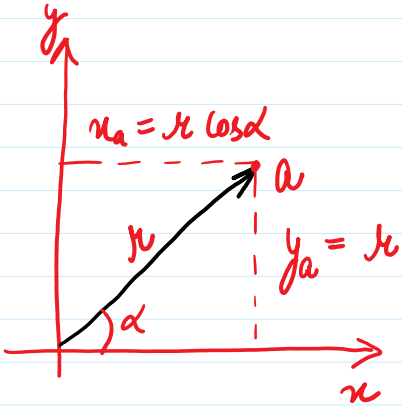
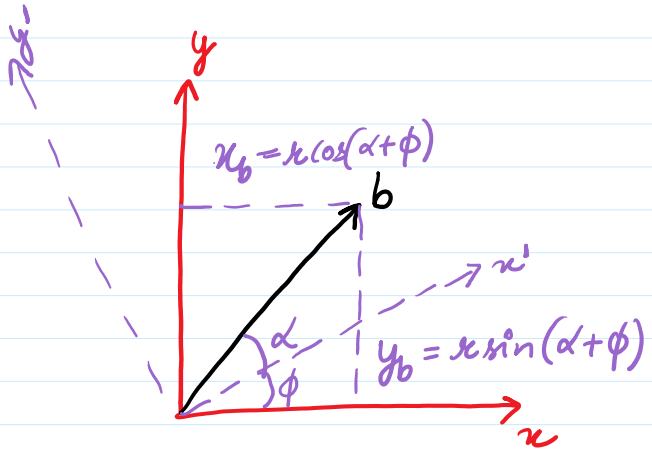
Rotation :-



$$x_a = r\cos\alpha \quad -(1)$$
$$y_a = r\sin\alpha$$



$$x_b = r\cos(\alpha+\phi) = r\cos\alpha\cos\phi - r\sin\alpha\sin\phi$$

$$y_b = r\sin(\alpha+\phi) = r\sin\alpha\cos\phi + r\cos\alpha\sin\phi$$

from eq ①

$$x_b = x_a\cos\phi - y_a\sin\phi$$

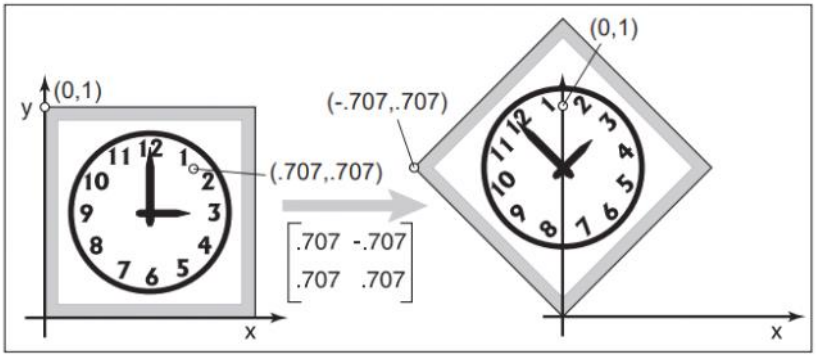
$$y_b = y_a\cos\phi + x_a\sin\phi$$

$$\begin{bmatrix}\cos\phi & -\sin\phi\\ \sin\phi & \cos\phi\end{bmatrix}\begin{bmatrix}x_a\\ y_a\end{bmatrix} = \begin{bmatrix}x_b\\ y_b\end{bmatrix}$$

⇒ Let $\phi = +45^\circ$

$$\begin{bmatrix}\cos 45^\circ & -\sin 45^\circ\end{bmatrix}$$

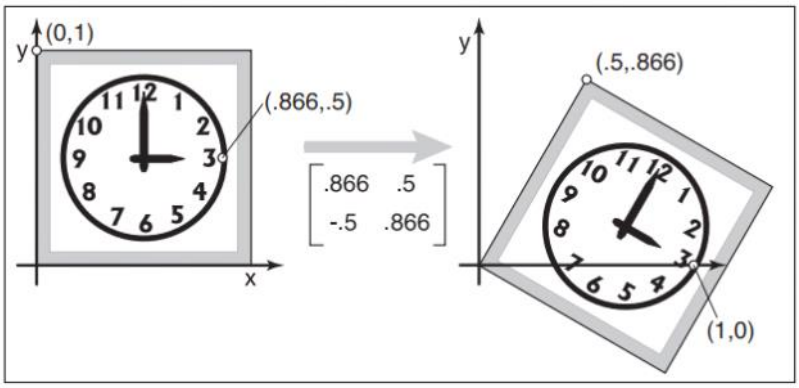
$$\begin{bmatrix} \cos 45^\circ & -\sin 45^\circ \\ \sin 45^\circ & \cos 45^\circ \end{bmatrix}$$



