Rubik's Magic

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What is Rubik's Magic? top

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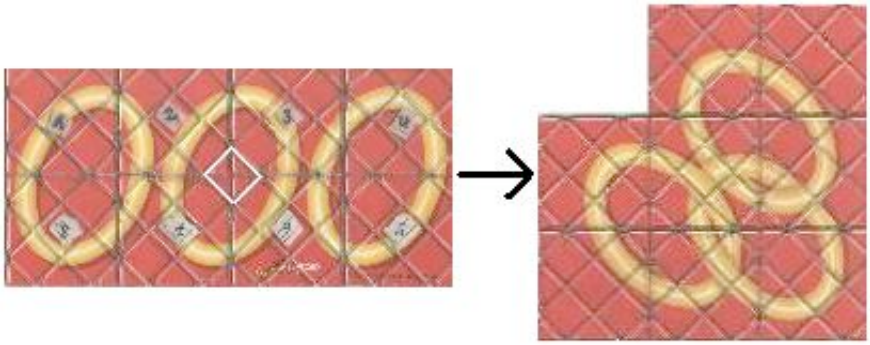

Rubik's Magic is a folding game for one person.

A rectangle of 4x2 squares is to be changed to a six-cornered polygon in heart shape by a sequence of foldings.

...

At the same time three separate rings change into three linked rings on the reverse side.

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The first Magic of Matchbox from the 1980s is black and has the same rings. They are more beautiful because of the rainbow colours.

The black Magic rectangle stands on its head compared with the red one.

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Description top

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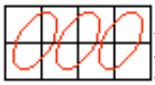

When you buy Rubik's Magic, you get it as a 4x2-rectangle with the three rings. After several random foldings some squares lie on each other. If you stretch Magic you find strange three-dimensional configurations.

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Sometimes squares even penetrate each other.

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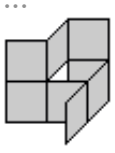

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If you put a rectangle on its head, it looks the same. If you take into account the writing


"Rubik's Magic", you can say: Magic stands upright, if the words stand upright. The black Magic stands upright, if the words stand upside down.
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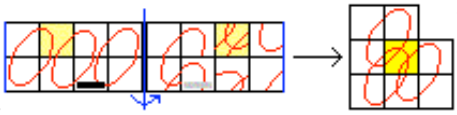
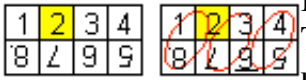
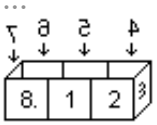
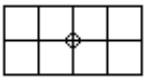

The reverse side of Magic has disordered squares.
There is one unique square: It has three arcs. Here it is marked yellow.
If you have solved Magic, this square goes into the centre.
If you play with Magic and you want to control your movings, you can look at the three-arcs-square (Book 3).
I prefer numbering the squares (Similar to book 2).


I suggest numbering the squares as shown at the drawing on the left. Then there is a ring with eight squares, where the numbers stand upright.



The centre diamond

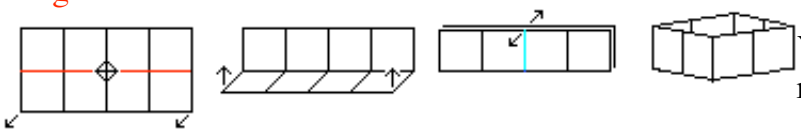

This is important to understand the following sequences:
The 4x2-rectangle has a diamond formed by groves on four squares on both sides.
If there are strings in it, it is drawn as shown on the right.



