

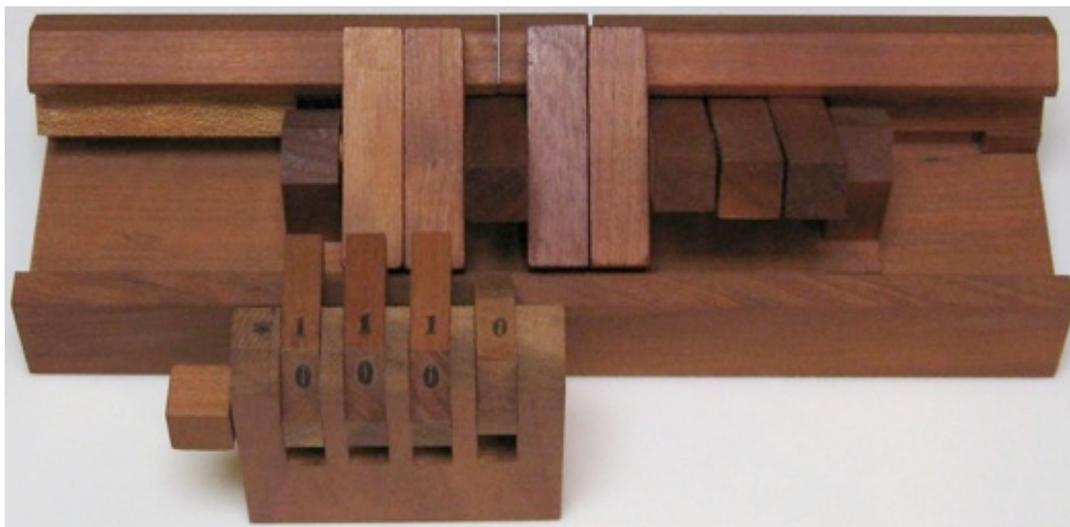
Hexadecimal Puzzle



Patented by W. Keister 1972, made by Binary Arts.

(Cherry, 8.75 inches, in a 6.2 by 10.75 by 2.2 inch cardboard box)

There are eight bars that can either be up or down; and four fingers that can be either up (one) or down (zero). In the photo below, the leftmost two bars are up, the third bar from the left is down, the fourth and fifth bars from the left are up, the rightmost three bars are down, the left three fingers are up (three ones), and the rightmost finger is down (a zero). The assembly that holds the bars cannot slide out to the right and can only slide out to the left if all the bars are up. The finger assembly can be pushed in (it is spring loaded) to cause a center portion of the back edge to go back, allowing the bar that is lined up with the right edge of the finger assembly to move up or down; the difficulty is that the finger assembly can only push in when each 1-finger is aligned with a down bar and each 0-finger is aligned with a down bar (or the finger is to the left of the bars); in the photo below, it can be pushed in. The fingers can be set to any of the sixteen possible patterns by pulling out the peg that runs through them and rotating each as desired. The corresponding sixteen puzzles all have the goal of starting with all bars down, and sliding the finger assembly out to the left. Setting 1111 allows the bars to be moved up one at a time and the bar assembly easily slid out. Setting 1110 is the hardest setting, which gives a puzzle equivalent to the *Chinese Rings*, and requires 170 moves.



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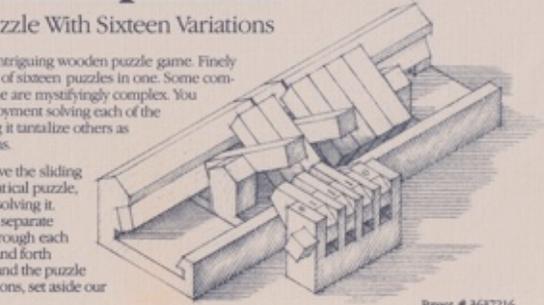
The Booklet Sold With The Hexidecimal Puzzle

THE HEXADECIMAL PUZZLE™  binary art.

