Exercises on projections onto subspaces

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15.1

$$P = A(A^TA)^{-1}A^T = \begin{bmatrix}100\\010\\001\\000\end{bmatrix}\begin{bmatrix}100\\010\\001\end{bmatrix}\begin{bmatrix}1000\\0100\\0010\end{bmatrix} = \begin{bmatrix}1000\\0100\\0010\\0000\end{bmatrix}.$$

It is a 4 by 4 matrix.

15.2

$(I-P)^2 = I^2 + P^2 - 2IP = I + P - 2P = I - P$

P projects onto the column space of A and from $I - P = \begin{bmatrix}0000\\0000\\0000\\0001\end{bmatrix}$, we can see that $I - P$ projects onto the left nullspace of A.