

Anyaha Valentine

16/ENG06/014

Mechanical Engineering

ENG 382

If the maximum percentage absolute error is desired to be $\leq 1\%$, using the Newton-Raphson iteration method and initial guess value of 0.5, find the root of the function given in eqn. (1-1)

a) manually and

b) with the aid of MATLAB

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

NB: for the manual solution, use all the values given by the

Calculator

Soln

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

$$f'(x) =$$

$$\text{let } u = e^{-0.5x} \quad \& \quad v = (4-x)$$

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

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

$$x_0 = 0.5 \quad [\text{Initial guess}]$$

General Newton-Raphson's formula

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

$$f(x_0) = f(0.5) = 0.725827407$$

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

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)} = 0.8388906061$$

$$f(x_1) = 0.07814829779$$

$$f'(x_1) = -1.642200929$$

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)} = 0.885708802$$

$$f(x_2) = 7.845 \times 10^{-10}$$

$$f'(x_2) = -1.642200704$$

$$x_3 = x_2 - \frac{f(x_2)}{f'(x_2)} = 0.885708802$$

0.88708802 is the root of eqn (1.1)

MATLAB (Assignment I)

function [x1, err, verror] = assign2(x0, maxI, tol, iter, f, fprime)

~~x0 = 0~~ x0 = 0.5;

max I = 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; max I

x1 = x0 - fval(f, x0) / fval(fprime, x0);

err = abs(x1 - x0); verror = abs(2x1 - x0) / x1;

fprime = (% 2 of % 10-10f % 10-10f % 10-10f % 10-10f % 10-10f % 10-10f %

10-10f |n, iter, x0, x1, err, verror)

x0 = x1, iter = 1 + iter;

if err <= tol, break, end

end