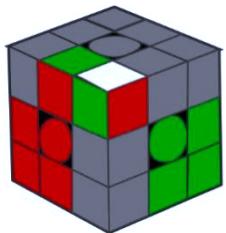
1,1: $R U' R' U2 R U R'$



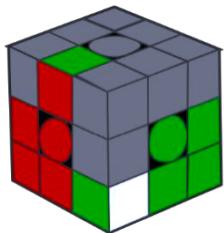
2,1: $y U2 L' U' L U' L' U' L$



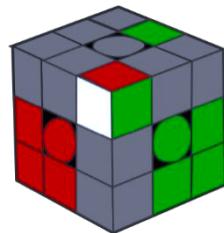
L1: $R U' R' U2 y L' U' L$



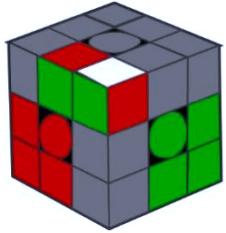
M2: $y L' U2' L U L' U' L$



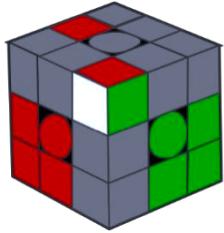
F2: $y' R' U R U' R' U R$



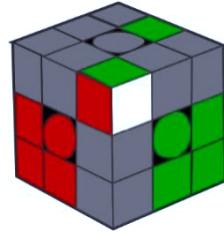
R2: $y' U R' U' R U' R' U' R$



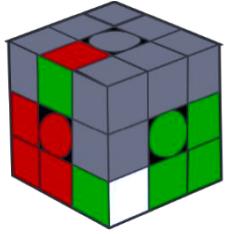
N2: $U2 R2 U2 R' U' R U' R2$



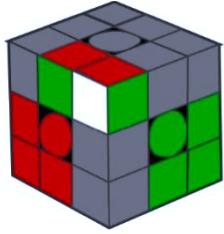
S2: $U' R U2' R' U2 R U' R'$



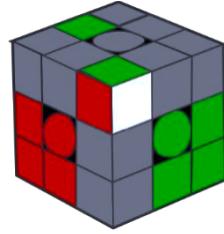
S1: $d R' U2 R U2 R' U R$



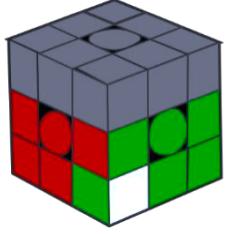
E1: $U' R U R' U' R U R'$



L2: $y L' U L U2' y' R U R'$



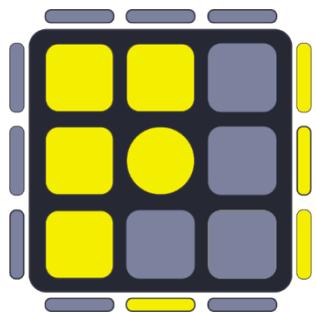
Q1: $d R' U' R U2 R' U R$



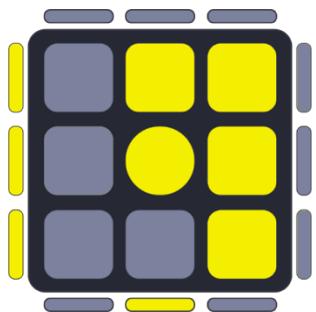
B1: $R U2 R' U R U' R' U R U' R'$

OLL

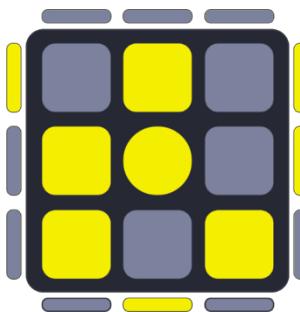
Orientation Last
Layer



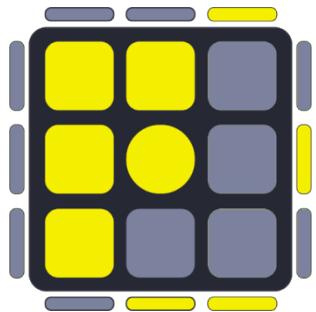
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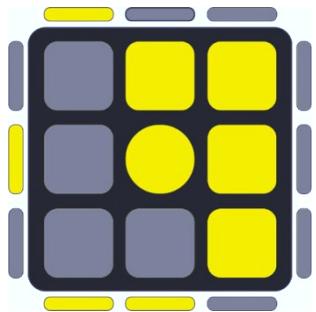
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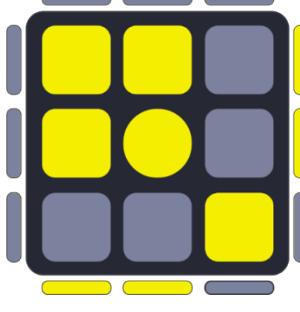
y2 R2 U R' B' R U' R2
U I U' I



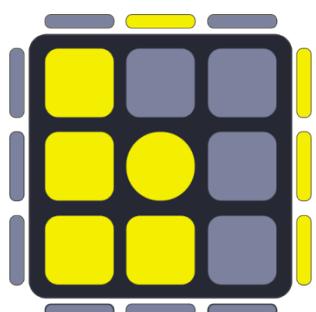
L U F' U' L' U L F' L'



