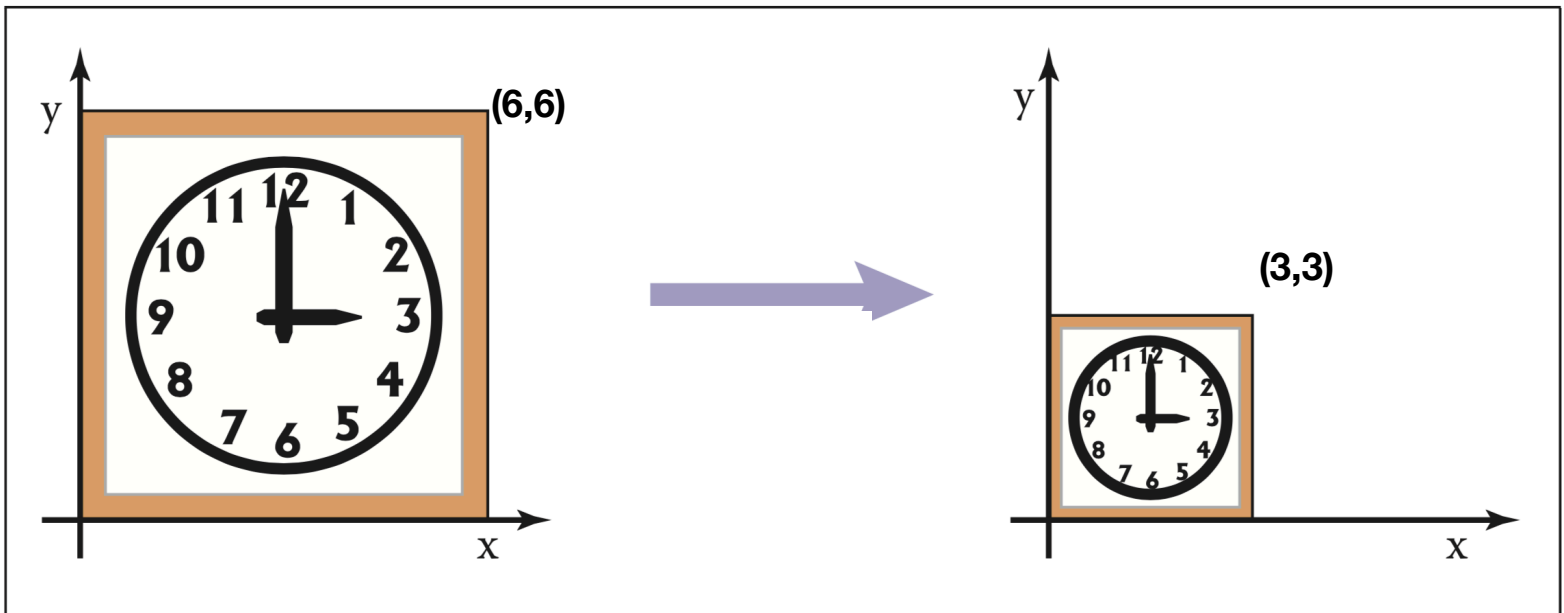# Lecture 03
Transformations in 2D
Short version