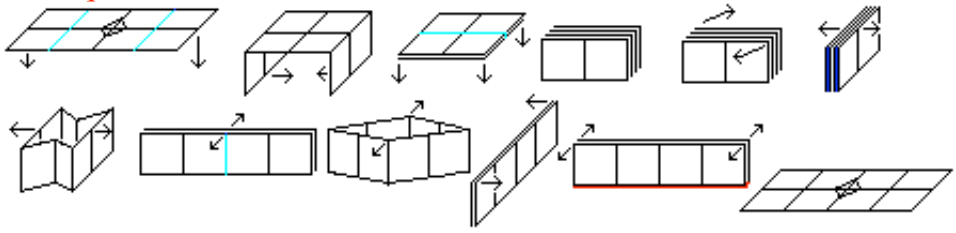
Sequences top

If you have mixed the Magic up, you must try to find any 4x2 rectangle.
If you succeeded, you should try the following sequences.

Ring

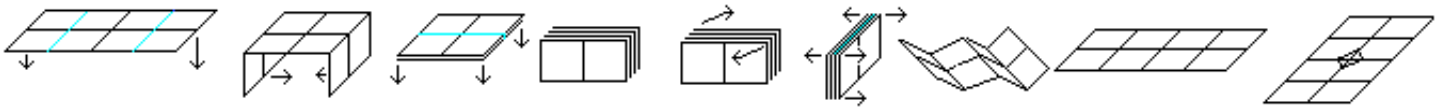

You quickly find out: You can open each rectangle to a ring.

Changing the rows (Sequence A)



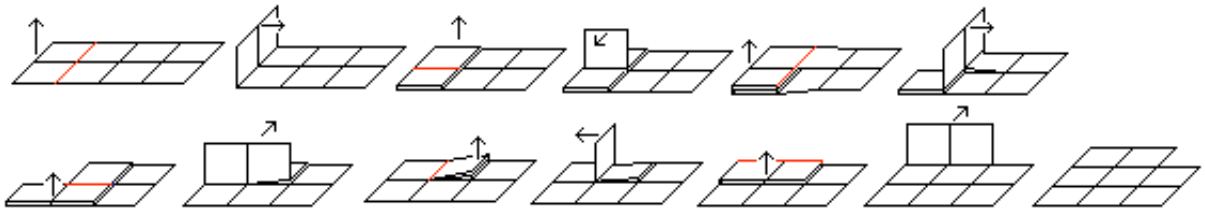
This sequence has the effect that two lines interchange. The writing "Rubik's Magic" stands horizontally as before.
If you repeat the sequences you return to the start pattern. The sequence has the order 2. - The moves are reversible.

Turning the squares (Sequence B)



The squares are ordered in another way at the same time. The writing "Rubik's Magic" stands horizontally before and vertically after making the moves.
If you repeat the sequences you return to the start pattern. The sequence has the order 2. - The moves are reversible.

Transformation



By the way: The right 2x2 square doesn't move during this procedure.

All Patterns of Eight Squares top

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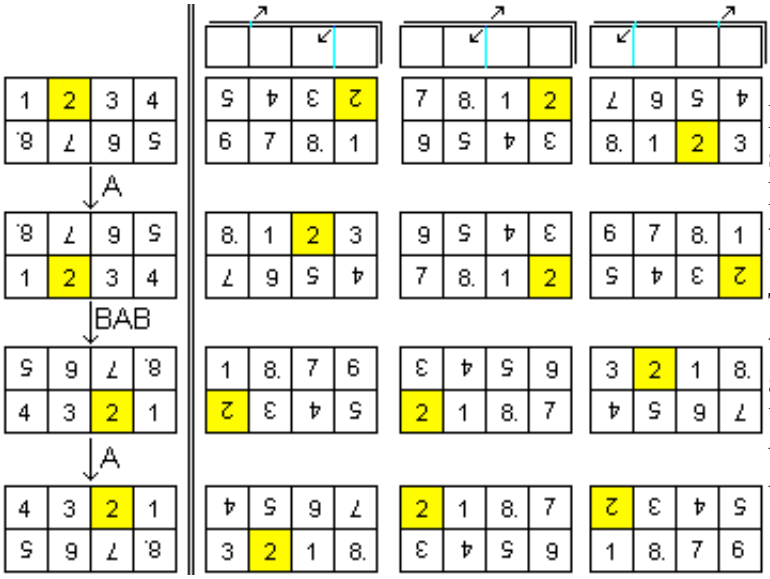

How many patterns can you make with the squares?
First observation: The sequence of the squares 1 to 8 is kept at every pattern.

