EE5600 Assignment 3

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***Abstract*—This document contains the solution to a Gradient decent question.**

Download all python codes from

https://github.com/Jayanth9969/EE5600/blob/master/Assignment4/code.py

1 Problem

Find the maximum and minimum values, if any of the following function
$f(x) = -(x-1)^2 + 10$

2 Solution

Given $f(x) = -(x-1)^2 + 10$
A function is said to be convex if following inequality is true:

$$\lambda f(x_1) + (1-\lambda) f(x_2) \geq f(\lambda x_1 + (1-\lambda) x_2 \tag{2.0.1}$$

or we can check that is f"(x)) > 0 then the function is convex else the function will be concave

$$f(x) = -(x-1)^2 + 10 \tag{2.0.2}$$
$$f'(x) = -2(x-1) \tag{2.0.3}$$
$$f''(x) = -2 \tag{2.0.4}$$

Since $f''(x) < 0$ so f(x) is concave function.So we can find the maximum using gradient ascent method.Since function is concave it has only maximum and minimum will be -infinity
we can also find the maximum as following, Since derivative of f(x) at maximum is zero.

$$f'(x) = -2(x-1) \tag{2.0.5}$$
$$0 = -2(x-1) \tag{2.0.6}$$
$$x = 1 \tag{2.0.7}$$

Thus maximum occurs at x = 1

$$x = 1 \tag{2.0.8}$$
$$f(x) = -(x-1)^2 + 10 \tag{2.0.9}$$
$$f(1) = -(1-1)^2 + 10 \tag{2.0.10}$$
$$f(1) = 10 \tag{2.0.11}$$

Thus maximum attainable value of f(x) is 10 at x = 1

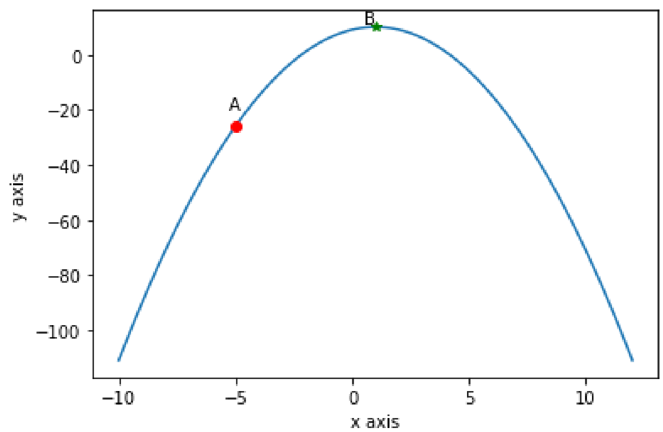

Fig. 2.0: Here B is maximum point and A is intial answer in gradient ascent method

The solution can found using gradient ascent method is as follows:
Let us Suppose at x = -5 (initial guess)be point where maximum value was attained,thus $x_0 = -5$. Our Update Equation will be:

$$x_1 = x_0 + f'(x_0) \times rate \tag{2.0.12}$$
$$error = |(x_0 - x_1)| \tag{2.0.13}$$
$$x_0 = x_1 \tag{2.0.14}$$

Here, rate = 0.1
we do update our x_0 until error between x_0 and x_1 becomes less than 0.000000001.
In this case using code.py ,we got answer after 95 iterations.we got maximum value attained is 10.0 occured at x = 0.9999999962700757 .