

RUBIKS CUBE ALGORITHM

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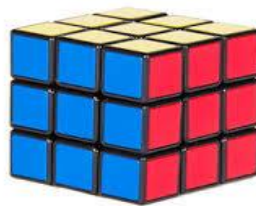
I. INTRODUCTION

The Rubik’s Cube is a 3-D mechanical puzzle originally called the “Magic Cube”. Invented in 1974 by Erno Rubik. He is a Hungarian inventor, architect and professor of architecture. Rubik cube is mind game. This game is very interesting and smartness game, this game is won the German game of the year. This game’s aim is all the same colors are in one said then the game is complete.

II. HOW TO USE

In a classic Rubik's Cube, each of the six faces is covered by nine stickers, among six solid colours. (traditionally:

- red
- white
- blue
- orange,
- green
- yellow)

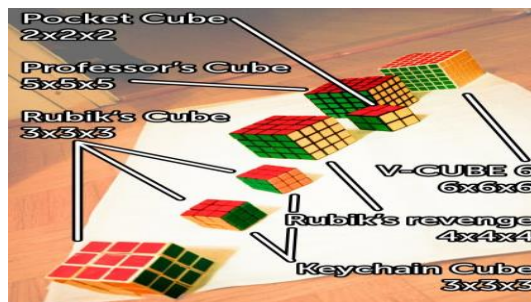


A standard Rubik's cube measures 5.7 cm (approximately 2¼ inches) on each side. The puzzle consists of 26 unique miniature cubes, also called “cubies” or “cubelets”



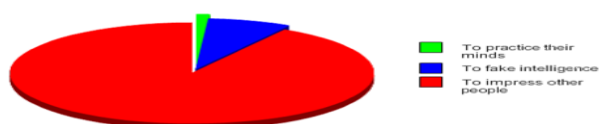
There are different types of Cubes as:

- **Pocket Cube(2x2)**
- **Rubik’s Cube(3x3)**
- **Rubik’s Revenge(4x4)**
- **Professor’s Cube(5x5)**
- **V-Cube(6x6)**



Actually, Rubik's cube was invented to express knowledge. But now it is used to impress the other people.

Why people learn to solve the Rubik's Cube



GraphJam.com

A survey of the literature in the field of mathematics education did not find any studies directly relating the Rubik's Cube to problem solving or self-efficacy. Since the goal of this study is to enhance the problem solving skills and problem solving self efficiency of students, we turn our attention to the findings of studies that have focused on problem solving using games and raising self-efficacy. We also consider studies which have focused on gender related differences in problem solving.

III) RUBIK'S CUBE FACTS

There are 43,252,003,274,489,856,000 different configurations, and only one solution. At the World's Rubik's Cube Championship people solve the cube blindfolded or with one hand or two handed. The youngest person to solve the cube was 3 year old from China.

IV) ROTATIONS

The rubik's Cube has 6 faces Namely:

- R= Right Face
- L= Left Face
- B= Back Face
- D = Down Face
- F= Front Face
- U = Upper Face

The Rubik's Cube consist of total 12 rotations out of which 6 are in clockwise and 6 are in Anticlockwise.

- A letter by itself = Turn face 90° clockwise
- A letter + apostrophe = Turn face 90° counter-clock wise
- A letter + 2 = Turn face 180°

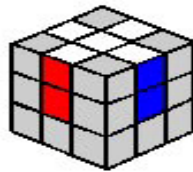


V) ALGORITHMS

A) The First Layer

1. Form the White Cross

- Go edge by edge
- Can't mess up what you've already done
- Edge flipped the wrong way.



2. Solve the White Corners

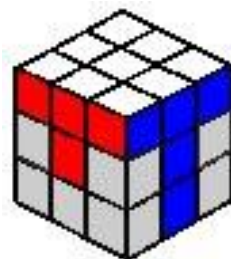
- Go corner by corner
- Can't mess up what you've already done
- Edge flipped the wrong way:



Next Step... The Middle Layer

B) The Middle Layer

- Put the white face on the Bottom
- Find the Blue/ Red piece so the Blue lines up.



D L D' L' D' F' D F

Or, If you See this...

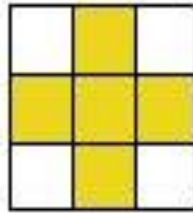


D' F' D F D L D' L'
then
D L D' L' D' F' D F

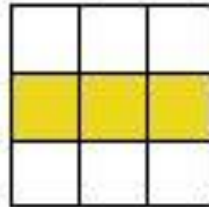
C) The Final Layer

Place white side on the Bottom 4 Possible States

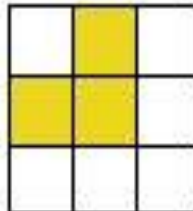
1) **State 1:** Ready to move on!



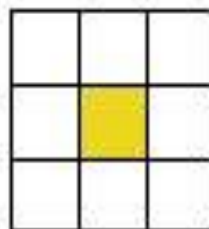
2) **State 2:** F U R U' R' F'



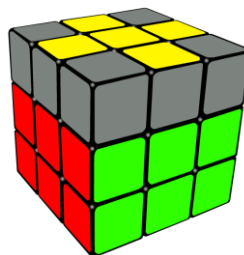
3) **State 3:** F R U R' U' F'



4) **State 4:** Do algorithm for state 2 or 3, then you will be in state 2 or 3.



