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Q. Using NR Method Solve $x \log_{10} x = 12.34$.
Start with $x_0 = 10$.

Soln

$$f(x) = x \log_{10} x - 12.34$$

$$f'(x) = x \frac{1}{x} \log_{10} e + \log_{10} x$$
$$= \log_{10} e + \log_{10} x$$

Given $x_0 = 10$

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$
$$= 10 - \frac{10 \log_{10} 10 - 12.34}{\log_{10} e + \log_{10} 10}$$

$$= 10 - \left[\frac{-2.34}{1.4343} \right]$$

$$= 10 + \frac{2.34}{1.4343}$$

$$= 11.6315$$



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$$\begin{aligned}x_2 &= x_1 - \frac{f(x_1)}{f'(x_1)} \\&= 11.6315 - \left[\frac{1.6315 \log_{10} 11.6315 - 12.34}{\log_{10} e + \log_{10} 11.6315} \right] \\&= 11.6315 - \frac{0.0549}{15} \\&= 11.5949\end{aligned}$$

$$\begin{aligned}x_3 &= x_2 - \frac{f(x_2)}{f'(x_2)} \\&= 11.5949 - \frac{11.5949 \log_{10} 11.5949 - 12.34}{\log_{10} e + \log_{10} 11.5949} \\&= 11.5949 - \frac{0.00006}{1.4986} \\&= 11.5949\end{aligned}$$

Hence the root is 11.5949