$$C = \frac{1}{2N} \sum_{n}^{N} \| F^{n}(x^{n}, \vec{w}) - y^{(n)} \|^2$$

extrema when

$$\frac{\partial C}{\partial w_j} = 0 = \frac{1}{2N} \sum^{N} \frac{\partial}{\partial w_j} \| w^T \phi(x) - y^{(n)} \|^2$$

$$= \frac{2}{2N} \sum^{N} (w^T \phi - y) \frac{\partial}{\partial w_j} (w^T \phi - y)$$

$$= (w^T \phi - y) \phi^T = 0$$

$$w^T \phi \phi^T - y \phi^T = 0$$

$$\phi^T \phi w - y \phi^T = 0$$

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