



$$\begin{aligned}
 x_i' x_i &= (e_i + p_i)'(e_i + p_i) \\
 &= e_i' e_i + p_i' p_i + 2e_i' p_i
 \end{aligned}$$

$$e_i' e_i = x_i' x_i - p_i' p_i \quad \text{orthogonal}$$

$$\text{total error for } L \text{ data points} \quad \sum_{i=0}^{L-1} e_i' e_i = \sum_{i=0}^{L-1} x_i' x_i - \sum_{i=0}^{L-1} p_i' p_i$$

to minimize this error, we need to maximize

$$\sum_{i=0}^{L-1} p_i' p_i$$