Assignment 4

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Gradient Descent

***Abstract*—This document contains the solution to find the maximum / minimum value of given function by gradient descent method**

Download all python codes from

https://github.com/rubeenaafreen20/EE5600AI−ML/tree/master/Assignment4/Code

Download latex-tikz codes from

https://github.com/rubeenaafreen20/EE5600AI−ML/tree/master/Assignment4

1 Problem

Find the maximum and minimum values, if any, of the follwing function

$$f(x) = 9x^2 + 12x + 2 \tag{1.0.1}$$

2 Solution

From figure 1, the line segment between any two points A and B on the graph of the real-valued function lies above the graph between the two points.
Therefore, the function is convex.
For a general quadratic equation,

$$f(x) = ax^2 + bx + c \tag{2.0.1}$$

The update equation for gradient descent to find minimum of a function is given by:

$$\lambda_{n+1} = \lambda_n - \mu f'(\lambda_n) \tag{2.0.2}$$
$$= \lambda_n - \mu(2a\lambda_n + b) \tag{2.0.3}$$

In equation (2.0.2) λ_0 is an initial guess and μ is a variable parameter,known as step size λ_{n+1} is the next position. The minus sign refers to the minimization part of gradient descent.
Assume,

$$\lambda_0 = 1 \tag{2.0.4}$$
$$\mu = 0.001 \tag{2.0.5}$$
$$precision = 0.00000001 \tag{2.0.6}$$
$$\implies \lambda_1 = 1 - 0.001(2 \times 9 \times 1 + 12) \tag{2.0.7}$$
$$\implies \lambda_1 = 1 - 0.03 \tag{2.0.8}$$
$$= 0.97 \tag{2.0.9}$$

following the above method, we keep doing iterations until $\lambda_{n+1} - \lambda_n$ becomes less than the value of precision we have chosen.

3 Results

Using python, the results are:

1) The local minimum occurs at -0.666666130125316.
2) The value of f(x) at minima is -1.9999999999974087

Figure 1 shows plot of parabola obtained from python code:

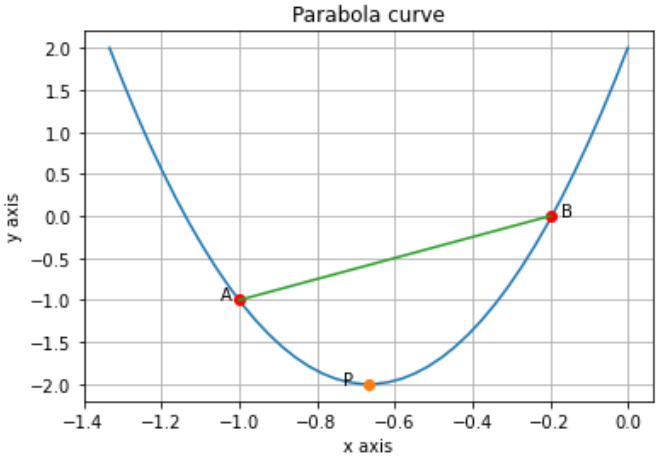

Fig. 1: Plot obtained from python code