

Assignment 2.

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15/MHS01/loop

Mechatronics

ENG 382: Engineering Mathematics IV

Solution.

a) $f(x) = e^{-0.5x}(4-x) - 2$

$f'(x) \Rightarrow$

Let $u = e^{-0.5x}$; $v = (4-x)$.

$du = -0.5e^{-0.5x}$; $dv = -1$

$f'(x) = -e^{-0.5x} - 0.5e^{-0.5x}(4-x)$.

$x_0 = 0.5$ {initial guess}

General Newton-Raphson's Formula.

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

$f(x_0) = f(0.5) = 0.7258027407$

$f'(x_0) = f'(0.5) = -2.141702153$

root 1 $\Rightarrow x_1 = x_0 - \frac{f(x_0)}{f'(x_0)} = 0.8388906061$.

$f(x_1) = 0.07814929779$

$f'(x_1) = -1.696486032$

root 2 $\Rightarrow x_2 = x_1 - \frac{f(x_1)}{f'(x_1)} = 0.8849560003$.

$f(x_2) = 1.236575203 \times 10^{-3}$

$f'(x_2) = -1.643060762$

root 3 $\Rightarrow x_3 = x_2 - \frac{f(x_2)}{f'(x_2)} = 0.885708605$.

$f(x_3) = 3.23583557 \times 10^{-7}$

$f'(x_3) = -1.642200729$

root 4 $\Rightarrow x_4 = x_3 - \frac{f(x_3)}{f'(x_3)} = 0.885708802$.

$$f(x_4) = 7.845 \times 10^{-12}$$

$$f'(x_4) = -1.642200704$$

$$x_5 = x_4 - \frac{f(x_4)}{f'(x_4)} = 0.885708802$$

$\therefore 0.885708802$ is the root of eqn (1.1)

b) MATLAB

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function [x1, err, relerr] = assign2(x0, max1, tol, iter, f, fprime)
    x0 = 0.5;
    max1 = 100;
    tol = 0.000000001;
    iter = 1;
    f = @(x) ((exp(0.5 * x)) * (4 - x)) - 2;
    fprime = @(x) (-exp(-0.5 * x)) + (0.5 * exp(-0.5 * x)) * (4 - x);
    for i = 1; max1
        x1 = x0 - fval(f, x0) / fval(fprime, x0);
        err = abs(x1 - x0); relerr = abs(x1 - x0) / x1;
        fprintf('%10.2f %10.10f %10.10f %10.10f %10.10f\n', iter, x0, x1, err, relerr);
        x0 = x1; iter = 1 + iter;
        if err <= tol, break, end;
    end

```