3. a). $x_1 = (1,1)^T$, $x_2 = (1,0)^T$

$\therefore\ w_1 + w_2 \geq 1$, $-w_1 \geq 1$

$1 - w_1 - w_2 \leq 0$, $1 + w_1 \leq 0$

$L(w, \alpha) = \frac{1}{2}(w_1^2 + w_2^2) + \alpha_1(1 - w_1 - w_2) + \alpha_2(1 + w_1)$

$d^* = \max_\alpha \min_w L(w, \alpha)$

$\frac{\partial L}{\partial w_1} = w_1 - \alpha_1 + \alpha_2 = 0$,

$\frac{\partial L}{\partial w_2} = w_2 - \alpha_1 = 0$

$\therefore\ w_1 = \alpha_1 - \alpha_2$

$w_2 = \alpha_1$

Sub w_1, w_2 into $L(w, \alpha)$.

$L(w, \alpha) = \frac{1}{2}((\alpha_1 - \alpha_2)^2 + \alpha_1^2) + \alpha_1(1 - \alpha_1 + \alpha_2 - \alpha_1) + \alpha_2(1 + \alpha_1 - \alpha_2)$

$= \frac{1}{2}(2\alpha_1^2 - 2\alpha_1\alpha_2 + \alpha_2^2) + (\alpha_1 - 2\alpha_1^2 + \alpha_1\alpha_2) + (\alpha_2 + \alpha_1\alpha_2 - \alpha_2^2)$

$\frac{\partial L}{\partial \alpha_1} = 2\alpha_1 - \alpha_2 + 1 - 4\alpha_1 + \alpha_2 + \alpha_2 = -2\alpha_1 + \alpha_2 + 1 = 0$

$\frac{\partial L}{\partial \alpha_2} = -\alpha_1 + \alpha_2 + \alpha_1 + 1 + \alpha_1 - 2\alpha_2 = \alpha_1 - \alpha_2 + 1 = 0$

$\therefore\ \alpha_1 = \frac{\alpha_2 + 1}{2}$

$\alpha_2 = \alpha_1 + 1$

$\therefore\ \alpha_1 = \frac{\alpha_1 + 2}{2}$

$\therefore\ \alpha_1 = 2$, $\alpha_2 = 3$.

Since $w_1 = \alpha_1 - \alpha_2$

$w_2 = \alpha_1$

$\therefore\ w^* = \begin{bmatrix} -1 \\ 2 \end{bmatrix}$