

CS/ECE/ME532 Activity 1

Note: Please include the names of all the classmates with whom you have collaborated on this activity in your submission.

1) Let $\mathbf{x} = \begin{bmatrix} 1 \\ b \\ 3 \end{bmatrix}$ and $\mathbf{w} = \begin{bmatrix} c \\ 4 \\ d \end{bmatrix}$.

- a) Write out and evaluate the inner product $\mathbf{x}^T \mathbf{w}$.
- b) Now write out and evaluate the inner product $\mathbf{w}^T \mathbf{x}$.

2) Consider the second-order polynomial $y = 2(x - 1)^2$.

- a) Write y as the inner product of a vector \mathbf{x} that depends on the value x and a vector \mathbf{w} containing the polynomial coefficients. That is, write $y = \mathbf{x}^T \mathbf{w}$. Define \mathbf{x} and \mathbf{w} .

- b) Suppose you have five (arbitrary) values $y_i = 2(x_i - 1)^2$, $i = 1, 2, \dots, 5$. Write

the vector $\mathbf{y} = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_5 \end{bmatrix} = \mathbf{X} \mathbf{w}$ and define the matrix \mathbf{X} in terms of the x_i .

- 3) Food involves fats, proteins and carbohydrates. There are 9 calories for every gram of fat, 4 calories for every gram of protein, and 4 calories for every gram of carbohydrates.

- a) Define a vector $\mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ where x_1 is the number of grams of fat, x_2 is the number of grams of protein, and x_3 is the number of grams of carbohydrate in a serving. Find the vector \mathbf{w} so that the number of calories in a serving may be expressed as $\mathbf{x}^T \mathbf{w}$.

- b) Write the calories per serving of four breakfast cereals in a vector $\mathbf{y} = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix}$ as a product of a matrix \mathbf{X} and vector \mathbf{w} (that is, $\mathbf{y} = \mathbf{X}\mathbf{w}$). y_i is the number of calories per serving in cereal i where each cereal has the following data per serving:

Cereal 1: 1 gram fat, 8 grams protein, 44 grams carbohydrate

Cereal 2: 0.5 grams fat, 2 grams protein, 25 grams carbohydrate

Cereal 3: 1.3 grams fat, 2.7 grams protein, 29.3 grams carbohydrate

Cereal 4: 9 grams fat, 4 grams protein, 16 grams carbohydrate

Identify both \mathbf{X} and \mathbf{w} .