Global Minima → Manual Calculations

Gradient Descent Problem

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CSE III A

Q:

$f(x) = x^4 + 3x^2 + 10$

Step1: Initialize variable (x) Randomly & initialize max epochs

$x = 1$ → random value

epochs = 2 → max epochs

$\eta = 0.1$ → learning rate

iter = 1 (initialize iter)

Step2: Calculate slope / first order derivative / Gradient of objective function

$$\left.\frac{\partial f}{\partial x}\right|_x = \left.4x^3 + 6x + 10\right|_{x=1}$$

slope = 4 + 6 = 10

Step3: Find change in variable value

$$\Delta x \propto -\frac{\partial f}{\partial x} \Rightarrow \Delta x = -\eta \frac{\partial f}{\partial x}$$

$$\Delta x = -(0.1)(10) = -1.0$$

Step4: Update variable

$$x = x + \Delta x = 1 + (-1.0) = 1 - 1.0 = 0.0$$

Step5: Update iter variable

iter = iter + 1 = 1 + 1 = 2

Step6: if (iter > epochs)

check

2 > 2 X

so goto step2

Step2 slope

$$\frac{\partial f}{\partial x}\Big|_x = 4x^3+6x\Big|_{x=0} = 0$$

Step3 Change in variable $\Delta x = -\eta \frac{\partial f}{\partial x}$

$\Delta x = -(0.1)(0) = 0$

Step4 Update variable

$x = x + \Delta x = 0+0 = 0$

$\boxed{x=0}$

Step5: Update iter

iter = iter + 1 = 2+1 = 3

Step6: if (iter > epochs)

3 > 2 ✓

∴ out of loop $\xrightarrow{go}$ step7

Step7 print x, f(x)

At x=0 we got $f(x) = ~~0+4x^4+6x^2~~$

$~~4~~x^4+3x^2+10$

$f(x) = 0+3(0)+10$

$\boxed{f(x)=10}$

∴ Global Minima value of f(x) = 10 at x = 0