* Manual Calculations for two iterations :—

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

1) Let $x = 10$ (initializing a Random variable value)

epochs $= 2$ (No of iterations)

$\eta = 0.001$ (learning rate)

initially consider $i = 1$ for iteration

2) $\dfrac{\partial f}{\partial x}\Big|_{x=10} = 4x^3 + 6x$

$= 4(10)^3 + 6(10)$

$= 4060$

3) $\Delta x = -\eta \dfrac{\partial f}{\partial x}\Big|_{x=10}$

$= -(0.001)(4060)$

$\boxed{\Delta x = -4.06}$

4) $x = x + \Delta x$

$= 10 + (-4.06)$

$\boxed{x = 5.94}$

increment $i = i + 1 = 1 + 1 = 2 \leq 2 \checkmark$

∴ We have to go to step 2 by taking x value in step 4.

$$\frac{\partial f}{\partial x}\bigg|_{x=5.94} = 4x^3 + 6x$$

$$= 4(5.94)^3 + 6(5.94)$$

$$= 873.978336.$$

3) $\Delta x = -\eta \left|\frac{\partial f}{\partial x}\right|_{x=5.94}$

$$= -(0.001)(873.978336)$$

$$\boxed{\Delta x = -0.87397}$$

4) $x = x + \Delta x$

$$= 5.94 - 0.87397$$

$$\boxed{x = 5.06603}$$

increment $i = i + 1 = 2 + 1 = 3 \leq 2 \times$

∴ we have to come out of the loop.

∴ $x = 5.06603.$

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

$$= (5.06603)^4 + 3(5.06603)^2 + 10$$

$$\boxed{f(x) = 745.6687}$$