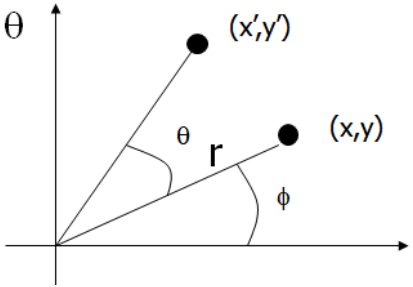
(x,y) -> Rotate *about the origin* by θ

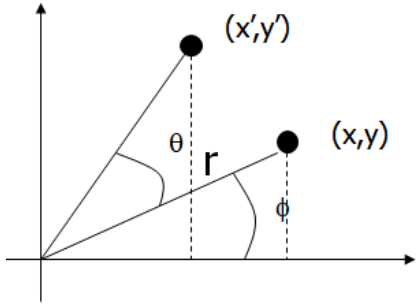
⟶ (x′, y′)

How to compute (x′, y′) ?



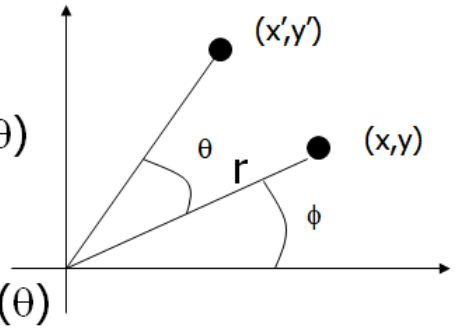
$$x = r\cos(\phi) \quad y = r\sin(\phi)$$

$$x' = r\cos(\phi+\theta) \quad y' = r\sin(\phi+\theta)$$



$x = r\cos(\phi) \quad y = r\sin(\phi)$

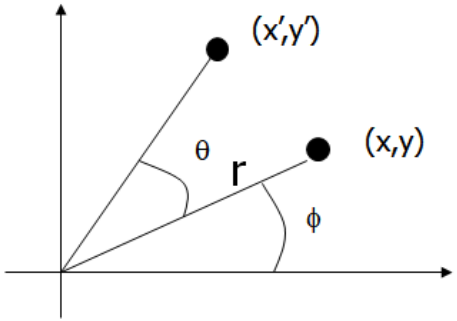
$x' = r\cos(\phi + \theta) \quad y = r\sin(\phi + \theta)$



$$x' = r\cos(\phi + \theta)$$
$$= r\cos(\phi)\cos(\theta) - r\sin(\phi)\sin(\theta)$$
$$= x\cos(\theta) - y\sin(\theta)$$

$$y' = r\sin(\phi + \theta)$$
$$= r\sin(\phi)\cos(\theta) + r\cos(\phi)\sin(\theta)$$
$$= y\cos(\theta) + x\sin(\theta)$$

$$x' = x\cos(\theta) - y\sin(\theta)$$
$$y' = y\cos(\theta) + x\sin(\theta)$$

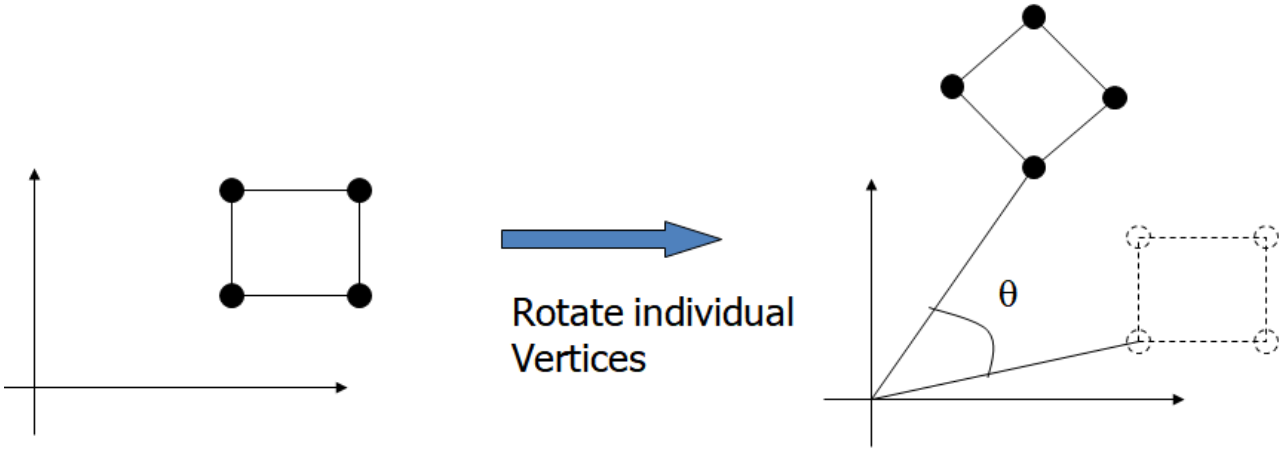


Matrix form?

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

Lecture No 21 Topic: Multiple Vertices

- How to rotate an object with multiple vertices?



2D Scaling

Scale: Alter the size of an object by a scaling factor (Sx, Sy), i.e.

$$x' = x \cdot Sx$$
$$y' = y \cdot Sy$$

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