

ENGR222 Assignment 6

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2. Suppose S is the subspace in \mathbb{R}^4 is spanned by $\begin{pmatrix} 1 \\ 1 \\ 1 \\ 1 \end{pmatrix}, \begin{pmatrix} 1 \\ 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 0 \\ 1 \\ 1 \end{pmatrix}$.

Find the point P closest to $\begin{pmatrix} 1 \\ 3 \\ 8 \\ 2 \end{pmatrix}$ (i.e. orthogonal projection).

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For $A = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 1 & 0 & 1 \end{pmatrix} v = \begin{pmatrix} 1 \\ 3 \\ 8 \\ 2 \end{pmatrix}$

$x = A^t \cdot v$

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A = Matrix([ [1,1,0], [1,1,0], [1,0,1], [1,0,1] ])
v = Matrix([1,3,8,2])
x = A.pinv()*v
A*x
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$x = \begin{pmatrix} \frac{7}{3} \\ -\frac{1}{3} \\ \frac{8}{3} \\ \frac{5}{3} \end{pmatrix}, Ax = \begin{pmatrix} 2 \\ 2 \\ 5 \\ 5 \end{pmatrix}$

5. Let $T : \mathbb{R}^2 \rightarrow \mathbb{R}^3$ is the linear transformation whose matrix is $A = \begin{pmatrix} 7 & 1 \\ 0 & 0 \\ 5 & 5 \end{pmatrix}$.

The image of the circle of radius 1 with centre at $(0,0)$ under T is an ellipse with the centre at $(0,0,0)$.

Find the points on this ellipse farthest from $(0,0,0)$ and the points closest to $(0,0,0)$.

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$U = \begin{pmatrix} \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} & 0 \\ 0 & 0 & 1 \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 0 \end{pmatrix}, D = \begin{pmatrix} 3\sqrt{10} & 0 \\ 0 & \sqrt{10} \\ 0 & 0 \end{pmatrix}, V = \begin{pmatrix} \frac{2}{\sqrt{5}} & -\frac{1}{\sqrt{5}} \\ \frac{1}{\sqrt{5}} & \frac{2}{\sqrt{5}} \end{pmatrix}$

Farthest point to $(0,0,0) \rightarrow \pm 3\sqrt{10}U_1 = \begin{pmatrix} 3\sqrt{5} \\ 0 \\ 3\sqrt{5} \end{pmatrix}$

Closest point to $(0,0,0) \rightarrow \pm \sqrt{10}U_2 = \begin{pmatrix} -\sqrt{5} \\ 0 \\ \sqrt{5} \end{pmatrix}$