There are four main patterns (left row), which turn into each other by the given sequences A and BAB.
You can find three more to every main pattern by using the main squares and the sequences below.

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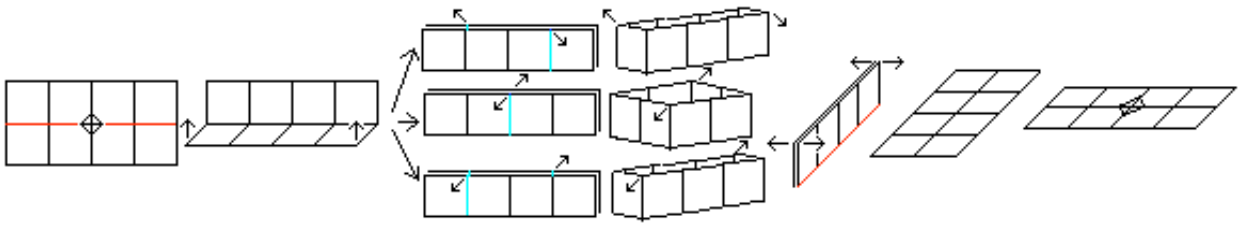
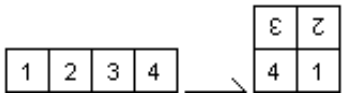
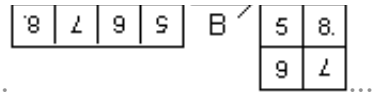


There are 16 patterns of the 4x2 rectangle.



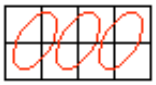
If you perform B at any 4x2 rectangle, you get different 2x4 rectangles.



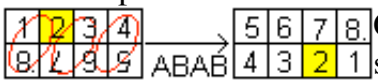
Thus there must also be 16 rectangles of this kind.

Result: There are 32 patterns of 8 squares altogether.

A Solution top

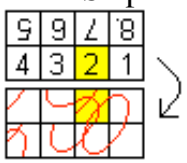


First Step



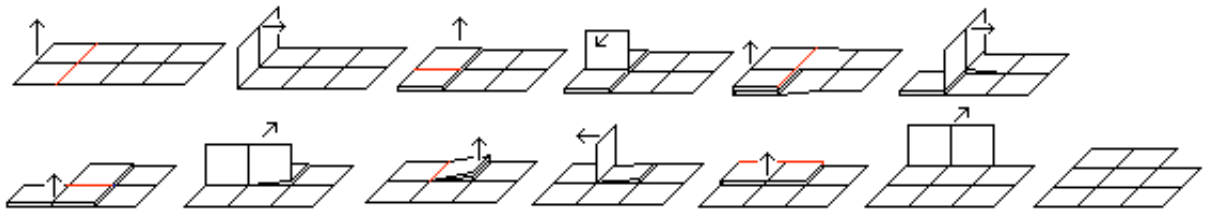
Change the basic rectangle to a rectangle with 1 in the right corner at the second row.

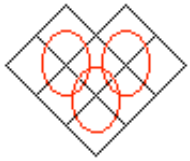
Second Step



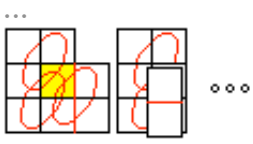
Turn the rectangle as shown on the left. Use the tansformation.

Transformation





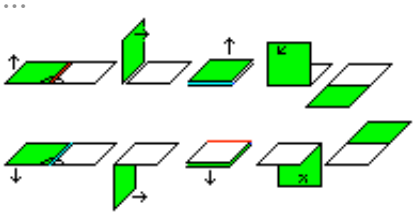
Eine kürzere Lösung



Use a "mirror" version of the transformation for the heart shaped form. You get the rectangle with the three rings by the sequences B and C1. The reverse path is a solution.

