

# Python Questions on Machine Learning Concepts

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## Question 1: Multivariate Linear Regression

Consider a dataset where the electricity usage of a building is influenced by two features: outside temperature  $T$  and number of people inside  $P$ . The data is given as follows:

$$\Phi = \begin{bmatrix} 1 & 10 & 4 \\ 1 & 8 & 25 \\ 1 & 5 & 40 \\ 1 & 2 & 38 \end{bmatrix}, \quad Y = \begin{bmatrix} 9 \\ 32 \\ 61 \\ 70 \end{bmatrix}$$

Implement multivariate linear regression using the `**normal equation**`:

$$W = (\Phi^T \Phi)^{-1} \Phi^T Y$$

Find the weight vector  $W$  using Python.

## Question 2: Polynomial Regression

Given the following dataset:

$$X = \begin{bmatrix} 0 \\ 1 \\ 2 \\ 3 \end{bmatrix}, \quad Y = \begin{bmatrix} -6 \\ -4 \\ -20 \\ 0 \end{bmatrix}$$

Fit a polynomial regression model of degree 3 using Python and obtain the polynomial equation.

## Question 3: Expected Value Calculation

Suppose there is a 20% chance of 1 inch of rain, a 70% chance of 2 inches of rain, and a 10% chance of 3 inches of rain. Compute the expected value of rainfall using Python.

### Question 4: Covariance Computation

The stock values of two companies over the years are given below:

$$X = \begin{bmatrix} 1245 \\ 1415 \\ 1312 \\ 1427 \\ 1510 \\ 1590 \end{bmatrix}, \quad Y = \begin{bmatrix} 100 \\ 123 \\ 129 \\ 143 \\ 150 \\ 197 \end{bmatrix}$$

Compute the `**covariance**` between  $X$  and  $Y$  using Python.