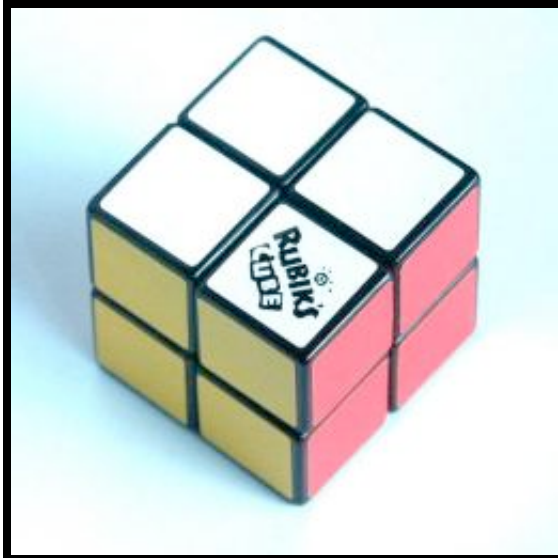
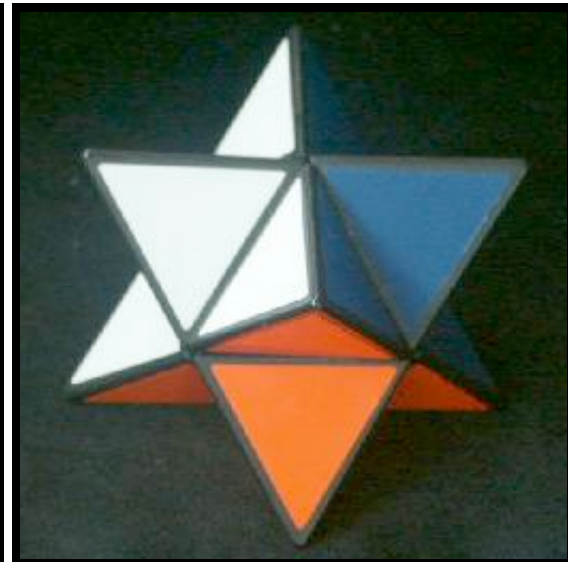


Jaap's Puzzle Page

Mini Cube, the 2x2x2 Rubik's Cube





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Links to other useful pages:

[Mefferts](#) sells the Mickey Mouse puzzle head, Pyramorphix, 2x2x2 cubes by Eastsheen, and many other puzzles.

[Rubik](#) sells the original 2x2x2 cubes, Darth Maul and Homer puzzle heads.

[Denny's Puzzle Pages](#) A very nice graphical solution.

[Matthew Monroe's Page](#) Although a solution for the 3x3x3 cube, it is corners first, and thus applies to the pocket cube as well.

[Philip Marshall's page](#) A relatively short solution.

[A Nerd Paradise](#) has solutions for the various cubes, Pyraminx, Skewb and Square-1.

This puzzle is a simpler version of the [Rubik's Cube](#). It goes under various names, such as Mini Cube and Pocket Cube. The puzzle is built from 8 smaller cubes, i.e. a 2x2x2 cube. Each face can rotate, which rearranges the 4 small cubes at that face. The six sides of the puzzle are coloured, so every small cube shows three colours.

This puzzle is equivalent to just the corners of the normal [Rubik's cube](#). It is a little confusing though, because there are no face centres to use as a reference point.

This puzzle has many guises, some of which are pictured above. There are the puzzle heads such as the Mickey Mouse puzzle head by [Meffert](#), and the Darth Maul or Simpson heads by Rubik. Also shown above is a version in the shape of a Nissan Micra, used for advertising. These puzzles change shape when they are mixed, sometimes in quite amusing ways. There are various ball versions, such as the Dreamball, the K8-ball, and the Octo. These balls have unique internal mechanisms. All these puzzles can be solved in the same way as the normal mini cube.

Another related puzzle is the pyramorphix, which is the tetrahedral puzzle shown above. It changes shape when mixed. It is like the cube but where the orientation of four of the pieces does not matter. Because of this, it has a slightly easier solution than the other versions. The Pyramorphix and the equivalent Stern puzzle are covered in more depth on a separate [Pyramorphix page](#).

