Jaap's Puzzle Page

Rubik's Clock


This puzzle consists of a disk with 9 small clocks on each side arranged in a square. The four corner clocks can be twisted (the front and back corner clocks are connected). In between the clocks are four buttons. By pushing then up or down, the front or back clocks adjacent to it are connected to the corner clocks so that they will be turned when the corners are turned. The aim of the puzzle is to set all clocks to 12 o'clock.

The pictures above show the original Rubik's Clock on the left, and an imitation version on the right. That imitation is called the Magic Compass, since it has points of the compass written around each face. It still has 12 positions for each 'compass' even though 8 or 16 positions would be more logical, since the mechanism is a direct copy of the original.

It is a little known fact that the clock was actually not invented by Rubik himself but by Christopher Wiggs and Christopher Taylor. They previously invented the Orb. Rubik's Clock was granted a patent on 26 September 1989, US 4,869,506.

If your browser supports JavaScript, then you can play Rubik's Clock by clicking the link below:

JavaScript Rubik's Clock

Links to other useful pages:

Stefan Pochmann has a very clear Rubik's Clock speed-solving solution.
'Simplest Solution' page. A textbased solution.
rec.puzzles archive has a solution.
Chris Eggermont's page. A somewhat cumbersome mathematical solution.
Raymond Penner's page. A Java game simulating the Rubik's Clock.

The number of positions:

There are 14 independent clocks, with 12 settings each, giving 12^{14} = 1,283,918,464,548,864 positions.

This is the one of the few non-trivial puzzles I know in which the order that the moves are performed is unimportant (i.e. the puzzle positions form an Abelian group). This means that it is not necessary to do any particular move twice during the solution because we could change the order to do them one after the other, and therefore combine them into one move. Another puzzle of this kind is the Lights Out puzzle.

There are 16 positions that the buttons can be in, and in 14 of these we can turn a corner next to an up button or one next to a down button. In the other two cases all the buttons are the same. This means there are 30 possible moves that can be performed.

Suppose we choose 14 independent moves. Independent means here that the effect of any of the 14 moves cannot be replicated by using only the other 13. These 14 moves can then always solve the puzzle. For any position of the clocks this can be done by writing down 14 independent equations in 14 unknowns and solving them. The unknowns represent the how far you have to turn for each type of move. Each equation represents a clock; the left side is the amount the clock is turned by all the moves, the right side is the amount it has to turn to set it to twelve.

The theoretical solution above is in general not very easy for humans to perform, but is well suited for computers. By rewriting the equations in matrix form, and inverting the matrix, finding a solution becomes nothing more than a simply multiplying the (constant) inverse matrix by a vector representing the current position to be solved.

The solution for humans below does indeed use exactly 14 moves. By a suitable choice of 14 moves, and by doing them in an easy order there is virtually no mental effort needed at all. Sometimes fewer than 14 moves are needed, because a clock happened to end up in the correct setting. There are 30 possible moves, and with a fixed choice of 14 independent ones there are always positions that need all 14 moves. It would be interesting to know for sure whether there are positions for which no choice 13 of the 30 moves can solve it. This is by no means certain, but I do not believe this is the case here.

Solution:

Note that in this solution, you only turn corners which are next to buttons in the up position. This way none of the clocks on the reverse side move, except for the corner clocks.

1. Push down the bottom two pins, push up the top two.
2. Turn a top corner until the centre clock matches the bottom middle.
3. Rotate the whole puzzle a quarter turn clockwise.
4. Repeat steps 1-3 three more times. Afterwards all the non-corner clocks on the front should match the centre clock.
5. Push up all pins.
6. Turn any corner till the centre clock is 12. All non-corner clocks on the front are now pointing to 12.
7. We are now done with the front side (the corner clocks will be solved later), so turn over the puzzle.
8. Repeat steps 1-4 for this side, so that all the non-corner clocks match. There is no need to do steps 5-6 just yet, as we have to make the corners match before setting everything to 12.
9. Push down the top left pin, push the other three up.
10. Turn the top-right corners till the centre clock matches the top left clock.
11. Rotate the whole puzzle a quarter turn clockwise.
12. Repeat steps 9-11 three more times. Afterwards all the clocks on this side should match each other.
13. Repeat steps 5-6 for this side. All the clocks are now at 12, so the puzzle is solved.