The Mechanism of Folding top

The first impression is that every piece has two hinges like the Jacob's ladder toy. This is partly right. The mechanism is more complicated however.
If you lay two squares on top of each other, then a new hinge appears at the **right angle** to the old hinge.



Where the hinge is depends on folding up or down. In the drawing strings are on the top in front.

The Labyrinth of Strings top

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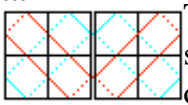

Two adjacent squares are connected with strings, actually by two rings of fishing line. You see them running in grooves partly in front or behind the squares. If you lay two squares on top of each other, then strings jump into empty grooves of the opposite square.

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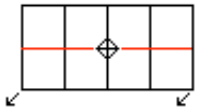
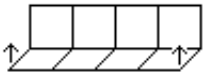
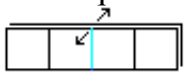
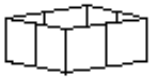
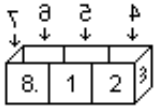
The following description refers to the ring with the ordered squares.

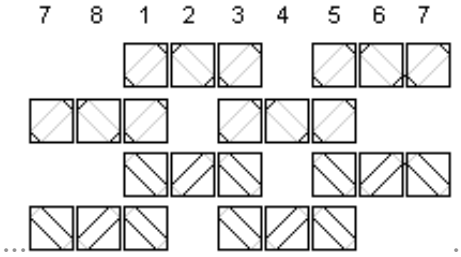












The eight squares are connected by 2x8 strings.

One pair of rings goes through three squares.

...

There are four strings in the grooves of squares 1,3,5, and 7, and there are two strings in the grooves of the squares 2,4,6, and 8. The squares are not of the same kind. If a string gets snarled up in one place (it can happen!), you can cut one string in a groove, which has two strings, and remove it. You can fold Magic in spite of that, in fact it is even better. But don't cut the strings without having to do so. Better safe than sorry.

Shapes top

Double square-figures

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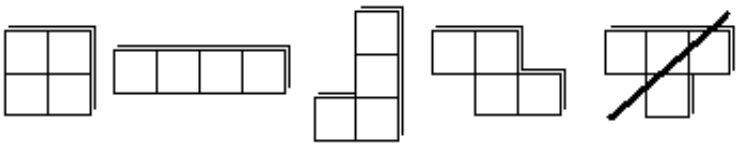

There are also the plane shapes on the left, which you can form with 4+4 squares. The T-form is missing.
If you stretch these shapes you find different 3D configurations. "L" especially is productive.

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Though the sequence 1 to 8 is kept, strange shapes will develop, because the squares penetrate (also several times) each other.

Cube

Folding the cube is a special challenge.

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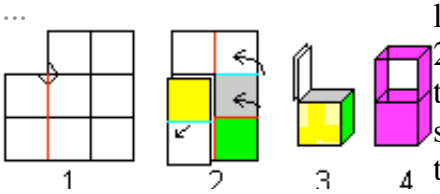
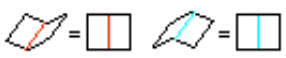
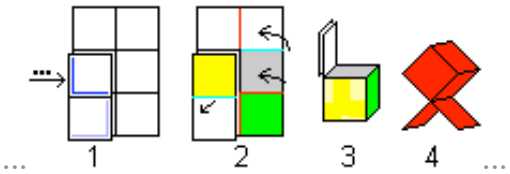


1 Start with the heart-like shape. Fold at the red lines.
2 Spread out the figure uand turn it at the same time. Watch at valleys and mountains.The two squares above stay above. The three right squares turn in direction of the arrows.



Be careful!

