Task 6

- Registration/Referral id : SIRSS2213
- Full name : Yashraj Deepak Bharambe

Q1. Calculate/ derive the gradients used to update the parameters in cost function optimization for simple linear regression.

The equation for simple regression is y= $a1 * x + a0$

we know that cost or error(e) = $y \wedge - y$

for n data points:

$$f(a) = \frac{1}{n}\sum_{i=1}^{n} (y^\wedge - y)^2$$

$$f(a) = \frac{1}{n}\sum_{i=1}^{n} (y^\wedge - (a1 * x + a0))^2$$

α= learning rate or the size of the step we take towards finding the optimal fit line

$\frac{df(a)}{da0}$ *partial derivative of* $f(a)$ *w.r.t* $a0$ *will give the value of parameter* $a0$

$$a0 = \frac{2}{n}\sum_{i=1}^{n} \left(y^\wedge - (a1 * x + a0)\right)$$

$\frac{df(a)}{da1}$ *partial derivative of* $f(a)$ *w.r.t* $a1$ *will give the value of parameter* $a1$

$$a1 = \frac{2}{n}\sum_{i=1}^{n} x\left(y^\wedge - (a1 * x + a0)\right)$$

New $a0$= $a0 - a0 * \alpha$

New $a1$= $a1 - a1 * \alpha$

Q2. What does the sign of gradient say about the relationship between the parameters and cost function?

The cost function is a function of the parameters and when the sign is positive then the step will decrease as seen below:

New $a0$= $a0 - [+ve\ gradient] * \alpha$

when the sign is negative then the step will increase as seen below:

New $a0$= $a0 - [-ve\ gradient] * \alpha$

New $a0$= $a0 + [\ gradient] * \alpha$

Q3. Why Mean squared error is taken as the cost function for regression problems.

MSE or Mean Squared Error is used to check how close predictions made by the model are to actual values. It calculates the error as actual - prediction and squares the difference to eliminate the negative values. The lower the MSE, the closer is prediction to actual. In Regression models, a lower MSE usually indicates a better fit.

Q4. What is the effect of learning rate on optimization, discuss all the cases?

In an ideal scenario with an optimal learning rate, the cost function value will be minimized rather quickly.

If we take a large learning rate then the cost function value will be minimized very quickly but will settle at a value that is not the lowest.

If we take a lower than optimal learning rate, then even after substantial iterations the cost function will not minimize sufficiently and will take longer time.