Hw5

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

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

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

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

$\begin{pmatrix} \cos\theta \\ \sin\theta \end{pmatrix}$ $\begin{pmatrix} -\sin\theta \\ \cos\theta \end{pmatrix}$ rotates vectors $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$

$$\theta = \frac{1}{2}\tan^{-1}\left(\frac{2\rho\sigma_x\sigma_y}{\sigma_x^2 - \sigma_y^2}\right)$$

$$= \tan^{-1}\left(\frac{y'x - x'y}{x'x + y'y}\right)$$

$$x' = x\cos\theta - y\sin\theta = x\left(\frac{y'x - x'y}{x^2+y^2}\right) - y\left(\frac{x'x + y'y}{x^2+y^2}\right)$$

$$y' = y\cos\theta + x\sin\theta = x\left(\frac{x'x + y'y}{x^2+y^2}\right) + y\left(\frac{y'x - x'y}{x^2+y^2}\right)$$