$$L = \| \hat{A} \cdot \vec{x} - \vec{b} \|_2$$

$$= \sqrt{(A \cdot x - b)(A \cdot x - b)}$$

$\vec{x}$, $\hat{A}$, $\vec{b}$ → $\vec{c} = \hat{A} \cdot \vec{x}$ → $\vec{d} = \vec{c} - \vec{b}$ → $e = \vec{d} \cdot \vec{d}$ → $L = \sqrt{e}$

$$\vec{x} = \hat{A}^T \cdot \vec{c}$$

$$\hat{A} = \vec{c} \cdot \vec{x}^T$$

$$\frac{\partial P}{\partial e} = \frac{\partial P}{\partial L} \cdot \frac{\partial L}{\partial e}$$

$$\frac{\partial P}{\partial \vec{d}} = \frac{\partial P}{\partial L} \cdot \frac{\partial L}{\partial \vec{d}} = \frac{\partial P}{\partial L} \cdot 2\vec{d}$$

$$\frac{\partial P}{\partial \vec{b}} = \frac{\partial P}{\partial \vec{d}} \cdot \frac{\partial \vec{d}}{\partial \vec{b}} = \frac{\partial P}{\partial \vec{d}} \cdot (-1) \cdot \vec{1}$$

$$\frac{\partial P}{\partial \vec{c}} = \frac{\partial P}{\partial \vec{d}} \cdot \frac{\partial \vec{d}}{\partial \vec{c}} = \frac{\partial P}{\partial \vec{d}} \cdot \vec{1}$$

$$\frac{\partial P}{\partial \hat{A}} = \frac{\partial P}{\partial \vec{c}} \cdot \frac{\partial \vec{c}}{\partial \hat{A}} = \frac{\partial P}{\partial \vec{c}} \cdot \vec{x}^T$$

$$\frac{\partial P}{\partial \vec{x}} = \frac{\partial P}{\partial \vec{c}} \cdot \frac{\partial \vec{c}}{\partial \vec{x}} = \hat{A}^T \cdot \frac{\partial P}{\partial \vec{c}}$$