Matrices are powerful tools for a wide variety of applications: computer gaming, massive data visualization, and designing buildings for earthquakes. This lesson goes over how to determine the inverse of a matrix and why it might be useful.

Matrix Inverse Explained

Olivia is one of those girls that loves computer games so much she wants to design them when she grows up. She has just learned that game graphics often make use of a powerful mathematical tool called matrices to make all that cool stuff appear on her screen. She wants to learn about these tools so she can get a leg up on her game design education.

Matrices, although cumbersome to use by hand, are very useful when employed by computers and can solve difficult problems very quickly - such as how a complicated digital monster might look as it is running quickly towards you. Olivia soon learns there are ways to add, subtract and multiply matrices, but there is no matrix operation equivalent of division. The closest we can get to division by a matrix is multiplying by its **inverse**.

Olivia knows from operations with integer numbers that dividing by a number gives you the same answer as multiplying by its reciprocal. 10 / 5 = 10 x (1/5) = 2. The same is true for the matrix inverses - as long as that matrix has an inverse. We'll see that not all matrices have an inverse.

Definition and Properties of the Inverse of a Matrix

Let's tighten up our loose definition of matrix inverses with some math:

$$AA^{-1} = A^{-1}A = I$$

$A = matrix$
$A^{-1} = inverse\ of\ matrix\ A$
$I = identity\ matrix$

'What is an **identity matrix**?' Olivia wonders. She reads a little further and finds that the identity matrix has the same number of rows and columns, has '1' in every spot of the diagonal from upper left to lower right, and has '0' everywhere else. Can you see the pattern in the matrices below?

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

2x2 Identity Matrix

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

4x4 Identity Matrix