Computer graphics using homogeneous coordinates

The problem

We want to transform images in 2D and 3D using matrices, but with more than just linear transformations.

The solution

For 2D transformations that aren't just linear transformations, write

points in the plane using **homogeneous coordinates** as $\begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$ and

use 3×3 matrices instead of 2×2 matrices.

Geometrically we could think about this as embedding the *xy*-plane as the plane $z = 1$ in 3-dimensional space.

Example. $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix}$