

# Programming Assignment 1: EE-5180

February 12, 2024

## 1 Instructions

1. Submission deadline: Monday (26/02/2024) 3.00 PM
2. You can discuss ideas, but you must write your own program.
3. There will be lab session on this.
4. You will have to show the output and answer questions related to program.

## 2 Linear Regression (Program)

Suppose  $y(x, \theta) = \theta x + \theta_0$ , suppose that  $\theta^*$ , and  $\theta_0^*$  are true values and it is unknown. For given input response  $x_i$ , the desired output response  $\tilde{y}_i = \theta^* x_i + \theta_0^*$ . The observed data  $\mathcal{D} = \{x_i, \tilde{y}_i\}_{i=1}^N$ .

Then the loss function  $L_i(\theta, \theta_0) = (y(x_i, \theta, \theta_0) - \tilde{y}_i)^2$  The total loss is

$$L(\theta, \theta_0) = \frac{1}{2N} \sum_{i=1}^N L_i(\theta, \theta_0) \quad (1)$$

1. Suppose that true  $\theta^* = 2.5$  and  $\theta_0^* = 3$ . For  $N = 300$  input data points of  $x$  in range of  $[1, 5]$ , write a program in python to generate Dataset  $\mathcal{D}$ .
2. Write a program to compute the total loss function for given dataset  $\mathcal{D}$ .
3. Compute gradient  $\frac{\partial L_i}{\partial \theta}$  and  $\frac{\partial L}{\partial \theta}$ . Write a program to compute the gradient for given dataset  $\mathcal{D}$ .
4. Write program of gradient descent algorithm for iteration  $T = 10000$ . Plot the cost function as function of iteration.