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## - Residual

$$e_i = y_i - \hat{y}_i = y_i - w^T x_i$$

$$e = \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_n \end{bmatrix}$$

$$= \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} - \begin{bmatrix} x_1^T w \\ x_2^T w \\ \vdots \\ x_n^T w \end{bmatrix}$$

$$= y - Xw$$

$$\underline{e = y - Xw}$$

## - Residual Sum of Squares (RSS)

$$e^T e$$

$$\sum_{i=1}^N e_i^2 = \sum_{i=1}^N (y_i - w^T x_i)^2 = e^T e = (y - Xw)^T (y - Xw)$$

Practice Try to prove the below equations are same with distributive law

$$(y - Xw)^T (y - Xw) = y^T y - w^T X^T y - y^T Xw + w^T X^T Xw$$

$$(y - Xw)^T (y - Xw)$$

$$= (y^T - w^T X^T) (y - Xw) = y^T y - w^T X^T y - y^T Xw + w^T X^T Xw$$