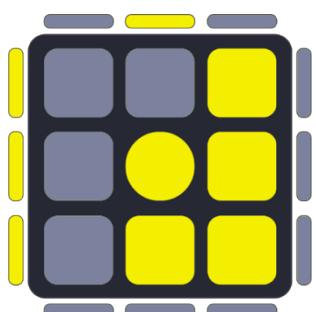
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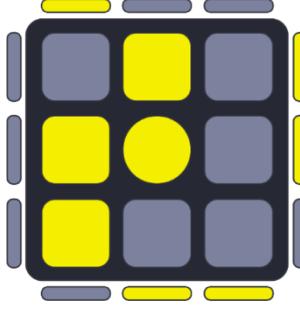
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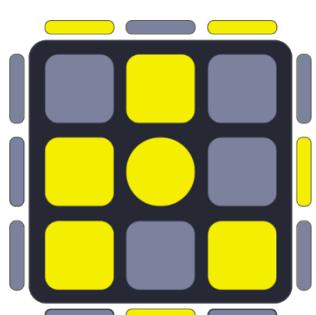
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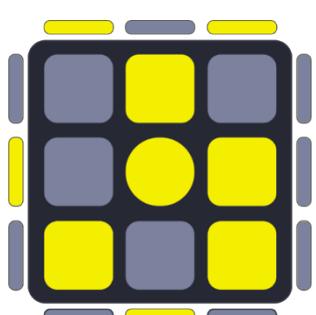
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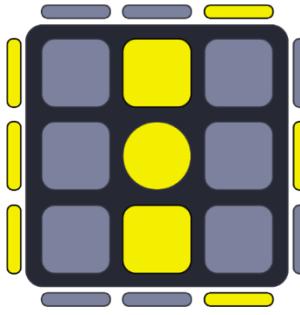
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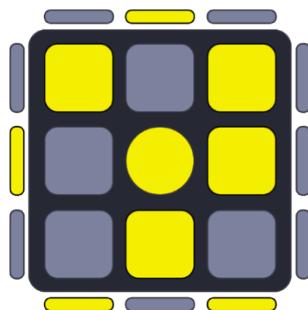
y2 R U' R' U2 R U y R
U' R' U' F'



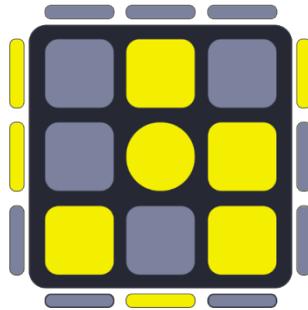
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U F



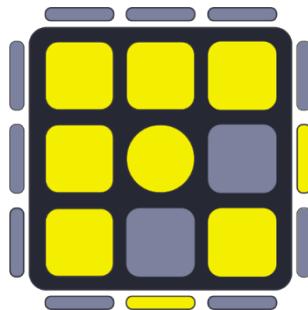
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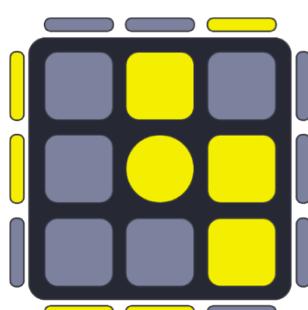
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LUF



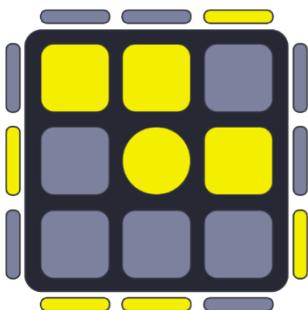
y2 L2 U' L B L' U L2 U'
r' U' r



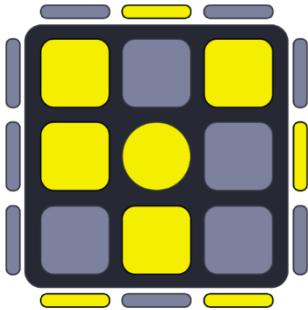
r U R' U' r' R U R U' R'



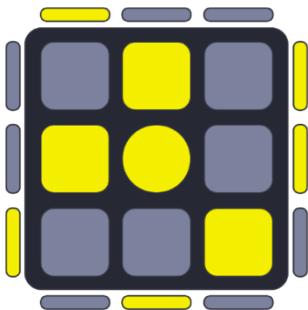
I' U' L U' L' U2 I



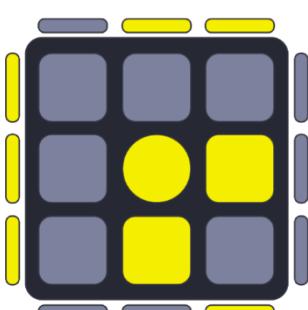
r R2 U' R U' R' U2 R U'
R r'



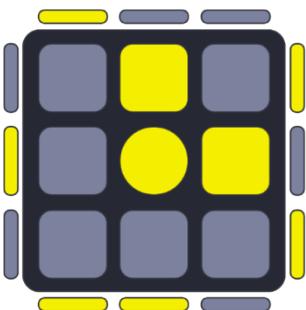
R' U' R U' R' U2 R F R
U R' U' F'



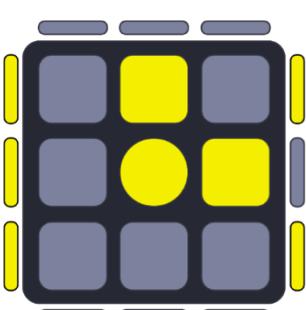
y' R U R' y' x' L' U L F'
L' U' L



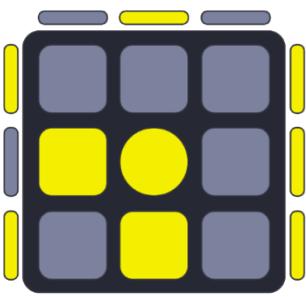
r' U r2 U' r2 U' r2 U r'



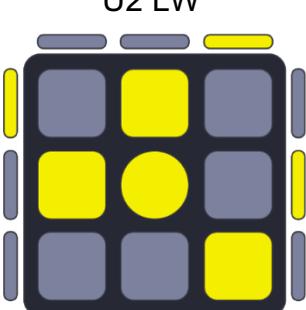
F' L' U' L U' U' L U F



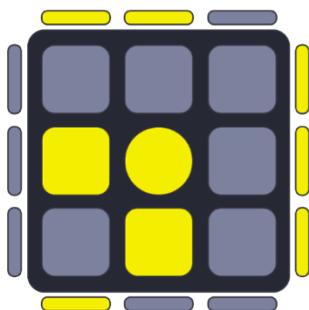
r U R' U R U' R' U R U2
r'



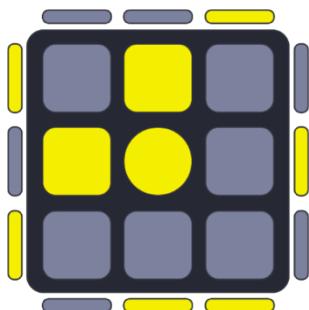
LW U L' U L U' L' U L
U2 LW'