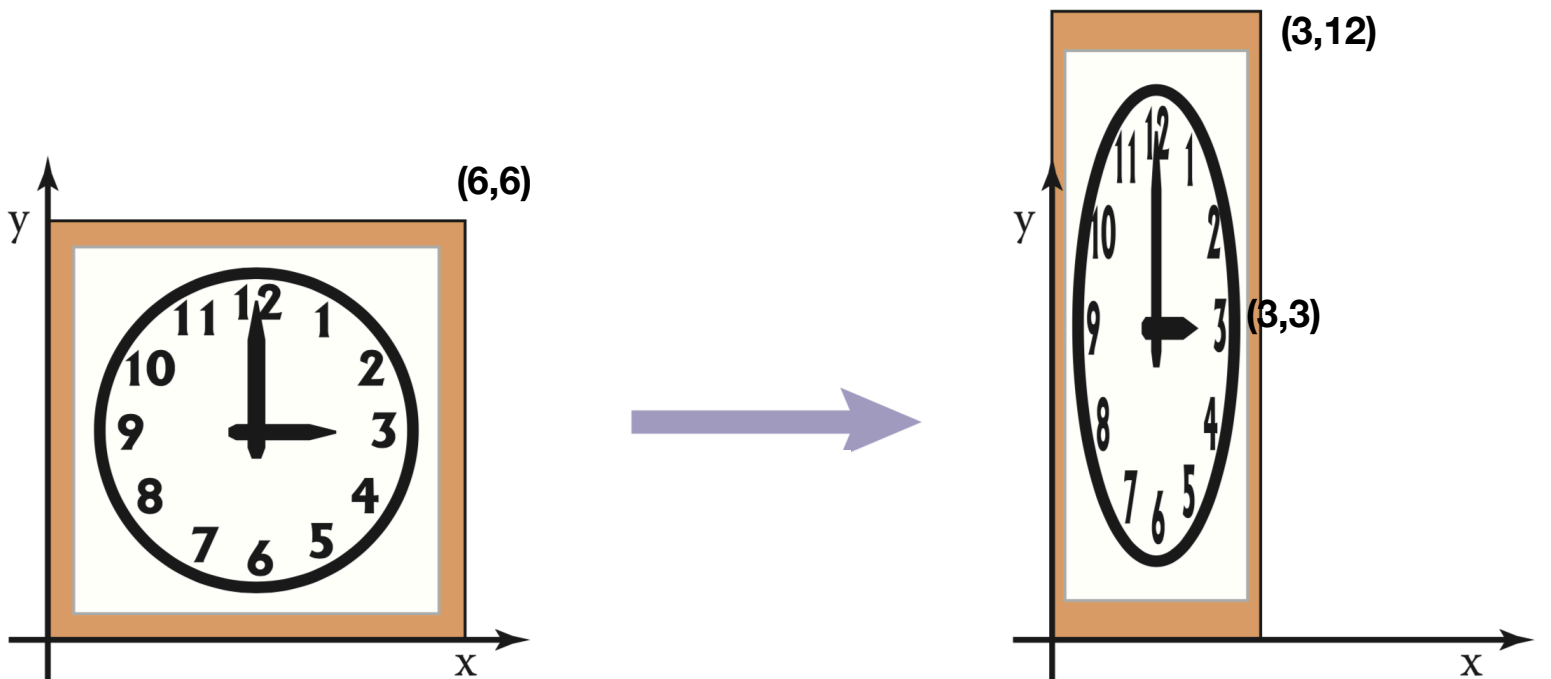We will discuss transformation in 3D, and with full details, later in the course

Scaling

- We can use different constants (s_x, s_y) for the x-axis vs. the y-axis. Then we shift each point *(x,y)* into the point