$\Rightarrow$ Let $\phi = -30^\circ$

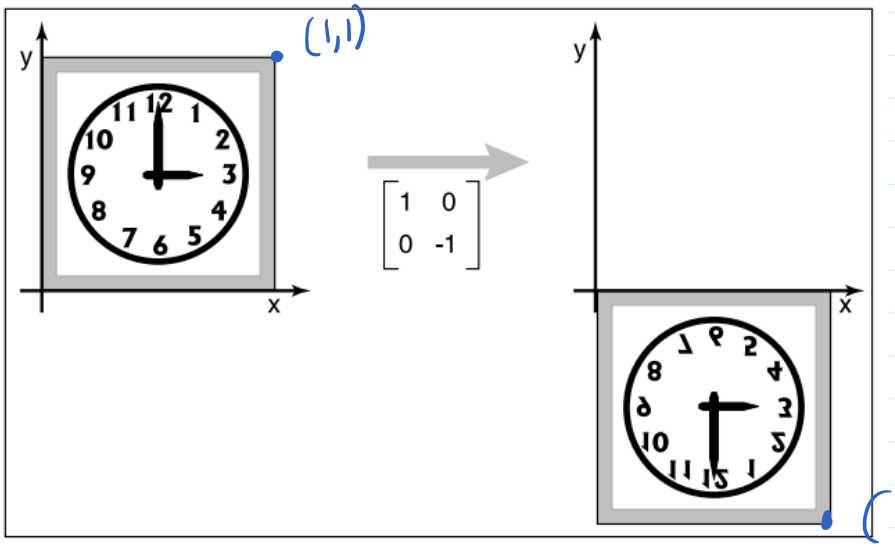
$$\begin{bmatrix} \cos(-30^\circ) & -\sin(-30^\circ) \\ \sin(-30^\circ) & \cos(-30^\circ) \end{bmatrix}$$

$$= \begin{bmatrix} \cos 30^\circ & \sin 30^\circ \\ -\sin 30^\circ & \cos 30^\circ \end{bmatrix}$$



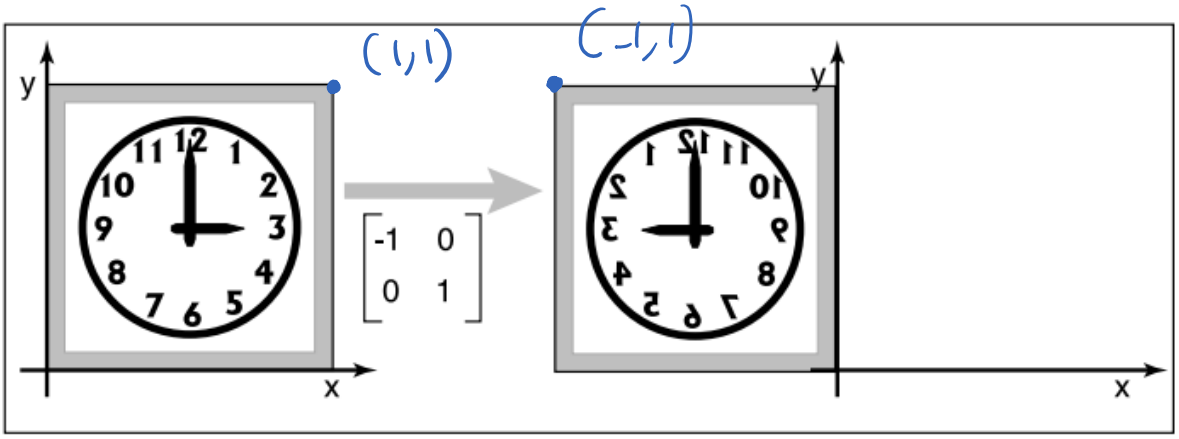
Reflection :-

About x-axis, reflect-x $= \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$



$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$$

About y-axis, reflect-y $= \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$



Compositions of Transformations :-

Applying more than one transformations.