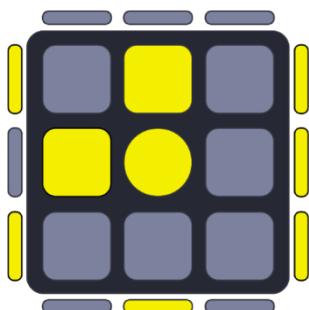
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U' F'



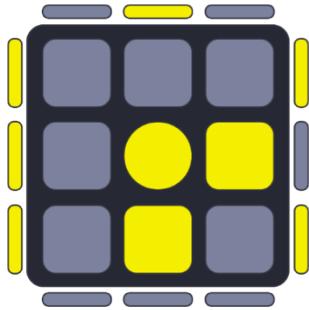
I U' I2 U I2 U I2 U' I



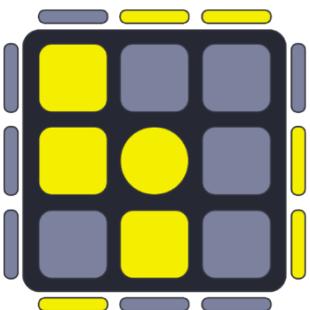
F R U R' U' R U R' U' F'



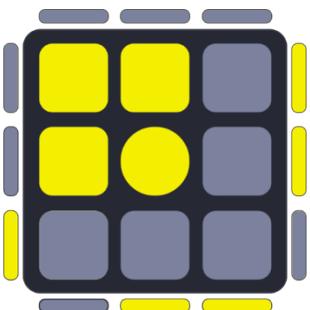
LW' U' L U' L' U L U' L'
U2 LW



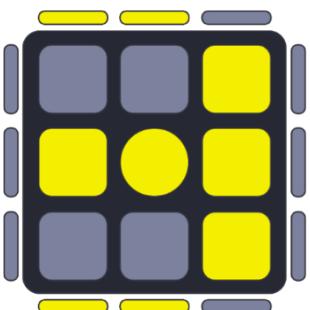
RW' U' R U' R' U R U'
R' U2 RW



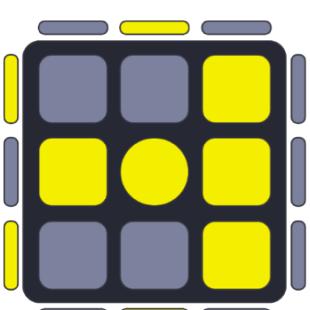
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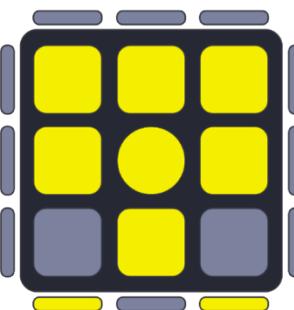
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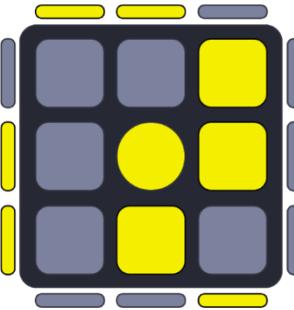
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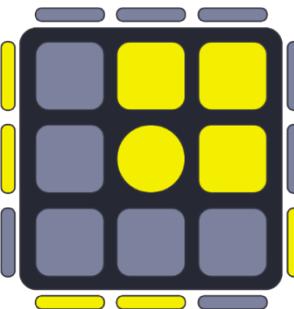
FRUR'U'E'



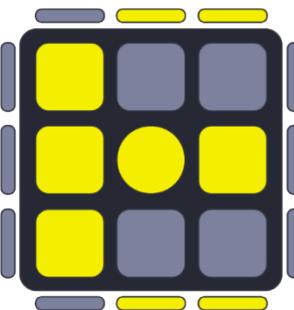
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R'



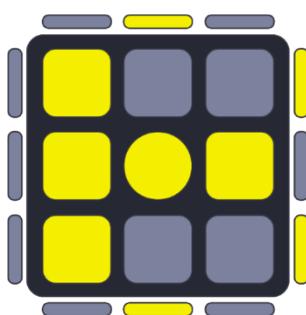
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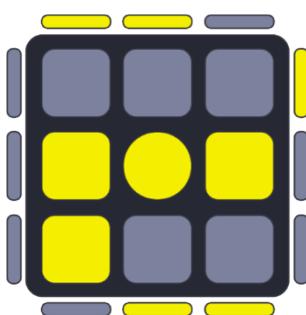
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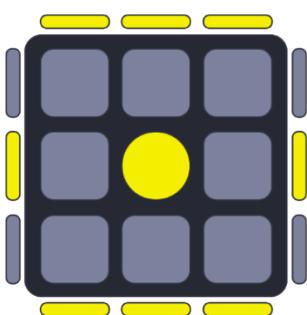
L' U' L U L F' L' F



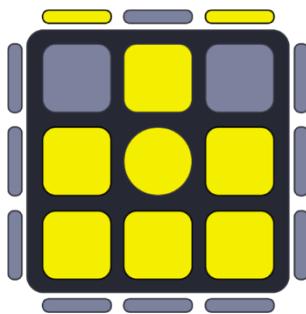
F' L' U' L U F



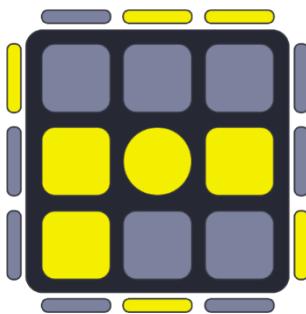
L F' L' U' L F L' y L' U L



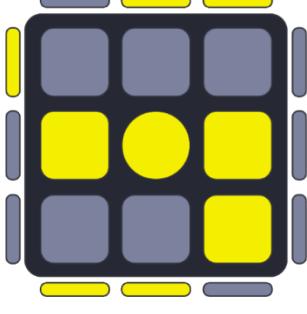
y R U2' R2' F R F' U2'
R' F R F'



