Title: Mathrix, The
Version Number: 1.0.0
Version Date: January 21, 2004

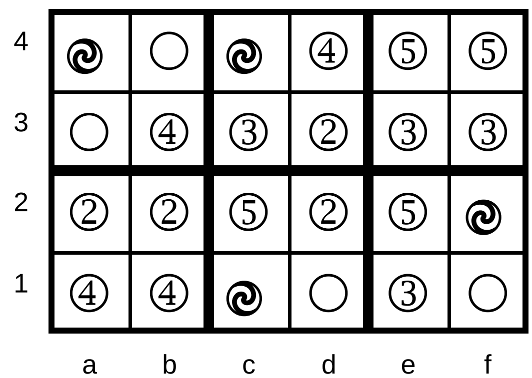
Number of Players: 1
Duration: Approximately 10 minutes
Equipment Needed: one standard piecepack (and if desired, a clock or timer)

The Mathrix

An abstract piecepack solitaire for the mathematically inclined

Setup

Arrange any six tiles face-down in a two tile by three tile rectangle to create a four space by six space rectangular grid. Shake all twenty four coins, then without peeking at their values, place one coin face-down onto each of the twenty four grid spaces. Finally, flip all of the coins face-up, and adjust their facings so the values are easily readable. Set the rest of the piecepack aside. One of the trillions of possible setups is shown below.



Goal & Play

Remove all but one coin by formulating mathematical equations using strings of coins. The coins that make up these equations must be orthogonally adjacent to one another (no gaps), but may be read in any of the four cardinal directions: left–right, right–left, up–down or down–up. Null coins have a value of zero, and ace coins have a value of one. Once an equation has been formulated, remove *any one coin* from the string that made up that equation (your choice). For example, in the above diagram, starting at space d2 and reading down–up: 2 + 2 = 4. With that equation, you could choose to remove any one of the three coins at d2, d3 or d4.

Repeat until only one coin remains (in which case you win) or until there are two or more coins remaining, none of which can be removed (in which case you lose). After learning the basics and winning a few games, keep track of your best time!

Note: Each equation must, in fact, be an *equation*. In other words, exactly one of the operators *must* be an equal sign. Inequalities are not allowed because they would trivialize the game with operations such as 4 < 5 and 3 ≠ 2. Likewise, operations which introduce variables (including most algebraic and calculus operations) are not allowed because they would make the game too easy. Almost anything else is legal, as can be seen in the sample game. Use good judgement; if it feels like cheating, it probably is.

Strategy Tips

1. *Check to see if your setup is solvable.* Most setups have a solution, but some are less obvious than others. Look for any two adjacent coins of equal value, a four adjacent to a two, or a string of any length ending in zero then one. If any of these are present, chances are very good that your setup can be solved.
2. *Start by deciding where you want to end.* The strings listed in the previous strategy tip are usually good places to end the game, so try to save them for last. The puzzle is figuring out how to get there.
3. *Stay connected.* Removing coins from the periphery is usually a good tactic. This reduces the likelihood of coins becoming stranded. Coins at the corners and edges have fewer connections, so they are harder to remove later in the game. Similarly, leaving holes in the middle of the board can make the ending much more difficult.
4. *Consider the consequences of every move.* Once a coin is removed, it can no longer be used to form other

equations. Formulating equations is very easy at first, but it gets progressively more difficult as fewer coins remain. Try to delay removing coins that reduce your choices for subsequent moves.

5. *Don't use a calculator.* While using a calculator *is* allowed, once you start playing against time, thinking through the equations in your head will be *much* faster than pressing buttons.

Annotated Sample Game

Looking at the sample setup, there are several adjacent pairs of coins having equal values. There are also several zeros next to ones and a couple of fours next to twos, so a solution should exist. In fact, many solutions do exist, but only one is presented here. Following the strategy tips, the 2,0,1 at a2,a3,a4 appears to be a good place to end. Ending there requires starting somewhere else, and the periphery is usually the best place.

At this point, you might want to construct the sample setup with your own piecepack and go through these steps to get a feel for how the process works. Each equation in the sample game is followed with the location of the removed piece enclosed by square brackets. If you are following along, remove the indicated coins as you come to them. By examining the neighborhood around the removed coin, you can find the strings of coins that generate each equation.

The simplest possible equation is the identity equation, which is just one number equal to another such as $4 = 4$ [a1]. There are several identity equations available in the sample setup, such as $5 = 5$ [f4]. While they are easy to find, saving identity equations for later in the game is usually prudent. The next equation type is the arithmetic relationship using one or more of the four basic operators: addition, subtraction, multiplication and division. Many equations of this type are readily available in the sample setup, such as $3 + 0 + 1 = 4$ [b1], $5 - 4 = 1$ [e4] and $4 \div 2 = 2$ [d4]. Making a positive quantity negative by preceding it with a minus sign is allowed, as is taking the absolute value to make a negative quantity positive. The well-known "My Dear Aunt Sally" priority sequence (multiplication and division before addition and subtraction) applies, but priority may be reassigned by using parentheses, such as $2 + ((2 - 5) \div (-2 + 5)) = 1$ [f2]. Next up are the series and transcendental functions such as raising numbers to powers, roots, factorials, logarithms and trigonometric functions. These are most useful when the number of coins begins to dwindle in the end game. Also note the special relationship that any number raised to the zeroth power equals one, so $(0 + 3)^0 = 1$ [f1]. The sequence $3^0 = 1$ [e1], $\cos(0) = 1$ [c1] and $2 - 2 = 0$ [d1] clears the first rank. The 3 coin at f3 should be removed before it gets stranded, and $3 = 3$ [f3] accomplishes this nicely. As with arithmetic operators, transcendental functions may be combined, so more complicated equations such as $3 \times 2^3 = 4!$ [e3] are also legal. Remember, any mathematical operations which do not introduce variables or differential terms are fine to use, but complicated equations are rarely (if ever) required. One possible example is $c(5,2) = p(5,2) \div 2!$ [e2], which employs probability functions.

If you have been following along so far, you should have a fairly good grasp of how things work. One possible sequence to finish the puzzle is: $2 = 2$ [d2], $2 = 3! - 4$ [d3], $5 - 3! = -1$ [c2], $\mathrm{alog}(0) - 4 = -3$ [c3], $\sqrt{4} = 2$ [b3], $2 = 2$ [b2], $1 + 0 = 1$ [c4], $\mathrm{acos}(1) = 0$ [b4], $2^0 = 1$ [a2], and finally $\cosh(0) = 1$ [a3].

Credits

Proofreading: Amanda J.-L. Rodeffer
Play Testing: Jonathan Dietrich, Marty Hale-Evans, Ron Hale-Evans, David Whitcher, Matt Worden

Revision History

0.0.1, September 15, 2003	initial concept, title, headers, setup, goal & play, strategy tips, revision history, license
0.0.2α, September 16, 2003	edited piecepack terminology, diagrams, examples, annotated sample game
0.1.0β, September 17, 2003	style editing, credits, updated examples, first external play test version
0.1.1β, October 27, 2003	changed title, contest version
1.0.0, January 21, 2004	minor updates in response to play test comments

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