The pocket cube was patented by Ernő Rubik on 29 March 1983, [US 4,378,117](#).

The Eastsheen 2x2x2 cube was patented by Chen Sen Li on 27 October 1998, [US 5,826,871](#).

The Mickey Mouse puzzle head was patented by Francisco Josa Patermann on 22 May 1996, [EP 712,649](#).

The Darth Maul puzzle head was patented by Thomas Kremer (Seven Towns Ltd.) on 17 April 2001, [US 6,217,023](#).

The K-ball was patented by Saleh Khoudary on 11 May 2000, [WO 00/25874](#).

The number of positions:

There are 8 pieces, with 3 orientations each, giving a maximum of $8! \cdot 3^8$ positions. This limit is not reached because:

- The total twist of the cubes is fixed (3)
- the orientation of the puzzle does not matter (24)

This leaves $7! \cdot 3^6 = 3,674,160$ positions.

Every position can be solved in at most 11 moves (or 14 if a half turn is considered to be two moves). Many people have used a computer search to find God's Algorithm, i.e. the shortest solution for each position, as far back as 1981. The result for both metrics is shown in the following table:

Q	Face turn metric												
	0	1	2	3	4	5	6	7	8	9	10	11	Total

- a. Rotate the D layer to get at least two pieces in the correct position, though they may be twisted.
- b. If necessary swap two pieces by using the following:
 1. To swap DFR, DBL do F'R'D'RDFD'
 2. To swap DFR, DFL do FDF'D'R'D'R

Phase 3: Twist the bottom layer pieces correctly.

- a. Do one of the following sequences to solve the remaining pieces. Clockwise twists are denoted by a +, anti-clockwise ones by a -.
 1. To twist DFL-, DBL+ do R'D'R F' DR'DR D2F2
 2. To twist DFL+, DBL- do F2D2 R'D'RD' F R'DR
 3. To twist DFL-, DBR+ do R2D'R D2R'D2R D'R2D
 4. To twist DFR-, DRB-, DBL- do R'D'RD' R'D2RD2
 5. To twist DFR+, DRB+, DBL+ do D2R'D2R DR'DR
 6. To twist DFR-, DRB+, DBL-, DLF+ do R2D2 R D2R2 D
 7. To twist DFR+, DRB-, DBL-, DLF+ do RDF R2D2F2 DF'DR2

This solution takes at most $24+8+10=42$ moves.

Solution 2:

This solution is loosely based on the Thistlethwaite algorithm adapted for the 2x2x2 cube. It uses fewer moves than solution 1, but is far more complicated since it uses a large table of sequences.

Phase 1: Orient all pieces correctly.

- a. Choose the colours which will go on the top and bottom faces of the cube.
- b. Hold the cube so that at least three of the pieces show one of those two colours on the top and bottom faces.
- c. Examine which pieces need to be twisted and in which direction to make the top/bottom faces a mixture of the two chosen colours.
- d. The following table lists all possible sequences needed to fix the orientations. The left column shows the twist the pieces need, in the order ULB, UBR, URF, UFL, DBR, DRF, DFL, DLB, where a + means it needs a clockwise twist, a - an anticlockwise twist.

-0+00000	FRU2R'F
-+000000	R2URF'UF
+ -000000	RU2RU2R
0---0000	R2U2F'RF
--++0000	RF'R2F2UR
-+-+0000	F2U2F
+000-000	FU'RF
00+0-000	R'FR'F
--00-000	R'UR
0-0--000	FRF
0-+-0000	R2U'F
0+-+0000	FR2F
+ -0+-000	R2F2U'F
--+--000	R'F2UR
++++-000	RU'R'FR2F
0+0+-0-0	R2F

