Q3:

a): $m_{w_1} = \begin{bmatrix} -1 \\ -1 \end{bmatrix}$ $m_{w_2} = \begin{bmatrix} +1 \\ +1 \end{bmatrix}$.

$mean\_diff = m_{w_1} - m_{w_2} = \begin{bmatrix} -2 \\ -2 \end{bmatrix}$

$S_{w_1} = \begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$ $S_{w_2} = \begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$.

$S_{within} = S_{w_1} + S_{w_2} = \begin{bmatrix} 4 & 0 \\ 0 & 2 \end{bmatrix}$

$S_{within}^{-1} = \frac{1}{det(S_{within})} adj(S_{within}) = \begin{bmatrix} \frac{1}{4}, & 0 \\ 0, & \frac{1}{2} \end{bmatrix}$

$w = S_{within}^{-1} \times Mean\_diff = \begin{bmatrix} \frac{1}{4}, & 0 \\ 0, & \frac{1}{2} \end{bmatrix} \times \begin{bmatrix} -2 \\ -2 \end{bmatrix} = \begin{bmatrix} -\frac{1}{2} \\ -1 \end{bmatrix}$

b): $w^T \cdot w_\perp = 0$

$\begin{bmatrix} -\frac{1}{2}, & -1 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = 0$

$x + 2y = 0$.

$w = \begin{bmatrix} x \\ y \end{bmatrix} \in \{R^2, x + 2y = 0\}$.