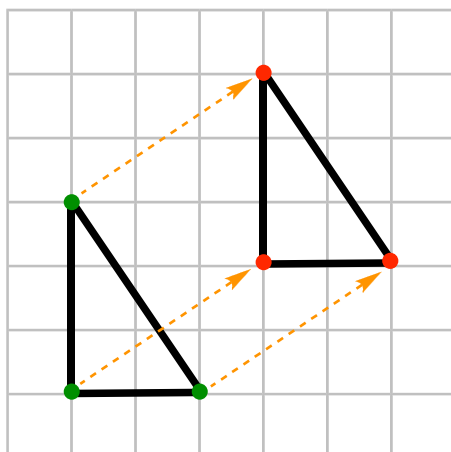


Translation

What's translation?

Translation is a kind of transformation that moves every point of a shape the same distance in the same direction. The shape remains the same size and stays in the same orientation after translation.



Column vectors describe translations

Column vectors are small grids that contain two numbers. They are instructions for translating a shape.

The upper number tells you how many units to move in the x-direction (towards the right) and the lower number tells you how many units to move in the y-direction (upwards).

It doesn't matter whether you do the left-right movement first or the up-down movement. The shape will end up in the same location.

$\begin{bmatrix} 1 \\ 2 \end{bmatrix}$ means move your shape 1 unit to the **right** and 2 units **upwards**.

$\begin{bmatrix} -2 \\ 3 \end{bmatrix}$ means move your shape 2 units to the **left** and 3 units **upwards**.

$\begin{bmatrix} 5 \\ -1 \end{bmatrix}$ means move your shape 5 units to the **right** and 1 unit **downwards**.

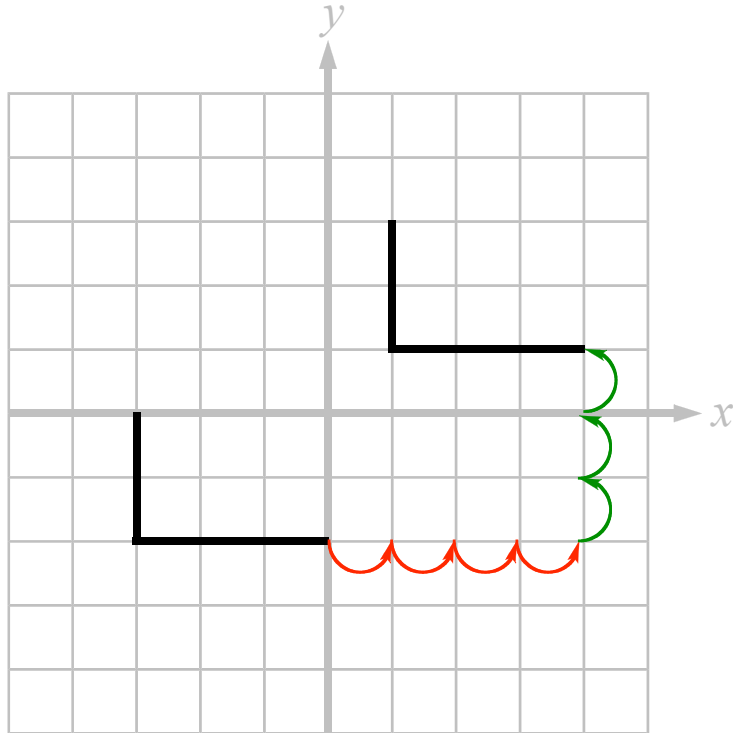
$\begin{bmatrix} -4 \\ -7 \end{bmatrix}$ means move your shape 4 units to the **left** and 7 units **downwards**.

$\begin{bmatrix} 0 \\ 6 \end{bmatrix}$ means move 6 units **upwards**.

$\begin{bmatrix} 5 \\ 0 \end{bmatrix}$ means move 5 units to the **right**.

$\begin{bmatrix} 0 \\ 0 \end{bmatrix}$ means don't move your shape at all.

In the diagram below, the L shape has moved 4 units to the right and 3 units up.



