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*:*

$F(x_0) = 10^2 - 10.10 + 5 = 5$ (since the starting point is x = 10 indicated as above)

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

∇F= *Take the derivative of* ***F(x) = 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.

$\nabla F \mid x_0$ = *we need to plug in x_0 = 10 in* ∇F *= 2x -10 => 2.10 – 10 =* ***10***

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

x_1= 10 – 0.1(2(10) – 10) =* ***9*** ($x = x - \alpha \nabla$ used this formula: x = 10, a = 0.1, ∇ = 2x -10) *:Update x_0 to find x_1 (5pts)*

$F(x_1)$ = plug in x_1 = 9 in the F(x) => $9^2 - 10.9 + 5 =$ ***-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

ANSWER: x_2 (x after 2 steps of gradient descent)= $x_1 - a\nabla F(x_1)$ => $9 - 0.1*(8) =$ **8.2**

$F(x_2) =$ plug in $x_2 = 8.2$ into $F(x)$ => $(8.2)^2 - 10.(8.2) + 5 =$ **-9.76**

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