

Assignment: 4

Weightage: 5

Attendance: 4 credit hours

Deadline: 27th April, 2024

Topic: Numerical Optimization (Gradient Descent Method)

Instructor: Usama Antuley

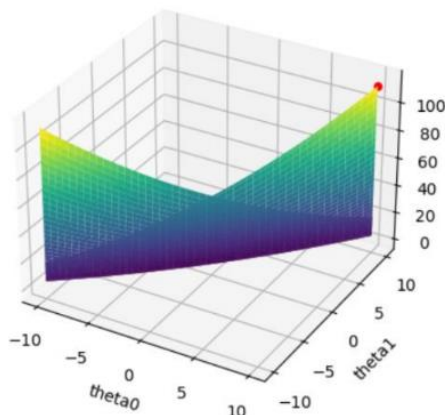
What should be submitted: All Submission must contain all the required plots and tables with working of each iteration mentioned in red color text below.

CLO2

Task: A

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)
 $x = \text{np.random.rand}(10, 1)$
 $y = 2 * x + \text{np.random.randn}(10, 1)$
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 $J(\theta_0, \theta_1) = \frac{1}{2m} \sum_{i=1}^m (h_{\theta_0, \theta_1}(x_{1i}) - y_i)^2$,
Where m is the number of data points and each data point can be read as (x_{1i}, y_i) , For $i = 1, 2, 3, \dots, m$
4. Congratulations! you have made a convex function of two variables θ_0 and θ_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 θ_0 and θ_1 .
 - b) A table with columns J, θ_0 and θ_1 and at each iteration make a plot of $J(\theta_0, \theta_1)$ on which value of J should be marked at updated (θ_0, θ_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.

Task: B

1. Summarise the opted research paper and make a PPT that must cover the main idea and all the key points of the research paper.

NOTE: PPT must include the code of ***TASK A*** in the starting slides.

Drive Link for Papers:

https://drive.google.com/drive/folders/1v1WajG2t6qexHXWxojXm-JAxF7UikFZy?usp=drive_link

2. You have to present both PPT + .ipynb file at the time of Presentation.
3. Also each of you need to submit both files at GCR.

Best of Luck
