

102architect-bootstrap

B-MAT-100

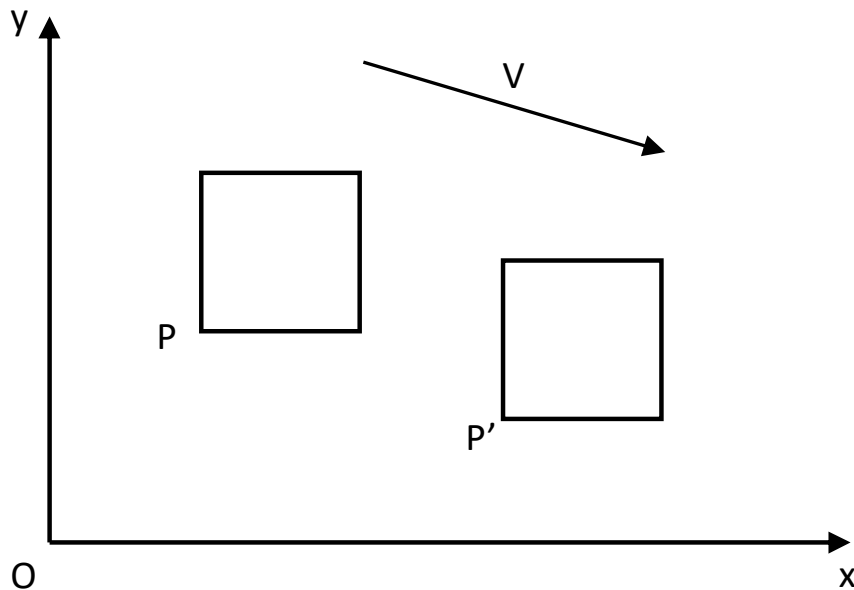
Exercise 1

- Create a function that takes two numbers x and y and returns a 3x1 vector in homogeneous coordinates:

$$\begin{pmatrix} x \\ y \\ 1 \end{pmatrix}$$

Exercise 2

- Create a function that takes two number i and j and return a translation matrix

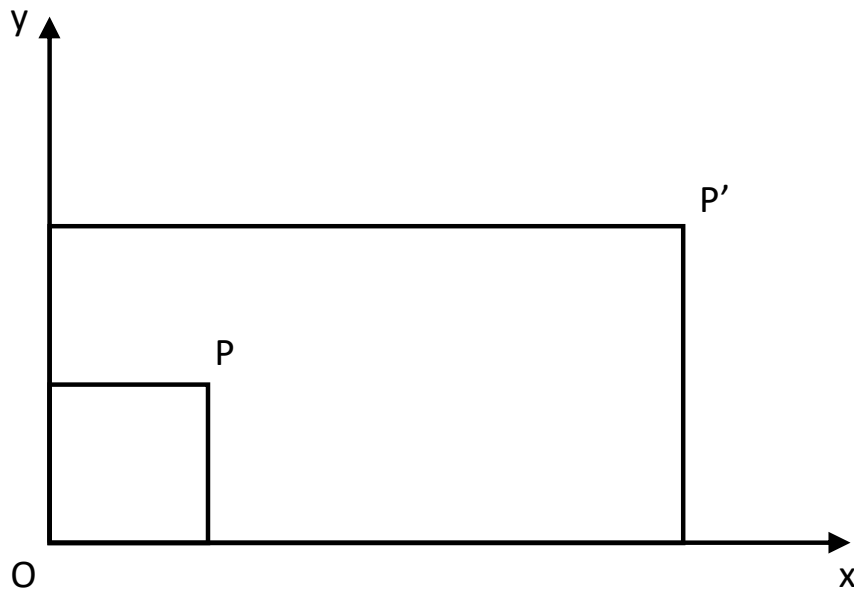


Translation along vector $V(i, j)$

$$\begin{pmatrix} x' \\ y' \\ 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & i \\ 0 & 1 & j \\ 0 & 0 & 1 \end{pmatrix} * \begin{pmatrix} x \\ y \\ 1 \end{pmatrix}$$

