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Activity 2

1) A) ex $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ $A^T = \begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix}$ $A^{T^T} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

B) $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ $B = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$

$A^T = \begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix}$ $B^T = \begin{bmatrix} 5 & 7 \\ 6 & 8 \end{bmatrix}$ $A+B = \begin{bmatrix} 6 & 8 \\ 10 & 12 \end{bmatrix}$ $(A+B)^T = \begin{bmatrix} 6 & 10 \\ 8 & 12 \end{bmatrix}$

$A^T + B^T = \begin{bmatrix} 6 & 10 \\ 8 & 12 \end{bmatrix}$ //

c) Because in a transpose a_{ij} becomes a_{ji}
when we add a_{ij} and a_{ji}, they become the same number
making the sum symmetric and a_{ji} and a_{ij}

ex $(A^T)^T = A$ $(A+B)^T = A^T + B^T$ $B = A^T$

$A + A^T = (A+B)^T = A^T + A^{T^T} = A^T + A = A + A^T$
if A is symm A^T is symmetric

d) $DD^T = (DD^T)^T = D^{T^T} D^T = D^T D = DD^T$

e) $A = A^T$ $B = B^T$ $\rightarrow$ $A + B = (A+B)^T$
$C^T = (A+B)^T = A^T + B^T$ By give A and B are symm
$A^T + B^T = A + B$
$C^T = A + B$ $C = A + B$ therefore C is symmetric if
A and B are

2) A) $x = \begin{bmatrix}5 & 0\\0 & 4\end{bmatrix}$ $\quad w = \begin{bmatrix}w_1\\w_2\end{bmatrix}$ $\quad w^T \cdot x + b = 0$

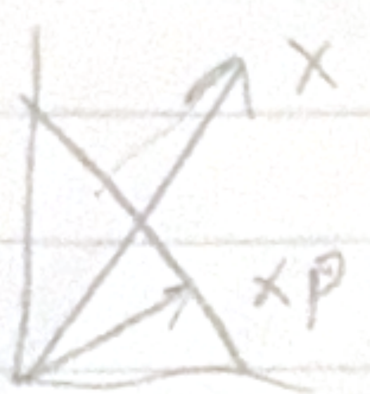
$$[w_1 \ w_2]\begin{bmatrix}5 & 0\\0 & 4\end{bmatrix} + b = 0$$

$$\begin{bmatrix}5w_1 + b\\4w_2 + b\end{bmatrix} = 0 \qquad \begin{bmatrix}5w_1\\4w_2\end{bmatrix} + b = 0$$

$b = -5w_1 \qquad 5w_1 = 4w_2 \qquad \sqrt{w_1^2 + w_2^2} = 1$

$b = -4w_2 \qquad w_1 = \frac{4}{5}w_2 \qquad w_1 = \frac{4\sqrt{41}}{41} \qquad w_2 = \frac{5\sqrt{41}}{41}$

$b = -\frac{20\sqrt{41}}{41}$

B) 

$x - x_p$ is a vector on the hyperplane which we project onto w to find the ortogonal distance

$w^T x_p + b = 0$

$$r = \frac{|(x - x_p)^T w|}{||w||} = \frac{|x^T w + b|}{||w||}$$

$(x - x_p)^T w = x^T w - x_p^T w$
$= x^T w - w^T x_p = x^T w - -b$

C) x is @ 0 so $w^T x = 0$ by the dist formula

$$r = \frac{|w^T x + b|}{||w||} = |b|$$

D) $c = \begin{bmatrix}4.5\\3\end{bmatrix}$ $\quad r = \frac{\left|[w_1 \ w_2]\begin{bmatrix}4.5\\3\end{bmatrix} + b\right|}{1} = \frac{33}{\sqrt{41}} + \frac{-20}{\sqrt{41}}$

$= 13/\sqrt{41}$

It is positive so that means the point is on the upper or positive side of the hyperplane