

Lab 1 Report: Gradient Descent

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1. Introduction

Gradient Descent is an iterative optimization algorithm used to find the local minimum of a function. In this lab, we minimize the quadratic function:

$$f(x) = x^2$$

Its derivative is:

$$f'(x) = 2x$$

We begin at a starting point and update the value of x iteratively using the gradient descent rule.

2. Algorithm

The general formula for updating x is:

$$x_{\text{new}} = x_{\text{current}} - \text{step_size} \times f'(x_{\text{current}})$$

Where:

- x_{current} is the current value of x
- **step_size** is the learning rate
- $f'(x_{\text{current}})$ is the derivative at that point

3. Methodology

In order to demonstrate the gradient descent process:

- Define the function $f(x) = x^2$ and its derivative $f'(x) = 2x$
- Start from an initial point $x = 99$
- A step size (learning rate) of 0.2 (used)
- The algorithm iterates 10 times to approach the minimum

4. Results

With the condition:

- Starting point: $x = 99$
- Step size: 0.2
- Number of iterations: 10

The output values per iteration are:

Step	x	f(x)
1	59.40	3528.36
2	35.64	1270.21
3	21.38	457.28
4	12.83	164.62
5	7.70	59.26
6	4.62	21.33
7	2.77	7.68
8	1.66	2.76
9	1.00	1.00
10	0.60	0.36