Assignment no 3
Weightage 5
Attendance: 4 credit hours
Deadline: 5th May
Topic: Numerical Optimization (Gradient Descent Method)
Instructor: Ms. Amber Shaikh
What should be submitted: All Submission must contain all the required plots and tables with working of each iteration mentioned in red color text below.

CLO2

Task

You will have to find the values of variables to minimize the function made by the following procedure.

1- Take 10 points of a data x and y (Generate it from numpy library of python using following command)

x = np.random.rand(10, 1)
y = 2 * x + np.random.randn(10, 1)

you can use other methods too but make it sure that linear correlation between x and y exists.

2- Let $h_\theta(x) = \sum_{j=0}^{j=1} \theta_j \, x_j$, where $x_0 = 1$

3- Make a function

$J(\theta_0, \theta_1) = \frac{1}{2m} \sum_{i=1}^{i=m} (h_{\theta_0,\theta_1}(x_{1i}) - y_i)^2)$,

Where m is the number of data points and each data points can be read as $((x_{1i}, y_i)$

For i=1,2,3…..m

4- Congragulations! you have made a convex function of two variables $\theta_0 and\ \theta_1$.

Kindly search what is a convex function. Write definition, an example equation and a picture of a convex function.

5- Now with the help of following tutorials understand gradient descent algorithm.

Your objective is to find the values of θ_0, θ_1 for which value of J will be minimum

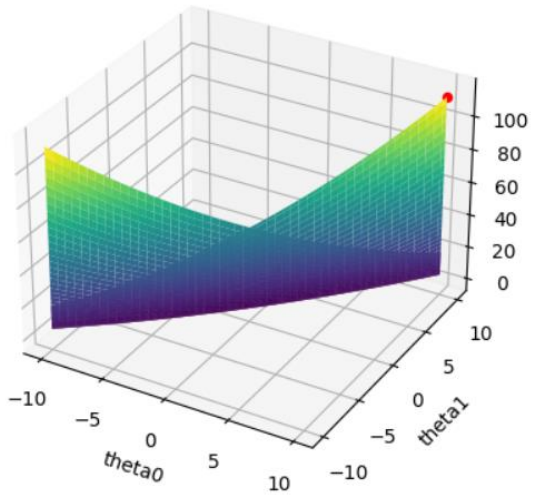
Gradient Descent is an iterative procedure in which you will update θ_0, θ_1 to get a better minimum J. Stopping criteria of procedure will be decided from knowledge obtained by tutorial.

Tutorial no 1: https://www.youtube.com/watch?v=vsWrXfO3wWw&t=7s
Tutorial no 2: https://www.youtube.com/watch?v=4b4MUYve_U8
Tutorial no 3: https://www.youtube.com/watch?v=AeRwohPuUHQ

6- What should be submitted

a) Plot of $J(\theta_0, \theta_1)$on python with a point specifying value of J at initially taken $\theta_0\ and\ \theta_1$.

b) A table with columns $J, \theta_0\ and\ \theta_1$ and at each iteration make a plot of $J(\theta_0, \theta_1)$ on which value of J should be marked at $updated(\theta_0, \theta_1)$ to see how far are you from your objective. Working of each iteration should also be submitted.



Above plot is an example of a function by taking random points, while red point is showing $J(\theta_0, \theta_1)$ at initial taken values of θ_0, θ_1

7- Draw a scatter plot of x and y with the plot of line $y = \theta_0 + \theta_1 x$, where θ_0 and θ_1 are your final values obtained after the last iteration of gradient descent method.