Homogeneous Coordinates -3

- A standard technique for expanding each two-dimensional coordinate position representation (x, y) to three-element representation, called Homogeneous Coordinates, where homogeneous h is a nonzero value such that

$$x = \frac{x_h}{h}, \qquad y = \frac{y_h}{h}$$

- A convenient choice is simply to set h=1, so each two-dimensional position is then represented with homogeneous coordinate (x,y,1).

Or, 3x3 Matrix Representations

- Translation:

$$\begin{vmatrix} x' \\ y' \\ 1 \end{vmatrix} = \begin{vmatrix} 1 & 0 & tx \\ 0 & 1 & ty \\ 0 & 0 & 1 \end{vmatrix} * \begin{vmatrix} x \\ y \\ 1 \end{vmatrix}$$

- Rotation:

$$\begin{vmatrix} x' \\ y' \\ 1 \end{vmatrix} = \begin{vmatrix} \cos(\theta) & -\sin(\theta) & 0 \\ \sin(\theta) & \cos(\theta) & 0 \\ 0 & 0 & 1 \end{vmatrix} * \begin{vmatrix} x \\ y \\ 1 \end{vmatrix}$$

- Scaling:

$$\begin{vmatrix} x' \\ y' \\ 1 \end{vmatrix} = \begin{vmatrix} Sx & 0 & 0 \\ 0 & Sy & 0 \\ 0 & 0 & 1 \end{vmatrix} * \begin{vmatrix} x \\ y \\ 1 \end{vmatrix}$$

Why use 3x3 matrices?

Why Use 3x3 Matrices?

- So that we can perform all transformations using matrix/vector multiplications
- This allows us to *pre-multiply* all the matrices together
- The point (x,y) needs to be represented as (x,y,1) -> this is called Homogeneous coordinates!
- How to represent a vector (v_x,v_y)?

Lecture No 23 Topic: Composing Transformation

- Composing Transformation – the process of applying several transformation in succession to form one overall transformation
- If we apply transforming a point P using M1 matrix first, and then transforming using M2, and then M3, then we have:

(M3 x (M2 x (M1 x P)))

Composing Transformation

- Composing Transformation – the process of applying several transformation in succession to form one overall transformation
- If we apply transforming a point P using M1 matrix first, and then transforming using M2, and then M3, then we have:

$$(M3 \times (M2 \times (M1 \times P))) = \underbrace{M3 \times M2 \times M1}_{M} \times P$$

(pre-multiply)