- $(x, y) \rightarrow (s_x \cdot x, \; s_y \cdot y)$
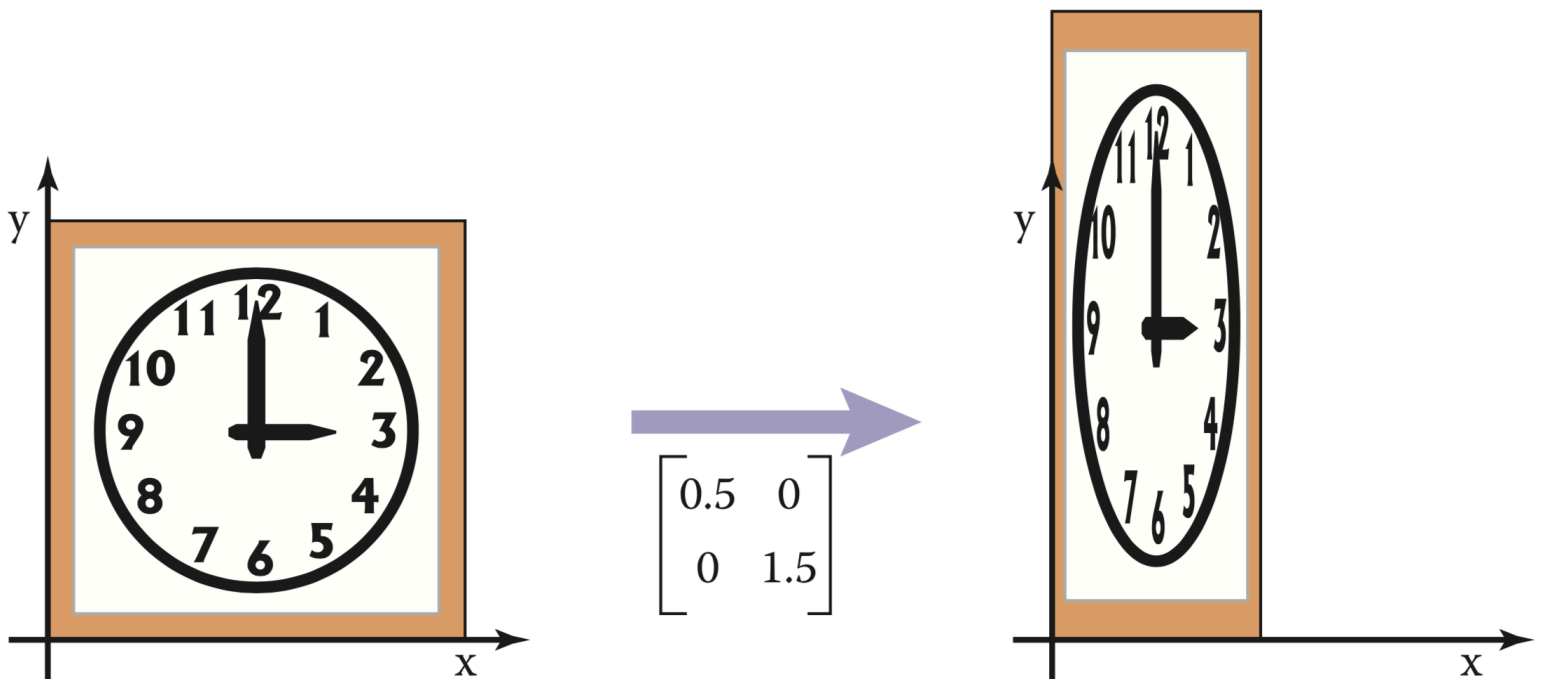
Scaling

- Let s be a constant. If we move each point (x,y) into the point $(x, y) \rightarrow (s \cdot x, \ s \cdot y)$ we scaled the image by s.
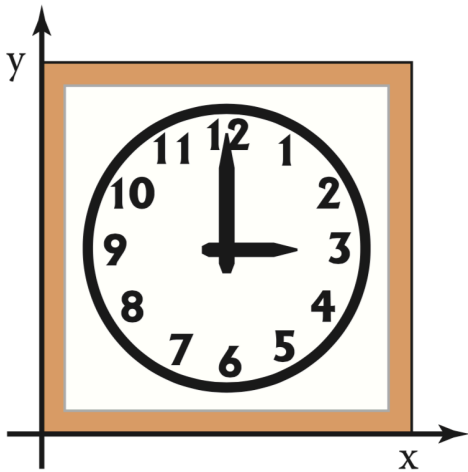
Scaling

