

Step 1: Given

$$y = x^4 + 3x^2 + 10$$

calculate derivative of y w.r.t x .

$$\Rightarrow \frac{\partial y}{\partial x} = \frac{\partial}{\partial x} (y) = \frac{\partial}{\partial x} (x^4 + 3x^2 + 10)$$

$$\Rightarrow \frac{\partial y}{\partial x} = 4x^3 + 6x$$

Step 2: Initialising x value, number of maximum iterations and learning rate η .

$$\Rightarrow x = 1$$

$$\eta = 0.1$$

$$\text{no. of iters} = 1$$

$$\text{max-iters} = 2$$

Step 3: calculate $\frac{\partial y}{\partial x}$ when $x = 1$.

$$\begin{aligned} \therefore \frac{\partial y}{\partial x} \Big|_{x=1} &= 4x^3 + 6x \Big|_{x=1} \\ &= 4(1)^3 + 6(1) = 4 + 6 = 10 \end{aligned}$$

Step 4: calculate change in x i.e. Δx .

Δx can be calculated using formula,

$$\Delta x = -\eta \frac{\partial y}{\partial x}$$

$$= -(0.1)(10)$$

$$= -\frac{1}{10} \times 10 = -1$$

$$\therefore \Delta x = -1$$

Step 5: ^{add} ~~subtract~~ change in x ^{to} ~~from~~ x i.e.
perform $x + \Delta x$

$$\Rightarrow x + \Delta x = 1 - 1 = 0.$$

no. of - iters = no. of - iters + 1.
Step 6: If no. of - iters > max - iters

stop calculations else repeat step 3 with
updated x value i.e. $x = 0$.

$$\therefore 2 > 2 \Rightarrow \text{false.}$$

\therefore repeat step 3 with $x = 0$.

Step 7: $\left. \frac{\partial y}{\partial x} \right|_{x=0} = 4x^3 + 6x \big|_{x=0}$
 $= 4(0) + 6(0) = 0.$

Step 8: calculate change in x (Δx) when
 $x = 0$.

$$\therefore \Delta x = -\eta \frac{\partial y}{\partial x}$$
$$= -(0.1)(0)$$
$$= 0$$

Step 9: calculate/update x as ^{adding} ~~subtracting~~ Δx
^{to} ~~from~~ x

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

Step 10: increment no. of iterations.

$$\text{no. of - iters} = \text{no. of - iters} + 1.$$

step 11: if no. of -iters > max -iters,
stop process else repeat step 3.

Here $3 > 2$.

Hence stop the process.

step 12: \therefore slope = 0.

Point at which slope = 0 $\Rightarrow y(0)$

$$= x^4 + 3x^2 + 10 \big|_{x=0}$$

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

$$= 0 + 10$$

Point at slope $\rightarrow 0 \Rightarrow 10 \Rightarrow$ GLOBAL MINIMUM