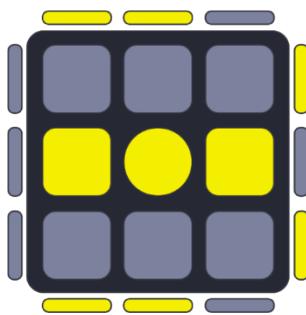
R2 D' R U2 R' D R U2
R



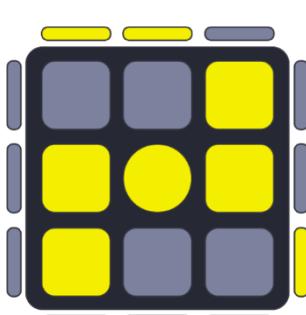
R B R' L U L' U' R B' R'



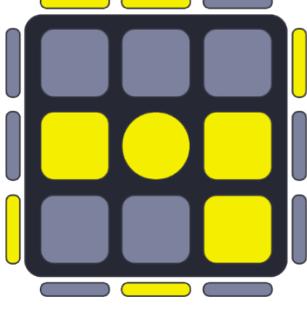
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R'



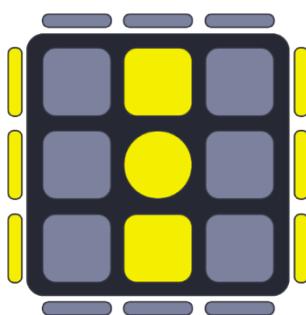
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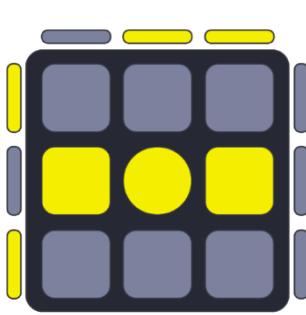
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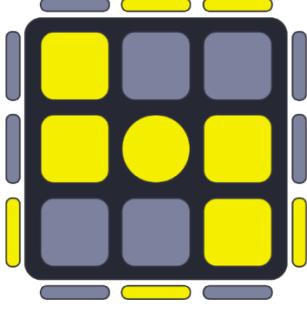
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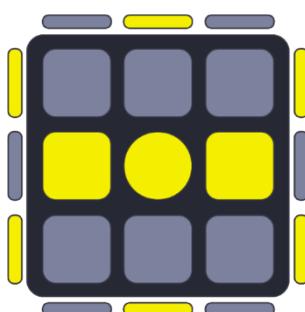
R' U2 R2 U R' U R U2
x' U' R' U



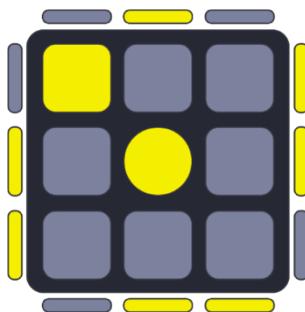
F' U' L' U L U' L' U L F



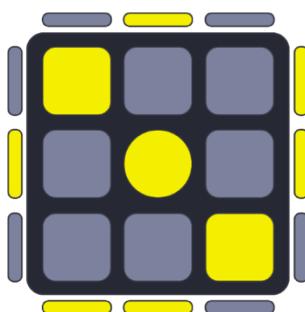
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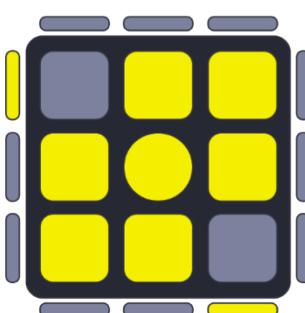
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R L' B L



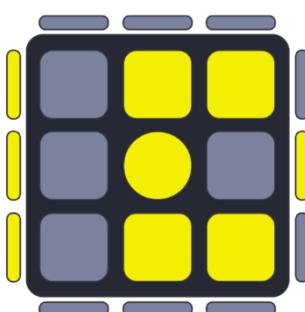
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R' r



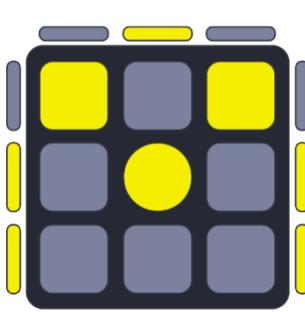
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F'



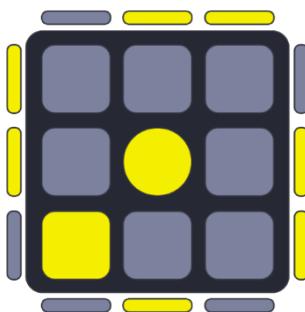
F' RW U R' U' L' U LW



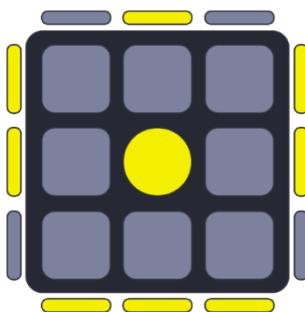
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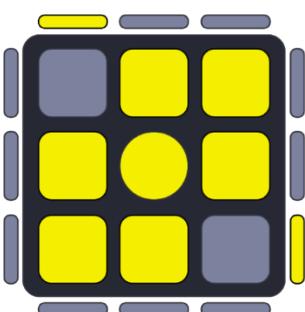
r' R U R U R' U' r R2' F
R F'



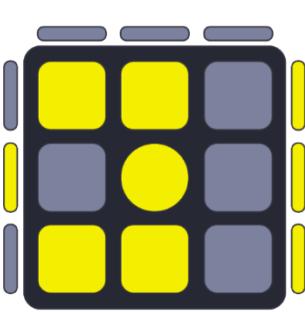
y' I L2 U' L U' I' U2' I U'
L' I'



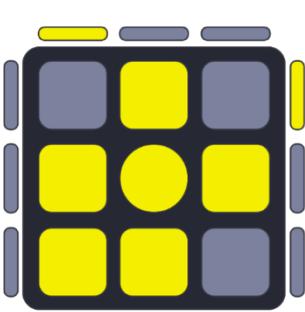
L F' L' F U y' R2 B' R' B
U' R'



