

Activity 1 Inner Products & Functions

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

$$a.) \quad \overset{1 \times 3}{\underline{x}^T} \overset{3 \times 1}{\underline{w}} = \begin{bmatrix} 1 & b & 3 \end{bmatrix} \begin{bmatrix} c \\ 4 \\ d \end{bmatrix} = (1 \cdot c + 4 \cdot b + 3 \cdot d)$$

$$= \boxed{c + 4b + 3d}$$

$$b.) \quad \overset{3 \times 1}{\underline{w}^T} \overset{1 \times 3}{\underline{x}} = \begin{bmatrix} c & 4 & d \end{bmatrix} \begin{bmatrix} 1 \\ b \\ 3 \end{bmatrix} = (1 \cdot c + 4 \cdot b + 3 \cdot d)$$

$$= \boxed{c + 4b + 3d}$$

$$2.) \quad y = 2(x-1)^2 = 2(x-1)(x-1) = 2(x^2 - 2x + 1)$$

$$a.) \quad y = 2x^2 - 4x + 2$$

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

$$\rightarrow \begin{bmatrix} \underline{x}^T = \begin{bmatrix} x^2 & x & 1 \end{bmatrix} \\ \underline{w} = \begin{bmatrix} 2 & -4 & 2 \end{bmatrix} \end{bmatrix}$$

$$b.) \quad y_i = 2(x_i - 1)^2, \quad i = 1, 2, \dots, 5$$

$$\underline{y} = \overset{5 \times 1}{\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{bmatrix}} = \underline{X} \underline{w} = \overset{5 \times 3}{\begin{bmatrix} x_1^2 & x_1 & 1 \\ x_2^2 & x_2 & 1 \\ x_3^2 & x_3 & 1 \\ x_4^2 & x_4 & 1 \\ x_5^2 & x_5 & 1 \end{bmatrix}} \overset{3 \times 1}{\begin{bmatrix} 2 \\ -4 \\ 2 \end{bmatrix}}$$

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Activity 1 cont'd

3.) a.) $\underline{x} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ $\begin{matrix} \leftarrow \text{fat} \\ \leftarrow \text{protein} \\ \leftarrow \text{carbs} \end{matrix}$

$\begin{bmatrix} x_1 & x_2 & x_3 \end{bmatrix} \begin{bmatrix} 9 \\ 4 \\ 4 \end{bmatrix}$ $\swarrow \underline{w}$

b.) $\underline{y} = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} = \underline{x} \underline{w}$

4×1		3x 4×3		3×1
$\underline{y} \uparrow$	$=$	$\underline{x} \uparrow$		$\underline{w} \uparrow$
$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix}$		$\begin{bmatrix} 1 & 8 & 44 \\ 0.5 & 2 & 25 \\ 1.3 & 2.7 & 29.3 \\ 9 & 4 & 16 \end{bmatrix}$		$\begin{bmatrix} 9 \\ 4 \\ 4 \end{bmatrix}$