Step-1

Suppose $AA^T = A^T A$ â€¦â€¦ (1)

The length of Ax is $\|Ax\|$ where the norm is a non negative quantity. â€¦â€¦ (2)

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

$= x^T (A^T A) x$

$= x^T AA^T x$ By (1)

$= (A^T x)^T (A^T x)$

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

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

In other words, the length of Ax = length of $A^T x$ when $AA^T = A^T A$