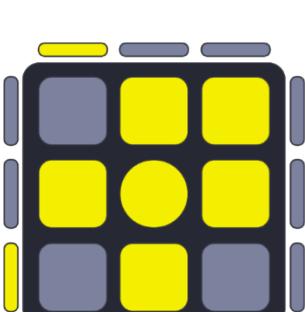
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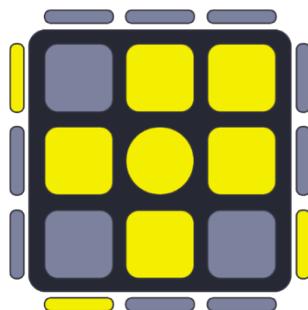
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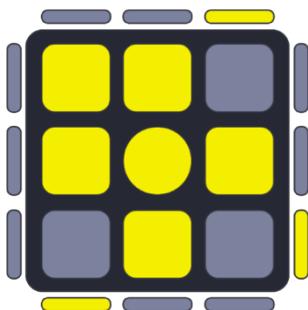
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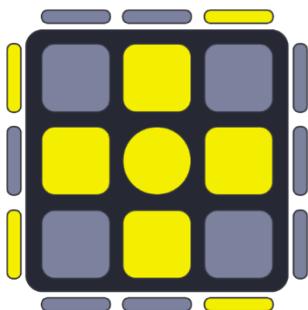
L U L' U L U2 L'



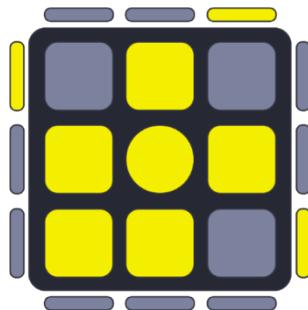
R U2 R' U' R U' R'



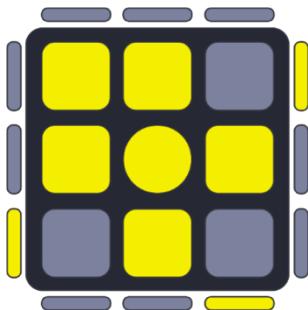
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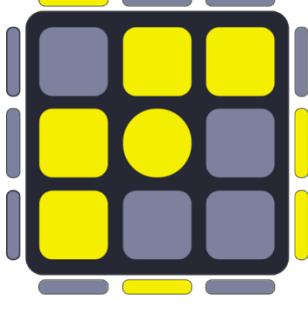
R U2 R2 U' R2 U' R2
U2 R



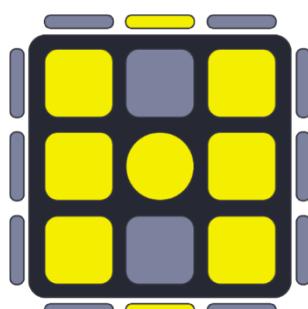
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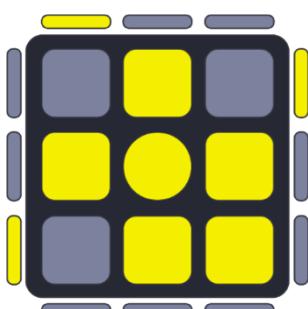
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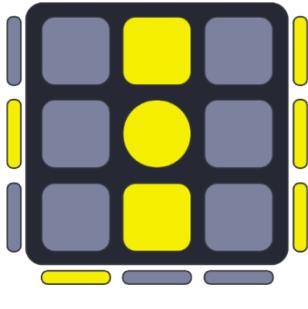
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R F'



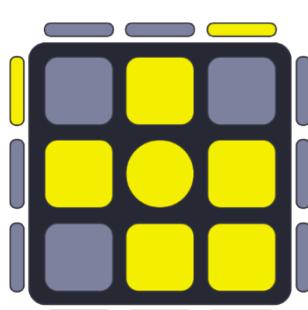
R U R' U' r R' U R U' r'



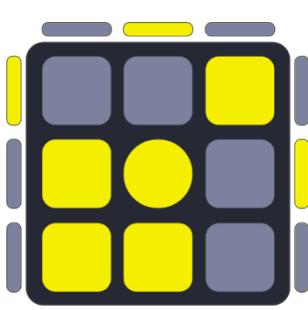
R' U2 R U R' U R



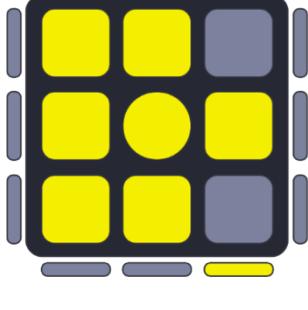
R' U' R U' R' y U L' U L
F



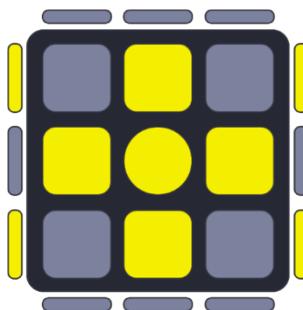
L' U' L U' L' U2 L



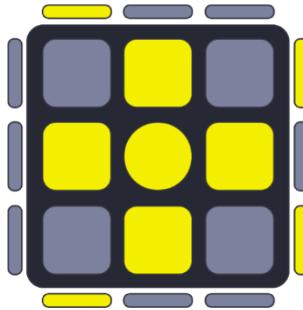
L' U2 L2 F' L' F L' U2 L



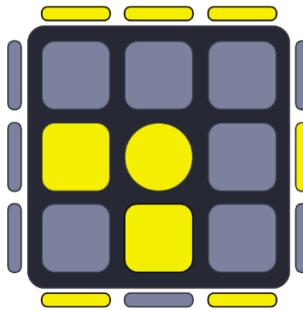
LW' U' L U R U' L' U



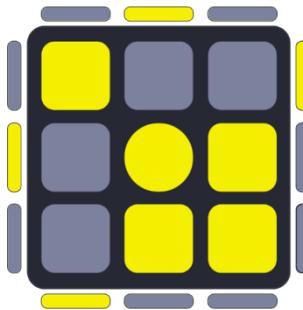
R U R' U R U' R' U R
U2 R'



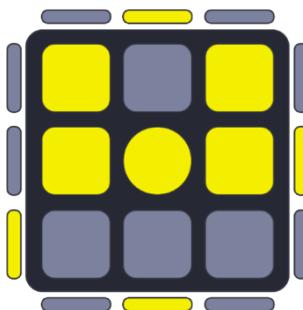
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L'