3 A cube arises.
4 You can lift the square at the top and you get a basket.

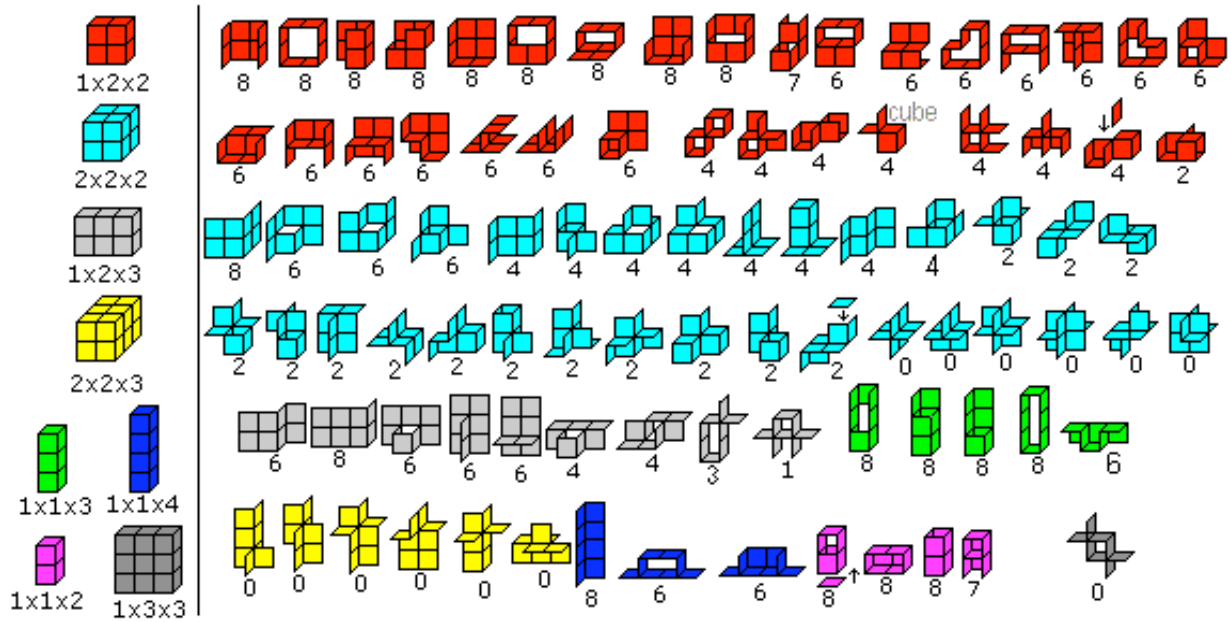


The cube is nicer, if it stands on two squares.

The dark blue lines give the position of the hinges.
But the way to figure 1 is long... (Book 3)

Symmetric Cubic Shapes

There are many shapes, which you can find by accident. I restrict myself to symmetrical shapes, the squares of which are perpendicular to each other and which have no double walls because of their multitude and their "beauty".



I ordered the shapes from two points of view:
(1) The colour indicates the smallest rectangular solid (on the left) you can lay round the shape ("wrapping solid").
(2) The number below the shape is the number of the squares the solid and the shape have in common.

Did I find all shapes?

Polyominoids top

You call figures of connected squares lying in cubic lattices **polyominoids** .

Jorge L. Mireles Jasso worked on these figures. He offers a program on the internet, which can find, show and count polyominoids (URL see below). I used this program for figures with eight squares because of Magic. You get the large number of 207265 figures, which are ordered by the form of the wrapping rectangular solid.

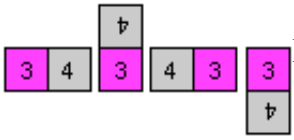
You can find much fewer shapes with Magic. There is a considerable reduction. You can explain that

by square 3, which is in place of one of the eight squares.

1st reduction:

Each square has exactly two neighbour squares.
This means the sequence of the squares is kept.

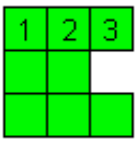
2nd reduction:



In Magic there are only **four** places for a neighbour square. Square 4 "rolls" around square 3.

Theoretically there are 16 possibilities for laying square number 4 to square number 3. If you turn number 4, you even get 32 cases.