Let R = Rotation Matrix

S = Scale Matrix

$V_1 \rightarrow SV_1 \rightarrow RV_2$

v_2 v_3

$\Rightarrow v_3 = R(S v_1)$

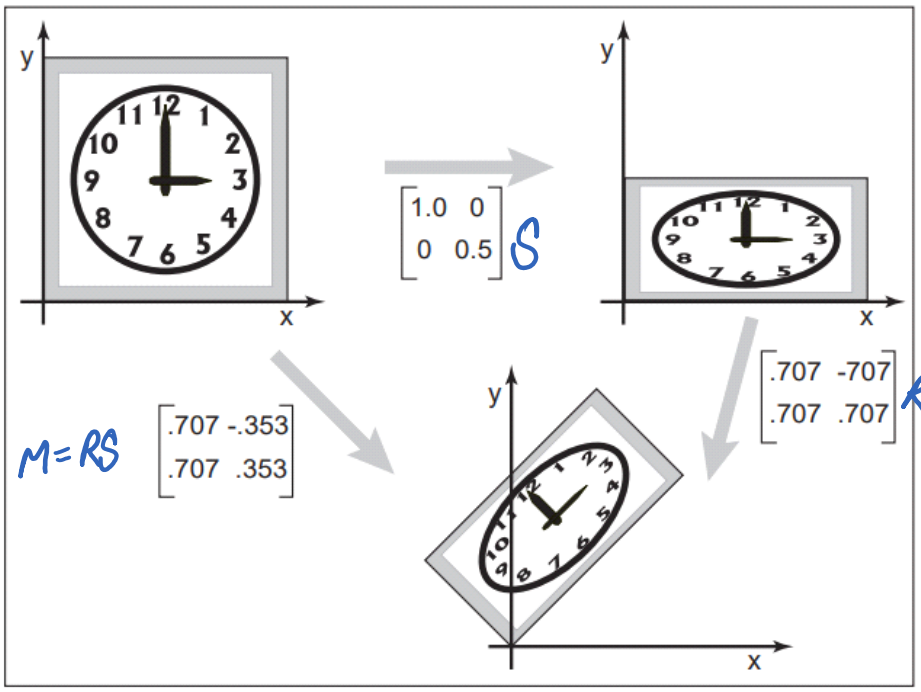
$$\boxed{v_3 = (RS)v_1}$$

$\Rightarrow M = RS$

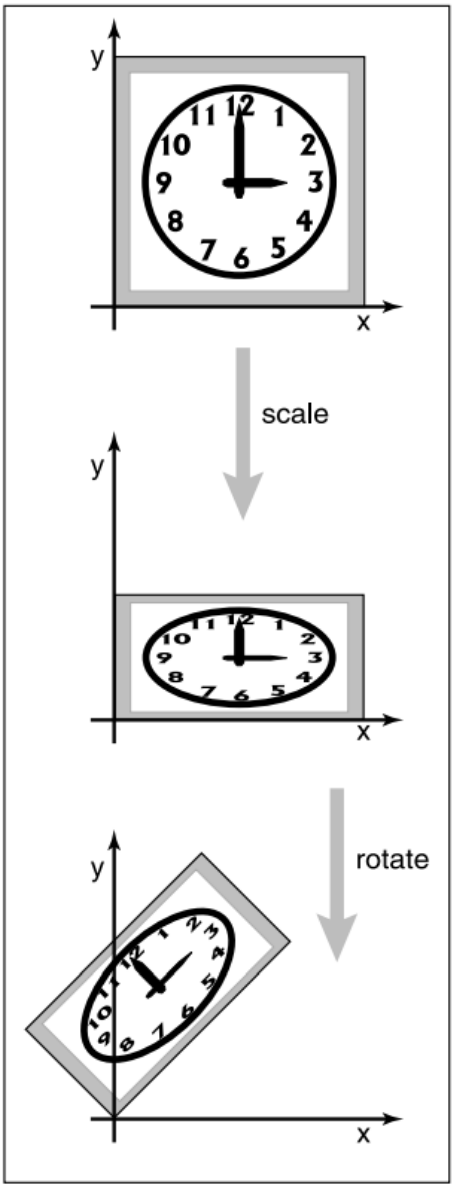
in terms of single matrix.

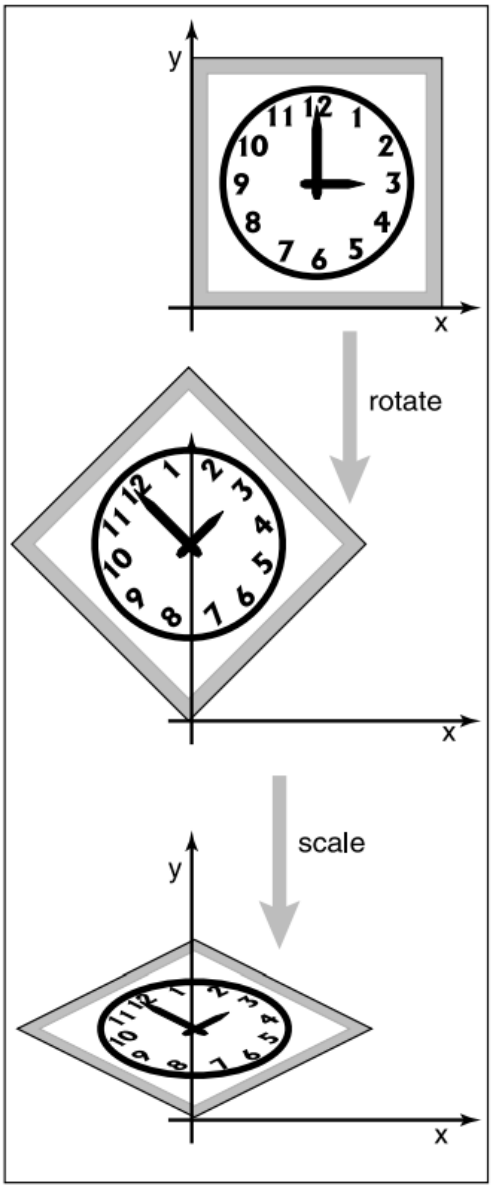
$$R = \begin{bmatrix} 1 & 0 \\ 0 & .5 \end{bmatrix}_{2\times2} \quad S = \begin{bmatrix} \cos 45^\circ & -\sin 45^\circ \\ \sin 45^\circ & \cos 45^\circ \end{bmatrix}_{2\times2}$$

$$M = RS = \begin{bmatrix} \quad \end{bmatrix}_{2\times2}$$



$RS = SR$?





"Any linear transformation can be thought of as a combination of rotation and scaling.