The column vector that describes this transformation is therefore $\begin{bmatrix} 4 \\ 3 \end{bmatrix}$.

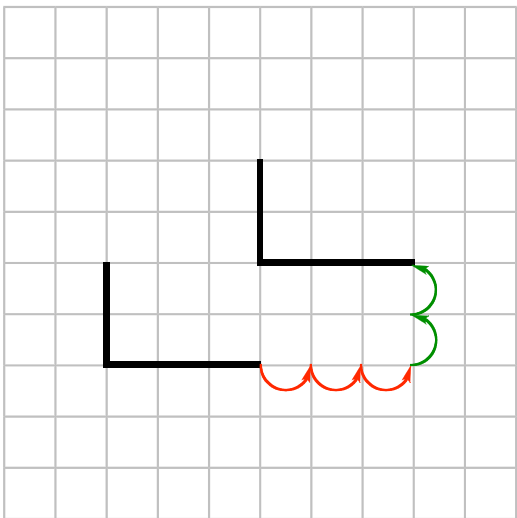
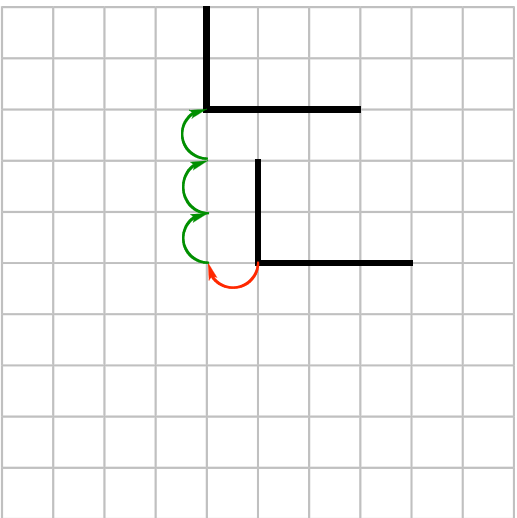
Combining translations

Sometimes, you have to translate an object by one column vector and then another.

If you have to translate an L shape by $\begin{bmatrix} 3 \\ 2 \end{bmatrix}$ then by $\begin{bmatrix} -1 \\ 3 \end{bmatrix}$, you can use one of two methods.

The hard way

You can do it the hard way, moving the shape once then applying the second translation afterwards:

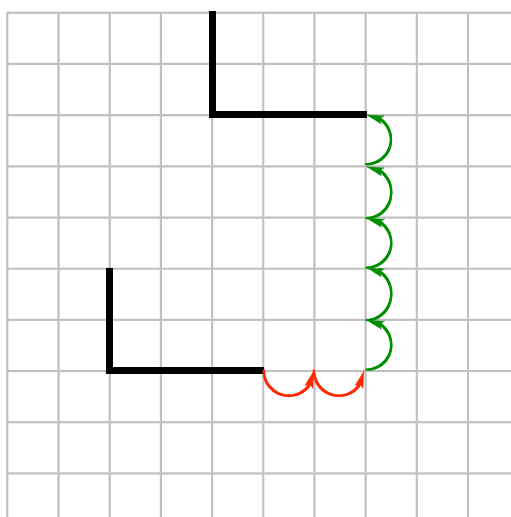
First do $\begin{bmatrix} 3 \\ 2 \end{bmatrix}$	Then do $\begin{bmatrix} -1 \\ 3 \end{bmatrix}$
	

The easy way

The easy way saves time because you only have to do one translation. You simply add the column vectors together:

$$\text{overall translation} = \begin{bmatrix} 3 \\ 2 \end{bmatrix} + \begin{bmatrix} -1 \\ 3 \end{bmatrix} = \begin{bmatrix} 3-1 \\ 2+3 \end{bmatrix} = \begin{bmatrix} 2 \\ 5 \end{bmatrix}$$

Then you apply the new column vector that describes the overall translation.



Compare this with the hard way. You'll see that the start points and the end points are the same. So you may as well use the easy way – it's quicker and easier and works just as well.