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 16/EWG01/008
 chemical engineering
 Assignment 2.

$$1.) f(x) = e^{-0.5x} (4-x) - 2$$

finding the root

$$\text{When } x=0, f(x) = e^{-0.5 \cdot 0} (4-0) - 2 = 2$$

$$\text{When } x=1, f(x) = e^{-0.5 \cdot 1} (4-1) - 2 = 0.180408$$

$$\therefore f'(x)$$

$$\text{expand } f(x) = e^{-0.5x} (4-x) - 2 \text{ or } f(x) = e^{-0.5x} (4-x) - 2$$

$$= 4e^{-0.5x} - xe^{-0.5x} - 2$$

differentiating with product rule.

$$f'(x) = \frac{d}{dx} (e^{-0.5x} (4-x)) - \frac{d}{dx} (2)$$

$$= e^{-0.5x} \cdot \frac{d}{dx} (4-x) + (4-x) \cdot \frac{d}{dx} (e^{-0.5x}) - 0$$

$$= e^{-0.5x} (-1) + (4-x) \cdot (-0.5e^{-0.5x})$$

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

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

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

$$f'(x) = 0.5xe^{-0.5x} - 3e^{-0.5x}$$

$$f'(x) = e^{-0.5x} (0.5x - 3)$$

using Newton Raphson method

$$x_{k+1} = x_k - \frac{f(x_k)}{f'(x_k)}$$

$$\% \text{ absolute error} = \left(\frac{x_{k+1} - x_k}{x_{k+1}} \right) \times 100\%$$

for iter 1

$$\text{let } x_k = 0.5 = x_0$$

$$f(x_0) = (4-0.5)e^{-0.5(0.5)}$$

$$f(x_0) = 0.7258$$

$$f'(x) = e^{-0.5(0.5)} (0.5 \times 0.5)^{-3}$$

$$= -2.142$$

$$x_{k+1} = 0.5 - \frac{0.7258}{-2.142}$$

$$= 0.8388$$

$$\% \text{ error} = \left(\frac{0.8388 - 0.5}{0.8388} \right) \times 100$$

$$\% \text{ error} = 40.396$$

for iter 2

$$\text{let } x_k = 0.8388 = 0.9$$

$$f(x_1) = (4 - 0.8388) e^{-0.5(0.8388)} - 2$$

$$f(x_1) = 0.0783$$

$$f'(x_1) = e^{-0.5 \times 0.8388} [(0.5 \times 0.8388)^{-3}]$$

$$f'(x_1) = -1.6906$$

$$\therefore x_{k+1} = 0.8388 - \frac{0.0783}{-1.6906}$$

$$x_{k+1} = 0.88496$$

$$\% \text{ error} = \left(\frac{0.88496 - 0.8388}{0.88496} \right) \times 100$$

$$= 5.2151$$

for iter 3

$$\text{let } x_k = 0.88496 = 0.9$$

$$f(x_2) = (4 - 0.88496) e^{-0.5(0.88496)} - 2$$

$$f(x_2) = 8.00123$$

$$f'(x_2) = e^{-0.5 \times 0.88496} [(0.5 \times 0.88496)^{-3}]$$

$$f'(x_2) = -1.64306$$

$$x_{(k+1)} = 0.88496 - \frac{0.00123}{-1.64306} = 0.885708605$$

$$\% \text{ error} = \left(\frac{0.88571 - 0.88496}{0.88571} \right) \times 100$$

$$= 0.0846\%$$

for iter 4

$$\text{let } x_k = 0.88571$$

$$f(x_3) = (4 - 0.88571)e^{-0.5(0.88571)} - 2$$

$$f(x_3) = -1.9674 \times 10^{-6}$$

$$f'(x_3) = e^{-0.5 \times 0.88571} ((0.5 \times 0.88571) - 3)$$

$$f'(x_3) = -1.64220$$

$$x_{(k+1)} = 0.8857 - \frac{1.96734 \times 10^{-6}}{-1.64220} = 0.88571$$

$$\% \text{ error} = \left(\frac{0.88571 - 0.88571}{0.88571} \right) \times 100$$

i	x_k	$f(x_k)$	$f'(x_k)$	x_{k+1}	$\delta_{\text{obs. error}}$
0	0.5	0.7258	-7.142	0.8388	40.396
1	0.8388	0.0783	-1.6466	0.88496	5.2151
2	0.88496	0.00123	-1.64306	0.88571	0.08266
3	0.88571	-1.9674×10^{-6}	-1.64220	0.88571	0.


```
1 function [x1, err, relerr] = newraph(x0, max1, tol, iter, f, fprime)
2     x0=0.5;
3     max1=100;
4     tol=0.00000000005;
5     iter=1;
6     f=@(x) exp(-0.5*x)*(4-x)-2;
7     fprime=@(x) exp(-0.5*x)*((-0.5*x)-3);
8     for i=1:max1;
9         x1=x0-feval(f,x0)/feval(fprime,x0)
10        err=abs(x1-x0); relerr=abs(x1-x0)/x1
11        fprintf('%2.0f %10.10f %10.10f %10.10f %10.10f\n', iter, x0, x1, err, relerr)
12        x0=x1, iter=1+iter;
13        if err<=tol, break, end
14    end
15
```

Command Window

New to MATLAB? See resources for [Getting Started](#).

ans =

0.88571