CS 1678/2078 Homework 2

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Written Responses (Part 1)

Given that $f_*(x) = 6x + 4\cos(3x+2) - x^2 + 10\ln(\frac{|x|}{10} + 1) + 7$, find the following:

Problem 1

In this part, I will need to find $\phi(x) = [?]^T$: Based on the given function and in order,

$$\phi(x) = \begin{bmatrix} x & cos(3x+2) & x^2 & \ln(\frac{|x|}{10}+1) & 1 \end{bmatrix}^T$$

Problem 2

In this part i will need to find the optimal weights that corresponds to the features in part 1:

$$w^* = \begin{bmatrix} 6 & 4 & -1 & 10 & 7 \end{bmatrix}^T$$

Problem 3

In this part, i will need to evaluate the same requirements for part 1 and 2 but for the following function:

$f_*(x) = 6x * 4\cos(3x+2) * x^2 * 10\ln(\frac{|x|}{10} + 1) * 7$.

The relationship between features in this case is multiplicative and not additive. Mathematically, i can apply a trick by using the natural log on $f_*(x)$ and this will convert the relationship between features into additive relationship:

$\ln f_*(x) = \ln(6x * 4\cos(3x+2) * x^2 * 10\ln(\frac{|x|}{10} + 1) * 7)$

$\ln f_*(x) = \ln(6x) + \ln(4cos(3x+2)) + \ln(x^2) + \ln(10\ln(\frac{|x|}{10} + 1)) + ln(7)$

$\ln f_*(x) = \ln(6) + \ln(x) + \ln(4) + \ln(cos(3x+2)) + \ln(x^2) + \ln(10) + \ln\ln(\frac{|x|}{10} + 1) + \ln(7)$

According to this and in order:

$\phi(x) = \begin{bmatrix} 1 & \ln(x) & 1 & \ln(cos(3x+2)) & \ln(x^2) & 1 & \ln\ln(\frac{|x|}{10} + 1) & 1 \end{bmatrix}^T$

And

$w^* = \begin{bmatrix} \ln(6) & 1 & \ln(4) & 1 & 1 & \ln(10) & 1 & \ln(7) \end{bmatrix}^T$