Exercise 3

- Create a function that takes two numbers m and n and return a scaling matrix

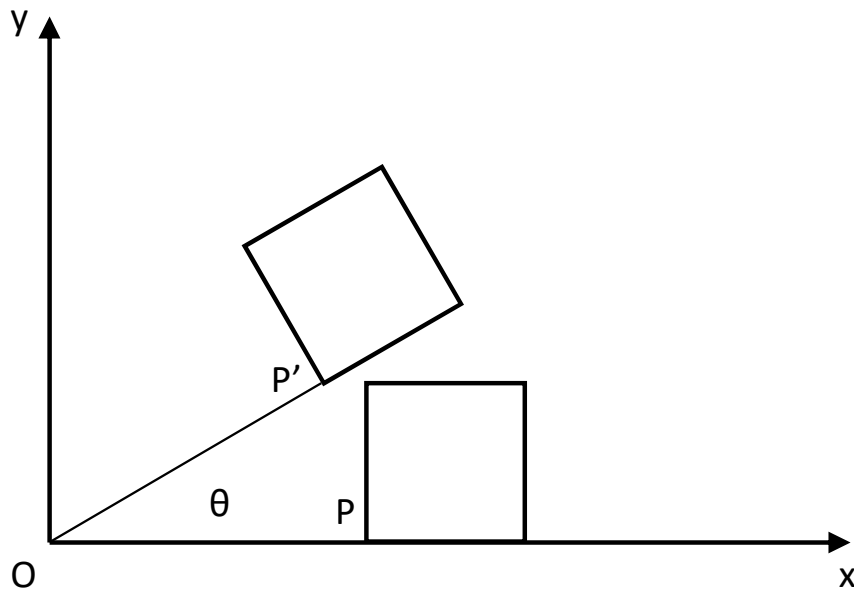


Scaling by factors m and n

$$\begin{pmatrix} x' \\ y' \\ 1 \end{pmatrix} = \begin{pmatrix} m & 0 & 0 \\ 0 & n & 0 \\ 0 & 0 & 1 \end{pmatrix} * \begin{pmatrix} x \\ y \\ 1 \end{pmatrix}$$

Exercise 4

- Create a function that takes a number and return a rotation matrix

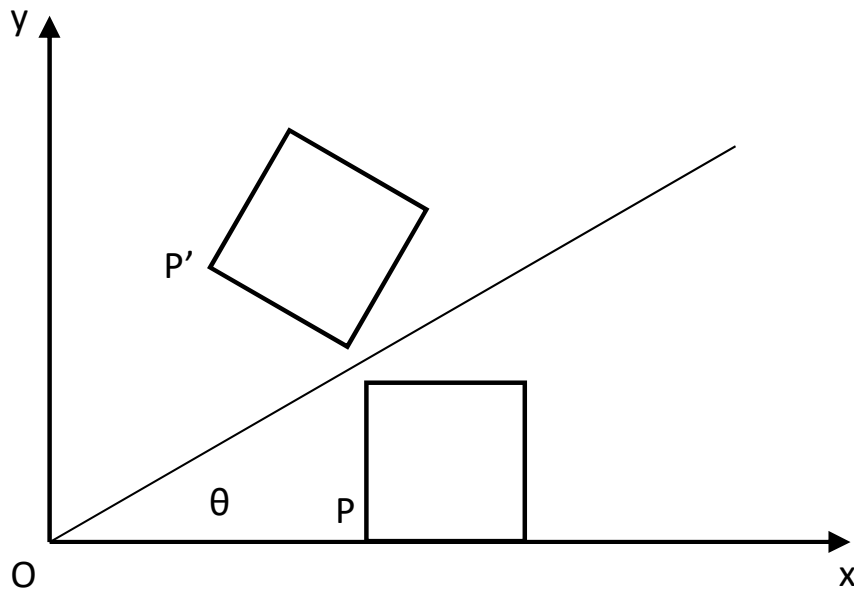


Rotation centered in O

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

Exercise 5

- Create a function that takes a number and return a reflection matrix



Reflection over an axis

$$\begin{pmatrix} x' \\ y' \\ 1 \end{pmatrix} = \begin{pmatrix} \cos 2\theta & \sin 2\theta & 0 \\ \sin 2\theta & -\cos 2\theta & 0 \\ 0 & 0 & 1 \end{pmatrix} * \begin{pmatrix} x \\ y \\ 1 \end{pmatrix}$$

Exercise 6

- Create a function that multiplies a 3x3 matrix with a 3x1 vector

The diagram illustrates the multiplication of a 3x3 matrix by a 3x1 vector. A 3x3 matrix $\begin{pmatrix} 3 & 2 & 1 \\ 2 & 1 & 3 \\ 3 & 1 & 4 \end{pmatrix}$ is shown on the left, with its first row $(3 \ 2 \ 1)$ highlighted by a red box. A red arrow points from this row to the first element of the resulting 3x1 vector $\begin{pmatrix} 23 \\ 18 \\ 23 \end{pmatrix}$, which is also highlighted by a red box. Above the result vector, the 3x1 vector $\begin{pmatrix} 3 \\ 6 \\ 2 \end{pmatrix}$ is shown, with its first element '3' highlighted by a red box. A red arrow points from this '3' down to the first row of the matrix, indicating the dot product calculation.

$$(3 * 3) + (2 * 6) + (1 * 2) = 9 + 12 + 2 = 23$$

Exercise 7

- Create a function that multiplies two matrices

$$\begin{pmatrix} 3 & 2 & 1 \\ 2 & 1 & 3 \end{pmatrix} \begin{pmatrix} 3 \\ 6 \\ 2 \end{pmatrix} \begin{matrix} 5 \\ 2 \\ 2 \end{matrix} \rightarrow \begin{pmatrix} 23 \\ 18 \\ 18 \end{pmatrix}$$

$$(3 * 3) + (2 * 6) + (1 * 2) = 9 + 12 + 2 = 23$$