ECE 532 – Period 1 Activity

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1) $x = \begin{bmatrix} 1 \\ b \\ 3 \end{bmatrix} \quad w = \begin{bmatrix} c \\ 4 \\ d \end{bmatrix}$

Thus, $x^T = [1 \; b \; 3]$

$w^T = [c \; 4 \; d]$

a) $x^T w = [1 \; b \; 3] \begin{bmatrix} c \\ 4 \\ d \end{bmatrix} = 1 \times c + b \times 4 + 3 \times d$

$= c + 4b + 3d$

b) $w^T x = [c \; 4 \; d] \begin{bmatrix} 1 \\ b \\ 3 \end{bmatrix} = c \times 1 + 4 \times b + d \times 3$

$= c + 4b + 3d$

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2) $y = 2(x-1)^2$

$= 2(x^2 - 2x + 1)$

$= 2x^2 - 4x + 2$

a) $x^T = [x^2 \quad x \quad 1] \quad w = \begin{bmatrix} 2 \\ -4 \\ 2 \end{bmatrix}$

$x = \begin{bmatrix} x^2 \\ x \\ 1 \end{bmatrix} \quad w = \begin{bmatrix} 2 \\ -4 \\ 2 \end{bmatrix} \Rightarrow y = \begin{bmatrix} x^2 \\ x \\ 1 \end{bmatrix}^T \begin{bmatrix} 2 \\ -4 \\ 2 \end{bmatrix}$

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b) $w = \begin{bmatrix} 2 \\ -4 \\ 2 \end{bmatrix}$ & $y_1 = 2x_1^2 - 4x_1 + 2$

$\vdots$

$y_5 = 2x_5^2 - 4x_5 + 2$

$$y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{bmatrix} = \begin{bmatrix} (2x_1^2 - 4x_1 + 2) \\ (2x_2^2 - 4x_2 + 2) \\ (2x_3^2 - 4x_3 + 2) \\ (2x_4^2 - 4x_4 + 2) \\ (2x_5^2 - 4x_5 + 2) \end{bmatrix} = Xw$$

from y & w, we can define X

$$X = \begin{bmatrix} x_1^2 & x_1 & 1 \\ x_2^2 & x_2 & 1 \\ x_3^2 & x_3 & 1 \\ x_4^2 & x_4 & 1 \\ x_5^2 & x_5 & 1 \end{bmatrix}$$

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3a) Since $x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$, where x_1 is the number of grams of fat, x_2 is the number of grams of protein & x_3 is the number of grams of carbs.

We can define $w = \begin{bmatrix} 9 \\ 4 \\ 4 \end{bmatrix}$ so that each index corresponds to each food component in the inner product.

b) $y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix}$ is given $\quad w = \begin{bmatrix} 9 \\ 4 \\ 4 \end{bmatrix}$ as before

Cereal data forms the X matrix

$$X = \begin{array}{c} \text{fat} \quad \text{protein} \quad \text{carbs} \\ \begin{bmatrix} 1 & 8 & 44 \\ 0.5 & 2 & 25 \\ 1.3 & 2.7 & 29.3 \\ 9 & 4 & 16 \end{bmatrix} \end{array}$$

Thus, $y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} = \begin{bmatrix} 1 & 8 & 44 \\ 0.5 & 2 & 25 \\ 1.3 & 2.7 & 29.3 \\ 9 & 4 & 16 \end{bmatrix} \begin{bmatrix} 9 \\ 4 \\ 4 \end{bmatrix} = \begin{bmatrix} 217 \\ 112.5 \\ 139.7 \\ 161 \end{bmatrix}$

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