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MEC 232

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Q1: Write and execute a MATLAB program to solve the following function by Bisection Method

$f(c) = 9.8 * 68.1 / c [1 - e^{(-0.146813c)}] - 40$. Search your answer between c values 12 to 16. Assume minimum error to be considered as 0.001.

Solution

clear all;

clc;

a = input('value of a = ');

b = input('value of b = ');

tol = 0.001;

count = 0;

f = @(c) (c \ (9.8 * 68.1) * (1 - exp(-0.146813 * c)) - 40);

while f(a) * f(b) > 0

b = input('value of b = ');

a = input('value of a = ');

end

while abs(b-a) > tol

c = (a+b)/2;

if f(a) * f(c) < 0

b = c;

else

a = c;

end

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```
count = count + 1;
end
fprintf('total iterations: %d\n', count)
fprintf('The root is %1.10f\n The value of f(x) is %f\n', c, c, f(c))
```

Q2. Write a MATLAB code to calculate the roots of the equation $f(x) = e^{-x} - x$ by newton raphson method, employing an initial guess value $x_0 = 1$. Assume minimum errors to be 0.001.

Solution

```
clear all;
clc;
tol = 0.001;
error = 1;
count = 0;
f = @(x) (exp(-x) - x);
df = @(x) (-exp(-x) - 1);
x = input('Initial approximation = ');
while error > tol
    x1 = x - (f(x)/df(x));
    error = abs(x1 - x);
    x = x1;
    count = count + 1;
end
fprintf('Total iterations: %d\n', count)
fprintf('The root is = %d\n', x)
fprintf('The value of function at root = %f\n', f(x))
```

Q3. Compare the results and number of iterations obtained from newton raphson and secant method for the equation $f(x) = e^{-x} - x$, employing an initial guess

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Solution

value of $x_0 = 0$. Assume the minimum error to be 0.001 .

clear all;

clc;

disp('Secant method')

count = 0;

 $f = @(x) (\exp(-x) - x);$ $x(1) = \text{input('1st guess: ')};$ $x(2) = \text{input('2nd guess: ')};$

for n = 3:50

 $x(n) = (x(n-2) * f(x(n-1)) - x(n-1) * f(x(n-2))) / (f(x(n-1)) - f(x(n-2)));$ if abs($x(n) - x(n-1)$) < 0.001 && $f(x(n)) < 0.001$ root = $x(n)$;

break

end

count = count + 1;

end

fprintf('Total iterations: %d\n', count)

fprintf('The root is %f\n', x(n))

fprintf('The value of function at root = %f\n', f(x(n)))

fprintf('\n')

clear all;


disp('Newton Raphson method')

tol = 0.001;

error = 0;

 $f = @(x) (\exp(-x) - x);$ $df = @(x) (-\exp(-x) - 1);$ $x = \text{input('Initial approximation = ')};$

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```
while error > tol
```

```
    x1 = x - (f(x)/df(x));
```

```
    error = abs(x1 - x);
```

```
    x = x1;
```

```
    count = count + 1;
```

```
end
```

```
fprintf('Total iterations: %d\n', count)
```

```
fprintf('The root is = %f\n', x)
```

```
fprintf('The value of function at root = %f\n', f(x))
```

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```
CA3_a.m CA3_b.m CA3_c.m
1 %Name: Rohan Kumar Saini
2 %Roll no: RM2041A01
3 %Reg no: 12011878
4 %Question1
5 clear all;
6 clc;
7 a=input('value of a= ');
8 b=input('value of b= ');
9 tol=0.001;
10 count=0;
11 f=@(c) (c*(9.8*68.1)*(1-exp(-0.146813*c))-40);
12 while f(a)*f(b)>0
13     b=input('value of b= ');
14     a=input('value of a= ');
15 end
16 while abs(b-a)>tol
17     c=(a+b)/2;
18     if f(a)*f(c)<0
19         b=c;
20     else
21         a=c;
22     end
23     count=count+1;
24 end
25 fprintf('total iterations: %d\n',count)
26 fprintf('The root is %1.10f\nThe value of f(%f) is %f\n',c,c,f(c))
```

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Command Window

```
value of a= 12
value of b= 16
total iterations: 12
The root is 14.7783203125
The value of f(14.778320) is 0.001395
>>
```

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```
1 %Name: Rohan Kumar Saini
2 %Roll no: RM2041A01
3 %Reg no: 12011878
4 %Question2
5 clear all;
6 clc;
7 tol=0.001;
8 error=1;
9 count=0;
10 f=@(x) (exp(-x)-x);
11 df=@(x) (-exp(-x)-1);
12 x=input('Initial approximation= ');
13 while error>tol
14     x1=x-(f(x)/df(x));
15     error=abs(x1-x);
16     x=x1;
17     count=count+1;
18 end
19 fprintf('Total iterations: %d\n',count)
20 fprintf('The root is= %f\n',x)
21 fprintf('The value of function at root= %f\n',f(x))
```

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Command Window

```
Initial approximation= 1
Total iterations: 3
The root is= 0.567143
The value of function at root= 0.000000
>> |
```

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```
1 %Name: Rohan Kumar Saini
2 %Roll no: RM2041A01
3 %Reg no: 12011878
4 %Question3
5 clear all;
6 clc;
7 disp('Secant method')
8 count=0;
9 f=@(c) (exp(-c)-c);
10 x(1)=input('1st guess: ');
11 x(2)=input('2nd guess: ');
12 for n=3:50
13     x(n)=(x(n-2)*f(x(n-1))-x(n-1)*f(x(n-2)))/(f(x(n-1))-f(x(n-2)));
14     if abs(x(n)-x(n-1))<0.001 && f(x(n))<0.001
15         root=x(n);
16         break
17     end
18     count=count+1;
19 end
20 fprintf('Total iterations: %d\n',count)
21 fprintf('The root is %f\n',x(n))
22 fprintf('The value of function at root is= %f\n',f(x(n)))
23
24 fprintf('\n')
25
26 clear all;
```

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```
17 end
18 count=count+1;
19 end
20 fprintf('Total iterations: %d\n',count)
21 fprintf('The root is %f\n',x(n))
22 fprintf('The value of function at root is= %f\n',f(x(n)))
23
24 fprintf('\n')
25
26 clear all;
27 disp('Newton Raphson method')
28 tol=0.001;
29 error=1;
30 count=0;
31 f=@(x) (exp(-x)-x);
32 df=@(x) (-exp(-x)-1);
33 x=input('Initial approximation= ');
34 while error>tol
35     x1=x-(f(x)/df(x));
36     error=abs(x1-x);
37     x=x1;
38     count=count+1;
39 end
40 fprintf('Total iterations: %d\n',count)
41 fprintf('The root is= %f\n',x)
42 fprintf('The value of function at root= %f\n',f(x))
```

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