An Advanced Mathematical Puzzle With Sixteen Variations

Congratulations on owning this fascinating and intriguing wooden puzzle game. Finely crafted, the Hexadecimal Puzzle actually consists of sixteen puzzles in one. Some combinations are relatively straightforward, and some are mystifyingly complex. You and your family or friends will find hours of enjoyment solving each of the combinations and then sitting back and watching it tantalize others as they work their way through the various solutions.

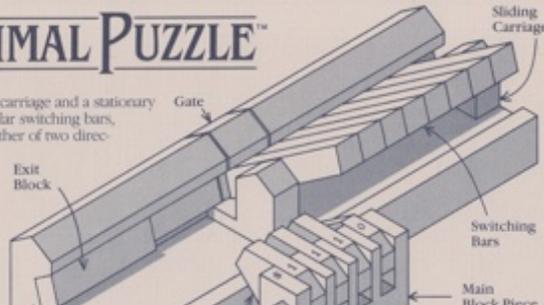
The object of the Hexadecimal Puzzle is to remove the sliding carriage from the stationary base. It is a mathematical puzzle, based on binary arithmetic. There is no trick to solving it. Although we have included a "helpful hint" on a separate page, the best solution may be simply to think through each combination, and work the switching bars back and forth until the sliding carriage is freed from the base and the puzzle is solved. For the strong of heart, read the directions, set aside our hints, and have at it. The fun is in the figuring!



THE HEXADECIMAL PUZZLE™

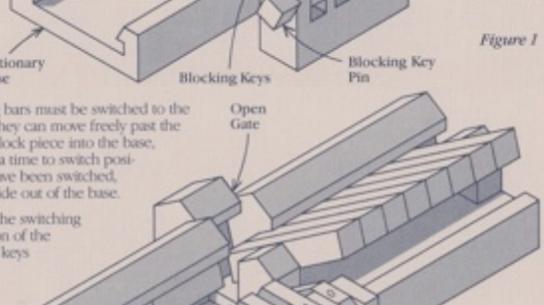
Your Hexadecimal puzzle consists of a sliding carriage and a stationary base. The carriage is fitted with eight rectangular switching bars, which can pivot on their centers to angle in either of two directions. The base, which holds the carriage during the puzzle's operation, is fitted with a main block piece containing four blocking keys. These components are illustrated in Figure 1.

As the puzzle is started, the carriage is set inside the puzzle base. The eight switching bars should slant away from the main block, set so the ends of the bars can tuck under the gate, as the puzzle is set in Figure 1. In this position, the carriage is trapped inside the base by the exit block.



To solve the puzzle, each of the switching bars must be switched to the opposite setting of that shown in Figure 2, so they can move freely past the exit block. This is done by pushing the main block piece into the base, which will open the gate and allow one bar at a time to switch positions (shown in Figure 2). When all the bars have been switched, the carriage is free of the exit block and can slide out of the base.

The gate, however, can be opened only when the switching bars facing the blocking keys match the position of the keys. Thus, slide bars obstructing the blocking keys must first be switched to form a pattern that matches the key pattern. As you will soon learn, switching bars to switch other bars to get to the bar you want to switch can be a frustrating experience. The solution is to find a switching sequence of the bars through the gate which places all bars free of the exit block.



SIXTEEN PUZZLES

The Hexadecimal Puzzle can be adjusted to sixteen different puzzles. This is done by adjusting each blocking key to either of two positions, an up or "1" setting and a down or "0" setting.

To adjust the keys, remove the blocking key pin at the side of the main block. The keys can now rotate to either of two settings; with the "1" or the "0" set on the top face, in the plane of the "*" character. This adjustment is shown in Figure 3.

Depending on the position of the blocking keys, the puzzle can be set in any of the following combinations:

*0000	*0100	*1000	*1100
*0001	*0101	*1001	*1101
*0010	*0110	*1010	*1110
*0011	*0111	*1011	*1111

Each key setting creates a different puzzle, requiring a different sequence of moves. For correct operation, the blocking keys should not be changed while solving a given puzzle.