Impossible Figures top



It is easy to understand that this figure can't be solved with Magic. There is no chain. Square 3 has no neighbour.

The next case is difficult to investigate.

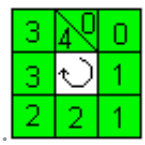
The eight squares form a chain and you can imagine that three squares could be connected by strings.

In spite of that there is no solution.

James G. Nourse has found a rule for possible or impossible figures [(3) page 18f.].

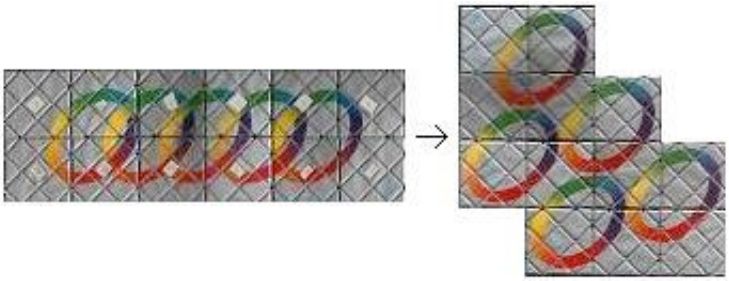
You must distinguish between squares with four and two strings.

Rule:
Go around the figure in a closed line. Start at a square and go back to it. Calculate a sum step by step. Start with nought.
>If you leave a square having **four** strings and go to the right, add 1. If you go to the left, subtract 1.
>If you leave a square having **two** strings and go to the right, subtract 1. If you go to the left, add 1.
>If you go straight, the sum doesn't change.
If the sum is 0 in the end, the figure is possible with the 4x2-Magic.



Here the sum is 4 (-4 respectively)

Rubik's Magic Master Edition top



There is a version of Magic with 12 squares in black or grey. You can transfer moves, but there are also new ones. The figures are more complicated.

You can find a solution of the problem on the left in Christian Eggermont's Homepage. He has the black Magic. You must turn the grey Magic at the beginning, so that the writing is upside down.

Purchase of Rubik's Magic top
In Germany you can buy Rubik's Magic in every good toy shop.
You pay 19.95 DM (1999).

Rubik's Magic on the Internet top

German:

Ronald Bieber
Lösung

English:

Christian Eggermont
Rubik's Magic (photos of figures, Solution to Rubik's Magic Master Edition)

Courtney McFarren (Mathematica)
Rubik's Magic I (@ Introduction @ Solving the Unlinked Side @ Solving the Linked Side @ Other Solutions)
Rubik's Magic II (@ Introduction @ Solving the Linked Side @ Solving the Unlinked Side @ Other Solutions)

Jaap Scherphuis
Rubik's Magic (Rubik's Magic, Links to other useful pages, Create the Cube puzzle, Master Edition of Rubik's Magic, Super Magic, "Magic Balls", Making your own Master/Super Magic)

Jorge L. Mireles Jasso
The Minoids Applet (Run it!, Instructions, Java Sources, Screenshots, Sample Report, *Polyominoids*)

Maarten Vermaak
Folding Puzzles

NN
Rubik's Magic (The moves, The Solution to Rubik's Magic, Try to make these figures with Rubik's Magic)

Rubik on-line (Ernö Rubik's Official Homepage)
The Amazing Folding Puzzle, Meet RUBIK'S Magic, Basic Magic

Wikipedia
Rubik's Magic

Spanish:

Javier Santos
Rubik's Magic (Descripción, Objetivo de la Página, Conceptos Básicos, Algoritmo, Operadores)

References top

(1) Christoph Bandelow: Rubik's magische Ringe, Niedernhausen/Ts. 1986
(2) Ashwin Belur, Blair Whitaker: Rubik's Magic, München 1986
(3) James G. Nourse: Simple Solutions to Rubik's Magic, New York 1986

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URL of my Homepage:
http://www.mathematische-basteleien.de/

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