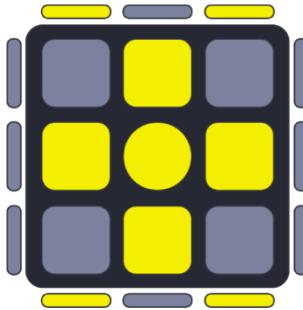
Rw' U2 R U R' U' R U
R' U Rw



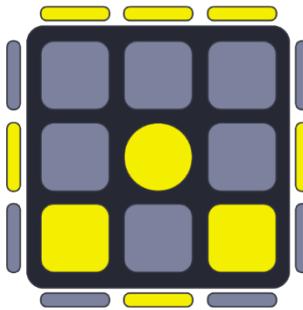
R U2 R2 F R F' R U2
R'



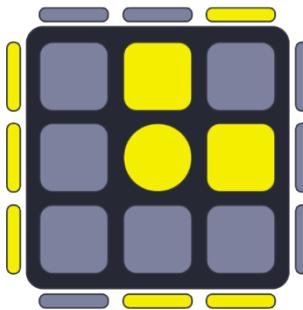
R' U' R U y' I U L' U' r
R'



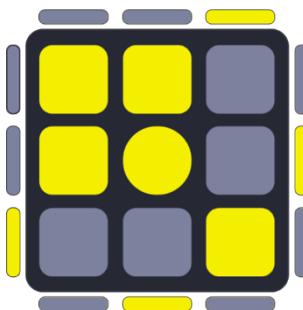
R U2 R' U' R U R' U' R
U' R'



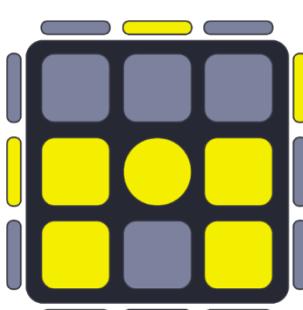
r' U' R U' R' U2 r2 U R'
U R U2 r'



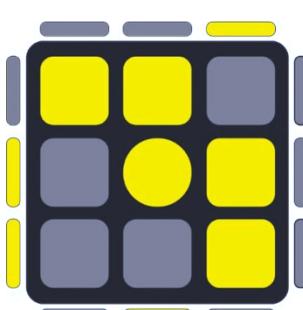
w U' Rw2 U Rw2 U
Rw2 U' Rw



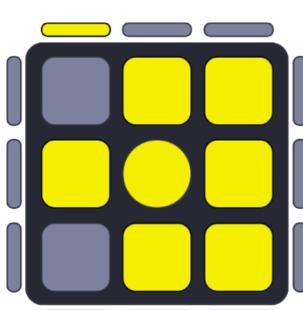
L U2 L2 B L B' L U2' L'



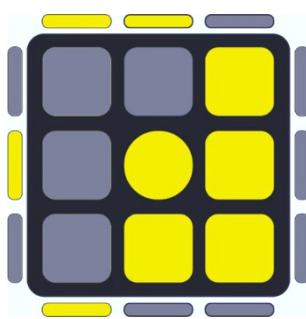
R U R2 U' R' F R U R
U' F'



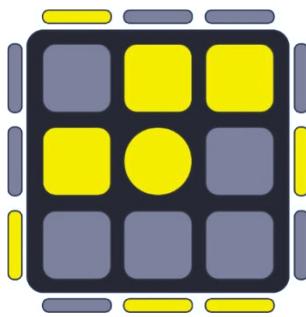
L' U' L U' L' U L U L F'
L' F



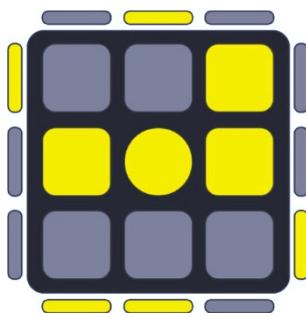
RW U R' U' L' U R U'



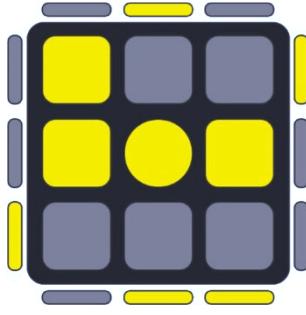
R U B' U' R' U R B R'



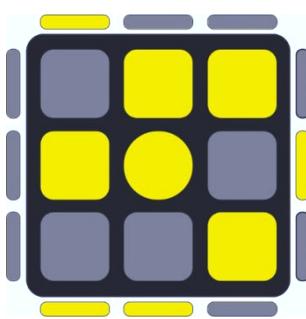
I' L2 U L' U L U2 L' U M



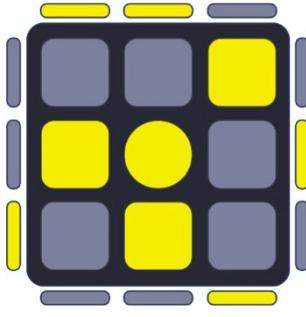
Rw U M U R' U' Rw U'
Rw'



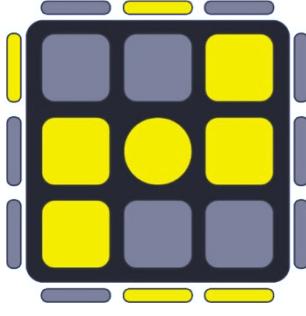
Lw' U' M U' L U Lw' U
Lw



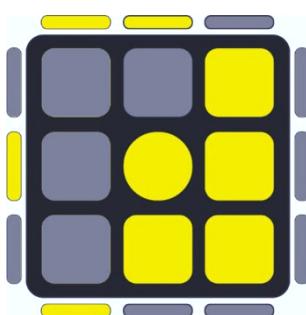
R U R' U' R U' R' F' U'
F R U R'



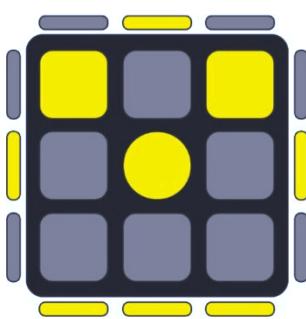
R' U' R U Lw U' Lw' R'
U' R U B



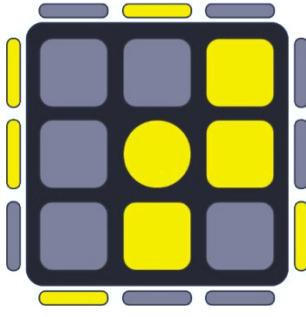
R B' R' U' R U B U' R'



