

## Step-1

(a) If  $P = P^T P$ , we have to prove that  $P$  is a projection matrix.

For this we need to prove that  $P^2 = P$ ,  $P^T = P$

$$\begin{aligned} P^T &= (P^T P)^T \\ &= P^T (P^T)^T \\ &= P^T P \\ &= P \end{aligned}$$

## Step-2

And

$$\begin{aligned} P &= P^T P \\ &= PP, \text{ since } P^T = P \\ &= P^2 \end{aligned}$$

Therefore  $P^2 = P$ ,  $P^T = P$

Hence  $P$  is a projection matrix.

## Step-3

(b) We have to find that what subspace the matrix  $P = 0$  project onto.

The matrix  $P$  projects onto the subspace  $Z = \{0\}$

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