

Question-6.5.3.7

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Question: Find the local maxima of the function $\frac{1}{x^2+2}$.

Solution:

Theoretical solution:

Given $f(x) = \frac{1}{x^2+2}$

$$\frac{dy}{dx} = -\frac{-2x}{(x^2+2)^2} = 0 \quad (0.1)$$

$$\Rightarrow x = 0 \quad (0.2)$$

$$\frac{d^2y}{dx^2} = -\frac{1}{2} \quad (0.3)$$

$$(0.4)$$

Since $\frac{d^2y}{dx^2}$ is negative and $\frac{dy}{dx} = 0$ at $x=0$

Therefore, $f(0) = \frac{1}{2}$ is the maximum value of the function.

Computational Solution Using Gradient Descent:

To verify the analytical results, we use gradient descent to find the local maximum.

Gradient descent for local maximum :

Start with $x_0 = -3$

Update the value of x by the following equation.

$$x_{n+1} = x_n + \eta \cdot f'(x_n) \quad (0.5)$$

$$(0.6)$$

where:

$$\eta = 0.1 \quad (0.7)$$

$$f'(x) = -\frac{2x}{(x^2+2)^2} \quad (0.8)$$

computational result

Local Maximum

$$x = 0, f(x) = 0.5 \quad (0.9)$$

