

$$\vec{p} = A (A^T A)^{-1} A^T \cdot b$$

Projection matrix

Q - $b = \begin{bmatrix} 3 \\ 4 \end{bmatrix}$ $a = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$

$$A^T A = \begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \end{bmatrix} = 1+4 = 5$$

$$A (A^T A)^{-1} = \begin{bmatrix} 1 \\ 2 \end{bmatrix} \frac{1}{5} = \begin{bmatrix} \frac{1}{5} \\ \frac{2}{5} \end{bmatrix}$$

$$A A^T = \begin{bmatrix} 1 \\ 2 \end{bmatrix} \begin{bmatrix} 1 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$$

$$\vec{p} = \frac{A A^T}{A^T A} \cdot b$$

$$p = \frac{\begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}}{5}$$

projection matrix of a

$$p = \begin{bmatrix} 0.2 & 0.4 \\ 0.4 & 0.8 \end{bmatrix} \begin{bmatrix} 3 \\ 4 \end{bmatrix}$$

$$p = \begin{bmatrix} 2.2 \\ 4.4 \end{bmatrix}$$

→ projection of b onto a

u to be subspace of unit length \vec{x}

$$p = \text{projected point of } \vec{x} = \text{proj}(u) \cdot \vec{x}$$

$$= \frac{u u^T}{u^T u} \cdot \vec{x}$$

$$= (\vec{x} u) u^T$$