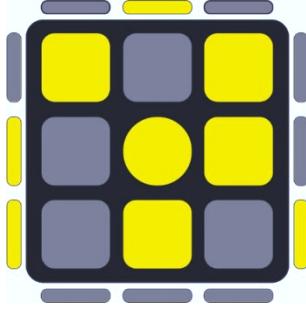
R U B' U' R' U R B R'



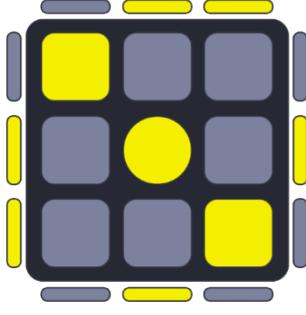
Rw U R' U R U2 Rw2
U' R U' R' U2 Rw



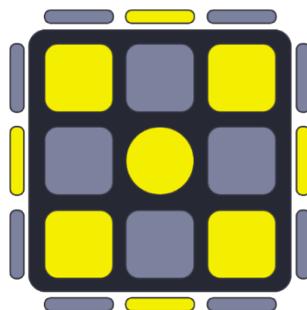
F R U R' U' F' y F R U
R' U' F'



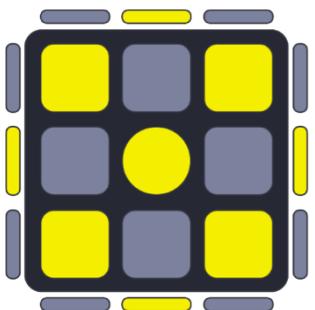
Fw R U R2 U' R' U R2
U' R' Fw'



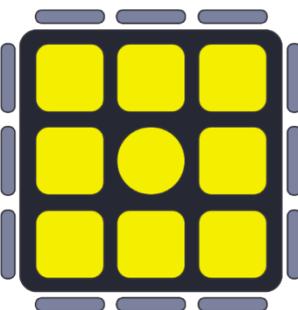
R U R' U R' F R F' U2
R' F R F'



M U' M U' M U' M U' M'
U' M' U' M' U' M'



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



OLL SKIP

OLL

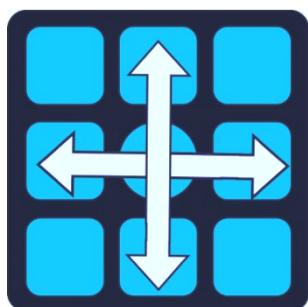
Orientation Last
Layer



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



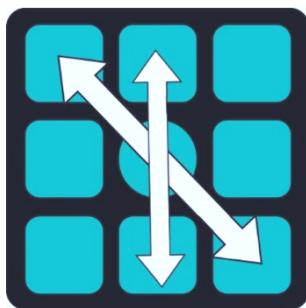
R' U R' U' R' U' R' U R
U R2



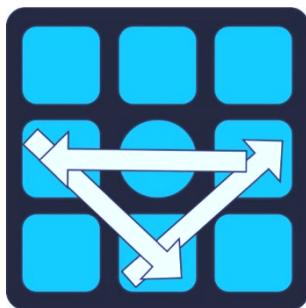
M2 U M2 U2 M2 U M2



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



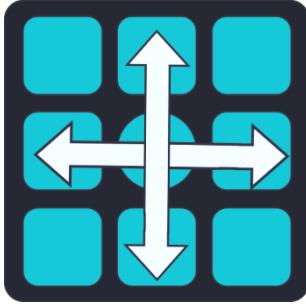
LU'R U2 L'UR'LU'R U2 L'
UR'U



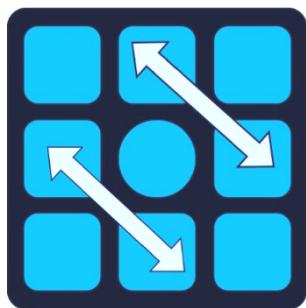
R U' R U R U R U' R'
U' R2



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



L R U2 R' L' y' L' R' U2
R L



M2 U M2 U M U2 M2
U2 M U2



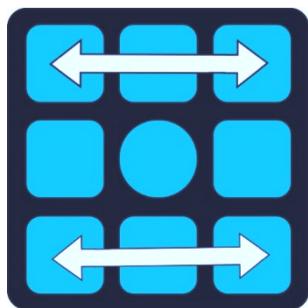
R'UL'U2RU'LR'UL'U2R
U'LU'



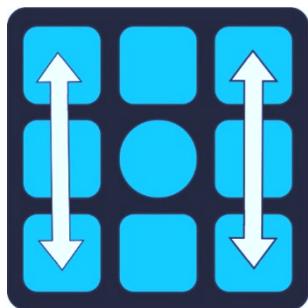
L F' L B2 L' F L B2 L2



R' F R' B2 R F' R' B2
R2



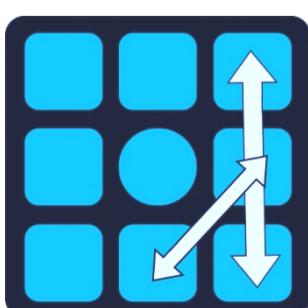
R U' L D2 L' U R' L U' R D2 R'
U L'



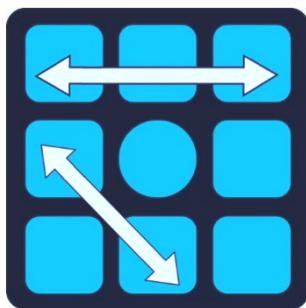
X' R U' R' D R U R' D' R U R'
D R U' R' D' X



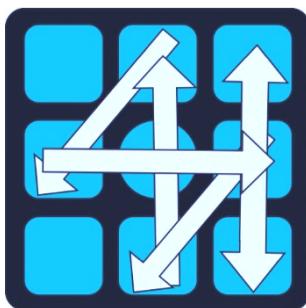
L' U2 L U L' U2 R U' L U R'