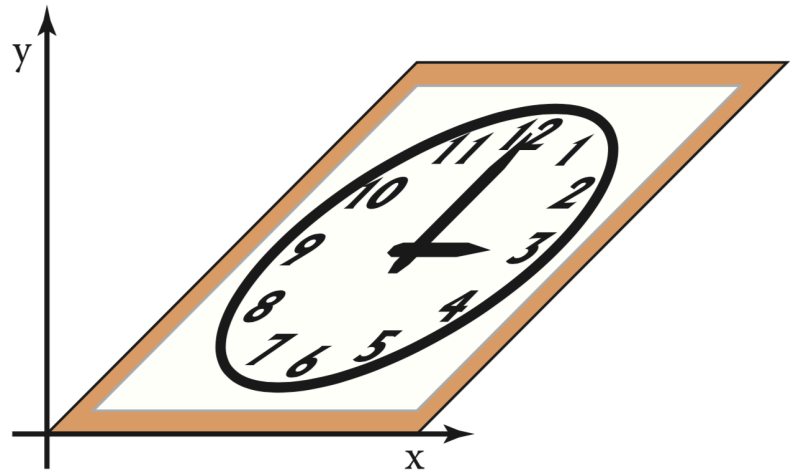- We might pick different constants to x and to y.

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$$\begin{bmatrix} 0.5 & 0 \\ 0 & 1.5 \end{bmatrix}$$

Shearing

- If we move each point (x,y) into the point
  $(x, y) \rightarrow (x + y, \; y)$ we scaled the image by s.

Shearing

- Vertical shearing shifts each column based on the x value.

$$(x, y) \to (x, \, x + y)$$
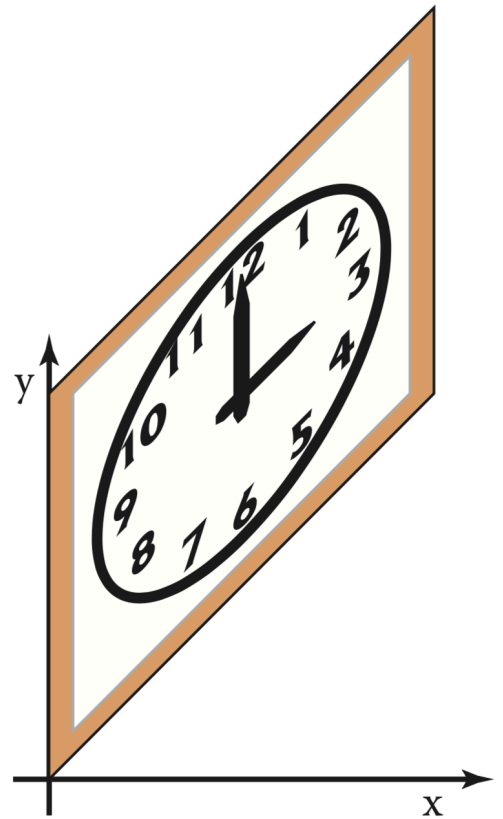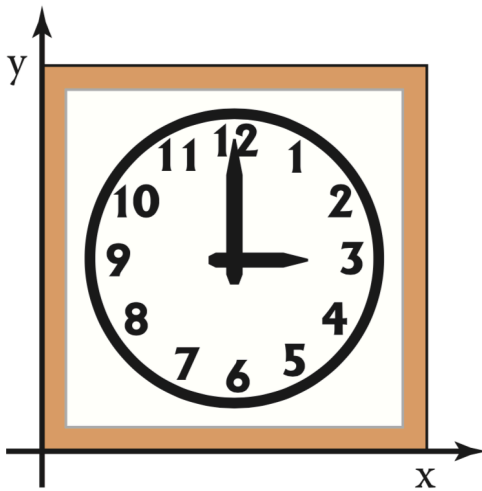
Rotation

- Rotate counterclockwise by an angle ϕ about the origin.

$$(x, y) \rightarrow (x\cos\phi + y\sin\phi, \ x\sin\phi - y\cos\phi)$$

New *x* New *y*