

Step-1

Given that if A has independent columns, and then $A^T A$ is square and symmetric and invertible.

So,

$$\begin{aligned} x^T A^T A x &= (Ax)^T (Ax) \\ &= \text{length squared} \end{aligned}$$

So, $x^T A^T A x = 0$ only if $Ax = 0$

Step-2

Given that A have independent columns

So, $Ax = 0$ only when $x = 0$

Therefore, $A^T A$ is positive definite.