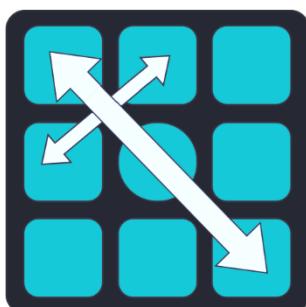
R U2 R' U' R U2 L' U R' U' L



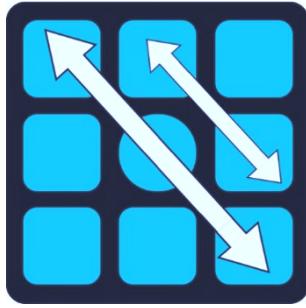
L U2 L' U2 L F' L' U' L U L F
L2



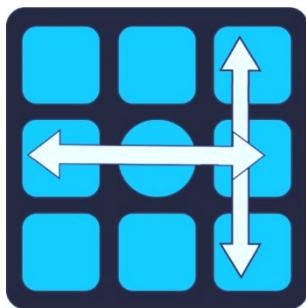
R' U' R y R2 u R' U R U' R u
R2



y2 R2 U' R' U R U' y' x' L' U' R
U' R' U' L' U



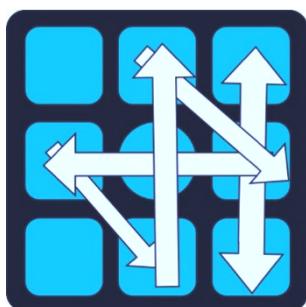
R' U R' U' Y R' F' R2 U' R' U
R' F R F



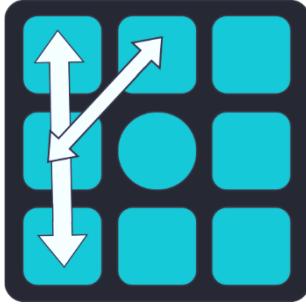
R U R' U' R' F R2 U' R' U' R U
R' F'



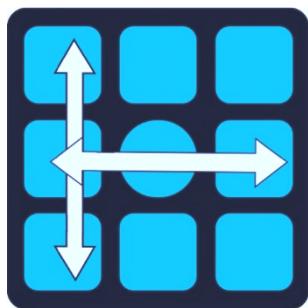
L' U R U' L U L' U R' U' L U2 R
U2 R'



R2 u' R U' R U R' u R2 y R U'
R'



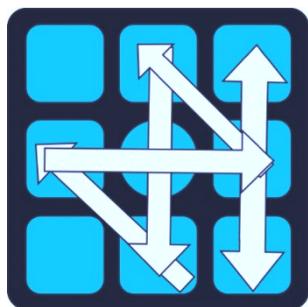
L U2 L' U' L U2 R' U L' U' R



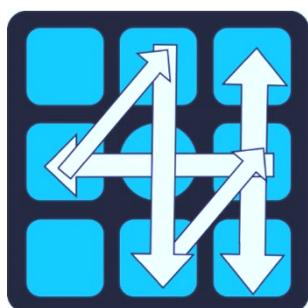
L' U' L U L F' L2 U L U L' U' L
F



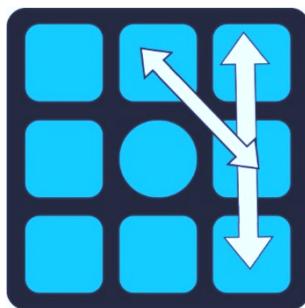
R' U2 R U2 R' F R U R' U' R'
F' R2 U'



R U R' y' R2 u' R U' R' U R' u
R2



R2 u R' U R' U' R u' R2 y L' U
L



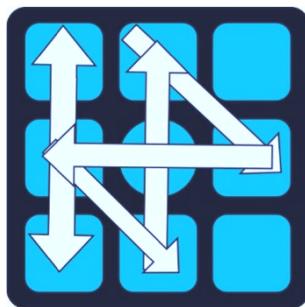
R' U2 R U R' U2 L U' R U L'



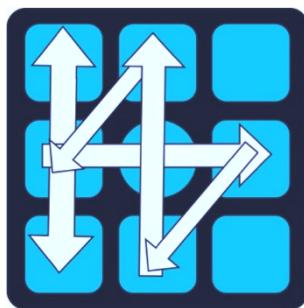
r' U L' D2 L U' L' D2 r2



I U' R D2 R' U R D2 I2



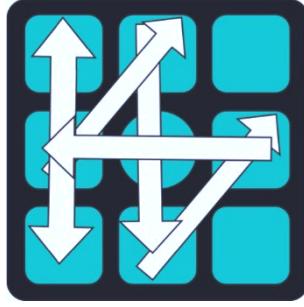
L U L' y R2 u' R U' R' U R' u
R2 U2



L2 u L' U L' U' L u' L2 y' L' U L



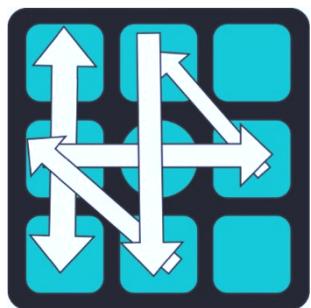
R' U R U' R' F' U' F R U R' F
R' F' R U' R



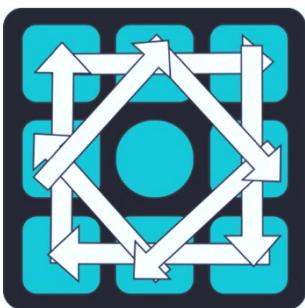
L' U' L y L2 u L' U L U' L u' L2



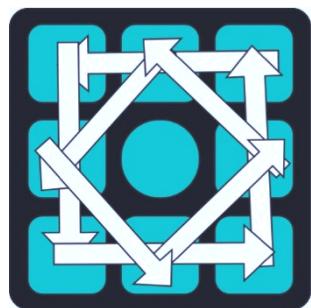
R U R' U R U R' F' R U R' U'
R' F' R2 U' R' U2 R U' R'



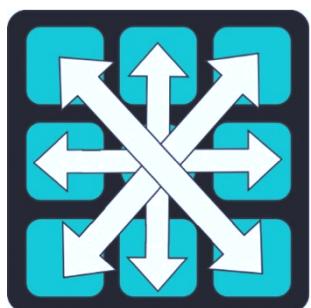
L2 u' L U' L U L' u L2 y' R U'
R'



U



U'



U2