Numerical Analysis: Lab 1

Bisection Method

Algorithm

Input: function $f(x)$, interval $[a, b]$, tolerance ϵ, max iterations N

1. Check if $f(a) \cdot f(b) < 0$.

   If not, stop: *Root not bracketed.*
2. For $i = 1$ to N:
   - Compute midpoint

$$c = \frac{a+b}{2}$$

   - If $|f(c)| < \epsilon$, return c.
   - If $f(a) \cdot f(c) < 0$, set $b = c$, else set $a = c$.
3. If max iterations reached → *No convergence.*

False Position Method (Regula Falsi)

Algorithm

Input: $f(x)$, interval $[a, b]$, tolerance ϵ

1. Check if $f(a)f(b) < 0$.
2. For each iteration:
   - Compute intersection point

$$c = \frac{af(b) - bf(a)}{f(b) - f(a)}$$

   - If $|f(c)| < \epsilon$, return c.
   - If $f(a)f(c) < 0$, set $b = c$, else set $a = c$.

Numerical Analysis: Lab 1

Secant Method

Algorithm

Input: $f(x)$, two initial guesses x_0, x_1, tolerance ϵ

1. For each iteration:
    - Compute

$$x_2 = x_1 - f(x_1)\frac{x_1 - x_0}{f(x_1) - f(x_0)}$$

    - Check convergence:
      If $|x_2 - x_1| < \epsilon$, return x_2.
    - Update values:
      $x_0 = x_1$, $x_1 = x_2$

Newton–Raphson Method

Algorithm

Input: $f(x)$, derivative $f'(x)$, initial guess x_0, tolerance ϵ

1. For each iteration:
    - Compute

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

    - If $|x_1 - x_0| < \epsilon$, return x_1.
    - Update: $x_0 = x_1$