0++0-0-0	RUF2U'R
++00-0-0	R'UR2FR
-0-+-0-0	RFUR
+0---0-0	FUR2F
0+---0-0	R'F2R'F
0--+-0-0	FRUF
00++--00	R2U2F2UR
0+0+--00	R'URU2R
0++0--00	FR2F2RF
+0+0--00	RU2FU'R
++00--00	RUF2R2F
+0----00	FRFU2R
0+----00	R2FR2U'R
-+0---00	FR2F'UR
-+-+--00	R'F'U2F
0--+-0-0	RUF'U'F
0-+---00	FR2F'R
--0+--00	R'U'RU2R
+--0--00	RU2RU'R
--+0--00	F2R'U2F'R
0+-0-+00	F2R2F
-0+0-+00	R'UR2U'R
-+00-+00	R2F'U2F
+0-0-+00	FU'R2U'R
0----+00	FR2U'R
---0-+00	RF'U2F
0-+0+-00	R
+0-0+-00	R'F'U'F
+--0+-00	F2R'U2R
-0--+-00	RF2UR
00+--0+0	RF'RF2R
00-+-0+0	FRFR
-0+0-0+0	R2UF2R
+--0-0+0	FR'U2RF
-00+-0+0	R2U'R'F2R
--0--0+0	R'U2F'R
---0-0+0	F'RU2F

Phase 2: Put the pieces in position.

- Find a tetrad of pieces, i.e. 4 pieces which in the solved cube are not adjacent (i.e. any two of them have exactly 1 colour in common).
- Rotate U/D to get these pieces into one of the following patterns and do the sequence shown:
 - UFL, ULB, DLF, DRB: R2 U R2 U F2
 - UFL, ULB, UBR, DLF: R2 U F2
 - UFL, UBR, URF, DLF: F2 U' F2

UFL, UBR, DLF, DBR: R2 U2 F2

ULB, URB, DLF, DFR: F2

This leaves the tetrad in the U layer, and the other tetrad in the D layer.

- c. Rotate U to get as many pieces from the U layer adjacent to matching pieces in the bottom layer, i.e. forming as many correct columns as possible.
- d. If there are 4 columns, then do UF2U2R2U; if there are 2 adjacent columns then holding the cube with those columns in the B face do the sequence F2U'F2U2R2UF2U; if there are 2 non-adjacent columns, then holding the cube with those columns at FR and BL do the sequence R2U2F2U.
- e. The cube can now be solved by using only half turns, and at most 4 are needed. This is trivial.

This solution takes at most 24 moves (not including cancellations between the steps in phase 2).

Nice patterns:

1. [U](#) 4 horizontal flags (not mirror symmetric)
2. [U2](#) 4 horizontal flags (mirror symmetric)
3. [F2 R2 F2](#) 4 vertical flags
4. [U2 F2 R2 U2](#) Supertwist; 6 flags
5. [U F2 U2 R2 U](#) 4 vertical flags, 2 checkerboards
6. [R2 F2 R2 U2](#) 4 checkerboards
7. [R U2 R' F2 R U' R2 U F2 U'](#) Cube in cube
8. [R F U' R2 U F' R U F2 R2](#) Cube in cube 2
9. [U R F2 U R F2 R U F' R](#) 3-Cycle
10. [U R U' R2 U' R' F' U F2 R F'](#) Column turn
11. [F' U R' F2 U' R F U R2 U R'](#) Corner swap
12. [U F2 U'](#) Zig-zag
13. [U' F2 U2 R2 U' F2 U2 R2 U'](#) 2 Checkerboards, 4 L

The following patterns are symmetric, but don't look as nice.

13. [U R F2 U F2 R U'](#) Triple swap.
14. [U' R2 F2 R' U2 F' R2 F2 U'](#) Two 3-cycles
15. [F U2 R2 F2 U](#) Supertwist 2
16. [F' R F2 U2 F' U' F U2 R2 U'](#) Six twist
17. [F R' F U2 F R' U R' F2 U'](#) Six twist
18. [F U' R' F2 U2 R2 U' F R'](#) Four twist
19. [U R U2 F' U2 F2 U' F2 R' U'](#) Four twist 2
20. [R2 F' R2 F2 R' F2](#) Four twist 3
21. [F2 U2 F' U2 F2 U'](#) Four twist 4
22. [F U2 R' F2 R2 F' U2 R'](#) Four twist 5
23. [F2 U R' F R U2 F' U R U2 R'](#) Double corner swap
24. [U F2 U F' U F U' F U2 F](#) 3-Twist

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