

CS412 Machine Learning - 2023

HW3-Gradient Descent

50pts

- 1) **50pts** - We are trying to minimize a function $F(x) = x^2 - 10x + 5$ with respect to its parameter x . In other words we want to find the x for which $f(x)$ is minimum.

Starting from the point $x=10$ use steepest descent algorithm *for TWO steps* to find the local minimum of the function around this point. You should use a “step size” of $\alpha = 0.1$ in update, as: $x = x - \alpha \nabla$

We will use a subscript to indicate the subsequent values of x , starting from x_0 .

Worksheet:

$$F(x_0) = 10^2 - 10 \cdot 10 + 5 = 100 - 100 + 5 = 5$$

: Just to note at what F value we start (5pts)

$$\nabla F = [dF(x)/dx] = [2x - 10]$$

: Compute the gradient (10pts)

Note: Even though F is a function of a single variable, you can still write/think of the gradient as a vector of size one.

$$\nabla F |_{x_0} = 2 \cdot 10 - 10 = 10$$

: This is the gradient **evaluated** at x_0 (10pts)

$$x_1 = x_0 - \alpha \nabla = 10 - (0.1) \cdot 10 = 9$$

: Update x_0 to find x_1 (5pts)

$$F(x_1) = F(9) = 81 - 90 + 5 = -4$$

: just checking to see if we are indeed minimizing

Now do the 2nd step similarly and write your results below (no partial so be careful please): :20pts

$$\text{ANSWER: } x_2 \text{ (x after 2 steps of gradient descent)} = 9 - (0.1) \cdot 8 = 8.2$$

$$f(x_2) = (8.2)^2 - 82 + 5 = -9.76$$

Submission: Write the ANSWER line as inline submission to homework and attach the filled page as a pdf document to Sucourse.