using the $(u-v)^T = u^T - v^T$

$$E(w) = (y - w^T x)(y - w^T x)^T$$

$x \in \mathbb{R}$

$x = x^T$

$$\Rightarrow E(w) = (y - w^T x)(y^T - w x^T)$$

$$\Rightarrow yy^T - y^T w x - y w x^T + w^T w x x^T$$

$$\Rightarrow yy^T - 2 w^T x^T y + w^T w x x^T$$

$y^T x w = (y^T x w)^T$

$\Rightarrow y w^T x^T$

$\Rightarrow y w x^T$

differentiate with respect to $\underline{w}$

$$\frac{\partial}{\partial w} E(w) = \frac{\partial}{\partial w} yy^T - 2\frac{\partial}{\partial w} w^T x^T y + \frac{\partial}{\partial w} w^T x^T x w$$

$$= 0 - 2x^T y + 2x^T x w$$

(b) By differentiating with respet to $\underline{w}$, to get the normal equation by setting the derivative equal to 0

$$-2x^T y + 2x^T x w = 0$$

$$x^T y - x^T x w = 0 \Rightarrow x^T (y - xw) = 0$$

By assuming that the x is a full coloumn rank with $x^T x$ is a nonsigular, the unique solution is $x^T y \Rightarrow x^T x w$

$$\hat{w} = (x^T x)^{-1} x^T y$$