And you will be at:



D) The Final Layer Linup:

- You Will get two of cubies crossing layered.
- Put them on back and left and follow:
- R U U R' U R U R' U



E) The Final Layer:

1) Permute the corners:

- Two adjacent LL corners need to be swapped:
 - Place white side on bottom, and corners to be swapped @ front top right and back right top
 - $L U' R' U L' U' R U^2$
- Two diagonal LL corners need to be swapped:
 - Do the above algorithm twice



2) Orienting the LL Corners:

You will be at one of three states

- a) **State 1:** Where the corners are correct
- b) **State 2:** Put Yellow color on right hand side and follow until Final solution:

$$R U U R' U' R U R'$$

$$L' U U L U L' U L$$


BLIND FOLDED

Solving the cube blind folded requires less algorithms than other algorithms. Using the old Pochmann method, you can solve the cube with as little as five algorithms:

- 1) T Permutation
 $R U R' U' R' F^3 U' R' U' R U R' F'$
- 2) J Permutation
 $R U^2 R' U' R U^2 L' U R' U' L$
- 3) L Permutation
 $R' U^2 R U R' U^2 L U' R U L'$
- 4) Y Permutation
 $R U' R' U' R U R' F' R U R' U' R' F R$
- 5) R Permutation
 $L U^2 L' U^2 L F' L' U' L U L F L^2 U$

Notations:

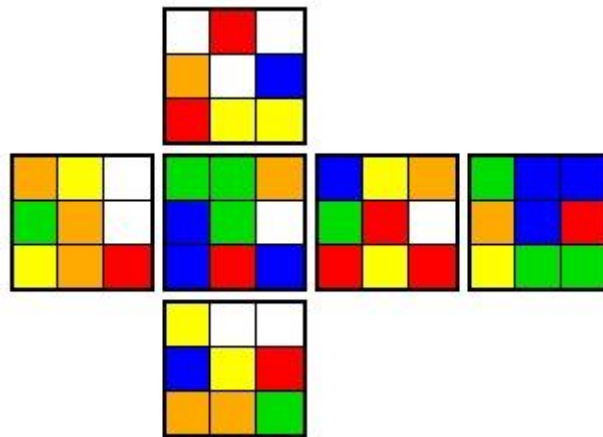
Each cubie is labeled with letter of colors of sticker on it. Notation is very important in blindfolded solving, as you need to know where you are going to send your pieces. You first need to pick your orientation. With blindfolded cubing, we work with stickers instead of pieces. When solving a piece, it needs to be in the correct orientation. Just remembering the piece itself is not sufficient, as there is a chance the piece will be flipped in its place. Therefore, each sticker on each face has a letter (except the centre sticker)

Buffer : Buffer for edges is UR edge and for corner piece is UBL.

Solution :

Tracing is not an easy task. So we are using buffer instead that. Buffer can be used to solve pieces to correct position. First solve the edges and then corners. You have to use the following trick:

(Setup) Permutaion (Undo Setup)



Here, UR should go to BU i.e UR > BU
Similarly, targeted replacement string is

UR > BU > FU > BD > DF > UL > DB > DR > LB > FL > DL > RU

To apply T permutation for placing BU, first setup BU to UL by following rotations:
R' B L R

Now, apply T-permutaion and undo setup i.e.
R' L' B' R

Similarly, follow following rotations or you can apply your own logic to setup any cubie to required place and apply rotations.

R F' L' R' T-Perm R L F R'
U U L' T-perm L U U
D' L L T-perm L L D
T-Perm
D L L T-perm L L D'
D D L L T-perm L L D D
U L' T-perm L U'
L' T-perm L
L L T-perm L L

Now As FR and UR are flipped , now setup cubie to LU and T-perm

L T L'
U U L T-perm L' U U
U' L' T-perm L U

Now, we have done with crossing of all sides. Now place corners in the same way where we place setup cubie to UBL.

Targeted replacement string is

UBL > URB > LDF > FUL > FDR > UFR > DBR > UBL

R D' Y-perm D R'

D D R Y-perm R' D D

F' D Y-perm D' F

F D Y-perm D' F'

F Y-perm F'

D D F' Y-perm F D D

VI) CONCLUSION

Simple Rubik's cube solving algorithm is easy to learn and apply. But has more number of algorithms.

Blind folded algorithm has less number of algorithms but complex to apply and require more number of rotations.

Blind folded algorithm can be done only by scanning cube once that means it does not require tracing of cubies. Where simple solving algorithm requires tracing of cubies.

REFERENCES

- I. <https://ruwix.com>
- II. <https://www.rubiks.com/>
- III. https://en.wikipedia.org/wiki/Rubik%27s_Cube
- IV. rubiks-cu.be/
- V. https://en.wikipedia.org/wiki/Rubik%27s_Cube/
- VI. <https://rubiks-cube-solver.com/how-to-solve/>
- VII. <https://www.youcandothecube.com/solve-it/3-x-3-solution>
- VIII. <https://how-to-solve-a-rubix-cube.com/>
- IX. www.rubikspace.com/
- X. www.learnhowtosolvearubikscube.com/how-to-solve-a-rubiks-cube-solution-overview/