$$\text{Loss}(B) = (Y - \hat{Y})^T (Y - \hat{Y}) \qquad \hat{Y} = \hat{B}^T X$$

$$= (Y - \hat{B}^T X)^T (Y - \hat{B}^T X)$$

$$= Y^T Y + X^T \hat{B} \hat{B}^T X - 2 X^T \hat{B} Y$$

$$\frac{\partial \text{Loss}(B)}{\partial B} = 2 X^T X \hat{B} - 2 X^T Y = 0$$

$$\Rightarrow X^T X \hat{B} = X^T Y$$

$$\Rightarrow \hat{B} = (X^T X)^{-1} X^T Y$$