The simplest combination is *1111, for which only eight bars must be switched. The longest sequence is the *1110 combination, which takes 170 switches to free the carriage. This is a binary Grey code sequence. As you will find, other combinations can be more or less difficult, and each of them represents a unique challenge.

Good luck with your new puzzle. We believe that it will be the most interesting and challenging puzzle you have ever tried.



Binary Arts Corporation
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Alexandria, VA 22302

The Solution Card Sold With The Hexidecimal Puzzle

Helpful Hints for your Hexadecimal Puzzle

(Please Read Only When Frustrated)

This is a helpful hint we can share with those who might welcome a little assistance in overcoming the puzzle's challenges. As you start, try to think of each blocking key combination as eight separate puzzles, one puzzle for each switching bar, starting with the eighth bar (furthest from the exit block). Focus first on how to switch that eighth bar. To get to it and move it, you must first set the other seven slide bars in exactly the right combination in relation to the blocking key pattern and the exit block to allow the gate to open for the eighth bar. If even one of the first seven bars is switched in the wrong direction, the last bar cannot reach the gate, or the gate cannot be opened to switch this bar.

How should you set the first seven bars? Focus next on the seventh bar. In its current position, would it be blocked by the blocking key which it would oppose when the eighth bar is in the gate to be switched? If so, it must be switched before the eighth bar can be switched.

If switching the seventh bar is necessary to switch the eighth bar, focus next on the sixth bar. Would the sixth bar be blocked by its opposite blocking key when the seventh bar is in the gate? If so, it must be switched to switch the seventh bar to switch the eighth bar. Is the fifth bar in proper position when the sixth would be in the gate? The fourth? and on and on.

The essential concept of the puzzle is to concentrate on solving the switching bars furthest from the main block, even though the puzzle constrains most of your actions to the bars nearest the block. Progress made on the near bars must give way to progress on the farther bars, because the relationship between switching bars and their opposing blocking keys changes with each puzzle move. With the Hexadecimal puzzle, you have to lose some to win some.

After the eighth bar is switched, of course, you are left with a new switching sequence to solve, which now has seven bars which may or may not have to be switched, instead of eight. The process explained above must be repeated, switching the seventh bar to the open position, and then the sixth, etc., until each of the eight bars have been solved in order.

Fortunately, each succeeding bar is easier than the last, because fewer remaining bars get in the way. When only the second and first bars are left, you are almost out of the woods. Out of the woods, that is, until you realize that the process must be reversed to get the carriage back on the base for the next would be puzzle-solver to take his or her turn!

One final suggestion. Although resetting the puzzle can be as challenging as solving it, once the puzzle has been solved it is sometimes handy to readjust all the keys to the "1" position. The bars can then be moved back into starting position in order, and the keys repositioned in any arrangement for the next puzzle sequence.

Hexidecimal Solution Lengths

The setting of 1110 that requires the longest sequence of moves can be solved exactly like *Spinout* (described in another Keister patent) or the *Chinese Rings* puzzle (see that page for information about *Gray Codes* and additional links), where moves alternate between the rightmost bar and the only other legal move. Shorter solutions for the other patterns can be solved by along the lines of the hints card provided with the puzzle. *Jaap's Page* gives some history of this puzzle (it was the first puzzle made by *Binary Arts*, which became *Think Fun*), cites an article about the inventor, and presents minimal solutions for each level, as well as some additional analysis of the solution space diameter (the maximum number of moves to go between any two positions, not necessarily the start and end positions); here is a table of the minimal solution lengths:

Pattern	No. Moves
1111	8
0111	16
0000	20
1011	26
1000	28
0101	36
0100	38
0011	42
1101	52
1100	54
1010	56
0010	72
0110	102
1001	118
0001	150
1110	170

Further Reading

Jaap's Page, from: <http://www.geocities.com/jaapsch/puzzles/hexadec.htm>

Keister Article, from: <http://www.puzzles.com/products/ElephantSpinOut/ElephantInventor.htm>

Keister Patent, from: www.uspto.gov - patent no. 3,637,216