Solve the ~~least squares~~ problem

$$\min_{w} \|y_1 - H_1 w\|^2 + \|y_2 - H_2 w\|^2$$

by articulating it as a LS problem

Hint: use the following realization

$$\|x_1\|^2 + \|x_2\|^2 = \left\| \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \right\|^2$$

By using the hint above, we can write

$$\min_{w} \|y_1 - H_1 w\|^2 + \|y_2 - H_2 w\|^2$$

$$= \min_{w} \left\| \begin{bmatrix} y_1 - H_1 w \\ y_2 - H_2 w \end{bmatrix} \right\|^2$$

$$= \min_{w} \left\| \begin{bmatrix} y_1 \\ y_2 \end{bmatrix} - \begin{bmatrix} H_1 w \\ H_2 w \end{bmatrix} \right\|^2$$

$$= \min_{w} \left\| \begin{bmatrix} y_1 \\ y_2 \end{bmatrix} - \begin{bmatrix} H_1 \\ H_2 \end{bmatrix} w \right\|^2$$

Soln. is obtained using the normal equations

$$\begin{bmatrix} H_1 \\ H_2 \end{bmatrix}^* \begin{bmatrix} H_1 \\ H_2 \end{bmatrix} w = \begin{bmatrix} H_1 \\ H_2 \end{bmatrix}^* \begin{bmatrix} y_1 \\ y_2 \end{bmatrix} \Rightarrow (H_1^* H_1 + H_2^* H_2) w = H_1^* y_1 + H_2^* y_2$$