UC Irvine, Division of Continuing Education

Deep Learning Using TensorFlow

Spring 2019

Homework#6

Date Given: May 13, 2019 Due Date: May 19, 2019

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The Gradient Descent (GD) algorithm was developed in HW05 Problem#1. We computed the values of the 'x' and 'y' variables where the value of the cost function is least. We also computed the number of epochs needed to converge. The criterion for convergence is when the incremental value of 'x' and 'y' is less than epsilon (0.000001).

Problem#1

Solve the same problem (HW05, Problem#1) but instead of using GD algorithm, use Momentum algorithm for optimization. Write your code in Python.

Answer (the 'x' and 'y' values where the cost function is minimum) will come out to be same as before (GD algorithm).

The number of epochs needed to converge using the Momentum algorithm would be less than the number of epochs needed to converge using the GD algorithm as long as the learning rate used in GD is same as the learning rate of Momentum algorithm.

Problem#2

The answer of Problem#1 will prove that the Momentum optimization algorithm can converge faster than the GD algorithm.

Compare the number of epochs to converge between GD and Momentum.

Homework#5, Problem#1

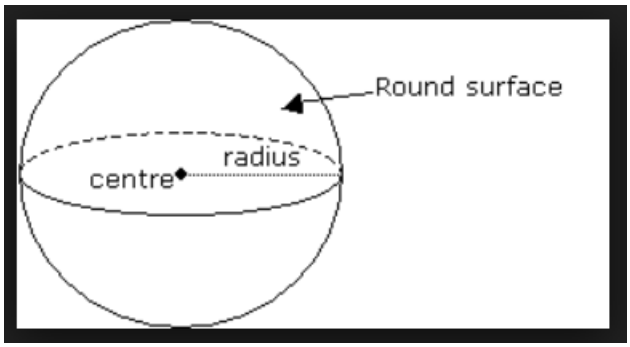
Suppose your cost function is as follows.

$$f(x,y) = z = -\sqrt{25 - (x-2)^2 - (y-3)^2}$$

This cost function represents the **bottom half** of a sphere with the following specifications.

Center of the sphere = x=2, y=3, z=0
Radius of the sphere = 5

The cost function is **convex** which means that it has a minimum point.



Find the values of 'x' and 'y' where the cost (z-value) is minimum using the Gradient Descent algorithm written in Python. The gradient (vector of partial derivatives) of this cost function is as follows.

$$\frac{\partial z}{\partial x} = \frac{2(x-2)}{\sqrt{25 - (x-2)^2 - (y-3)^2}}$$

$$\frac{\partial z}{\partial y} = \frac{2(y-3)}{\sqrt{25 - (x-2)^2 - (y-3)^2}}$$

Assuming learning rate = 0.01.

How many steps are needed for the Gradient Descent algorithm to converge? The criterion for convergence is when the incremental value of 'x' and 'y' is less than epsilon (0.000001).

Answer: The values of 'x' and 'y' where 'z' is minimum are as follows.
x = approximately 2, y = approximately 3. At this point the z = -5.

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