Step-1

Suppose $AA^T = A^T A \ \hat{a} \in \hat{a} \in \hat{a} \in (1)$

The length of Ax is ||Ax|| where the norm is a non negative quantity. $\hat{a} \in |\hat{a} \in Ax|$

By definition, we have $||Ax||^2 = (Ax)^T (Ax)$

$$= x^T \left(A^T A \right) x$$

$$= x^T A A^T x \text{ By } (1)$$

$$= \left(A^T x\right)^T \left(A^T x\right)$$

$$= \left\| A^T x \right\|^2$$

In view of (2), we can write this equation as $||Ax|| = ||A^Tx||$

In other words, the length of $Ax = \text{length of } A^Tx \text{ when } AA^T = A^TA$