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Feb/24/17

Math 131-05D

Homework #4 2a secant

2. a) $f(x) = cos\left(x + sqrt(2)\right) + x * \left(\frac{x}{2} + sqrt(2)\right)$ interval [-2,1]

b) $f(x) = exp(6 * x) + 3 * \left(\left(log(2)\right)^2\right) * exp(2 * x) - log(8) * exp(4 * x) - \left(log(2)\right)^3$

Interval [-1, 0]

The code uses secant method [$x_{n+1} = x_n - \frac{f(x_n)(x_n - x_{n-1})}{f(x_n) - f(x_{n-1})}$] to find roots of a function up to a tolerance of 10^{-5}within 100 iterations and graph the logarithmic error. For function (a) the code found the root to be at -1.4145 with 32 iterations with an order of convergence of 1. For function (b) the root was found to be -0.18330 this was found with 31 iterations with an order of convergence of 1.0245.

Matlab Output:

```
>> secantmethod

=======

number of iterations to solve function a:

 32

the root for function a is located at:

-1.4145

the order of convergence for function a is:

 1

=======

number of iterations to solve function b:

 31

the root for function b is located at:

-0.18330
```

the order of convergence for function b is:

1.0245

Matlab code used for this problem:

```
%============================================================
%Name: Yeash Patel
%Class: Math131-Numerical Analysis-05D-SP17
%Title: HW4
%
%problem 2 secantmethod method for a and b
%
%problem 3
% newtons is quadratic and requires the deriviative of the
% function also takes less iterations.
%
% Secant does not require the derivative of the function and
% therfore less function evaluations.
%
%============================================================
close all
clc
clear all
a=@(x)cos(x+sqrt(2))+x*(x/2+sqrt(2));
b=@(z)exp(6*z)+3*((log(2))^2)*exp(2*z)-log(8)*exp(4*z)-(log(2))^3


N=100;
```

```
TOL=10^-5;
i=1;
t=1;

x=-2;
x1=-1.5;
err=[];

errb=[];
z=-1
z1=-0.999



while(i<=N)
   xn(i)=x1-(a(x1)*(x1-x))/(a(x1)-a(x))
   err(i)=abs(xn(i)-x1)
  if(err(i)<=TOL||err(i)==0)
     disp(i)
     disp(x)
     break;
  end
  x=x1
  x1=xn(i)
  i++
```

```
end

while(t<=N)
    zn(t)=z1-(b(z1)*(z1-z))/(b(z1)-b(z))
    errb(t)=abs(zn(t)-z1)
   if(errb(t)<=TOL||errb(t)==0)
      disp(t)
      disp(z)
      break;
   end
   z=z1
   z1=zn(t)
   t++
end

u=length(err)-1
n=length(errb)

aa=log(err(2:u))./log(err(1:u-1))
ab=log(errb(2:n))./log(errb(1:n-1))

disp('=======')
disp('number of iterations to solve function a:')
disp(i)
disp('the root for function a is located at:')
```

```
disp(x)
disp('the order of convergence for function a is:')
disp(aa(u-1))
disp('=======')
disp('number of iterations to solve function b:')
disp(t)
disp('the root for function b is located at:')
disp(z)
disp('the order of convergence for function b is:')
disp(ab(n-1))

subplot(1,2,1)
loglog(errb(2:u),err(1:u-1),'*-')
axis on
title("secant method error for a")
xlabel('number of iteration')
ylabel('log(error)')

subplot(1,2,2)
loglog(errb(2:n),errb(1:n-1),'*-')
axis on
title("secant method error for b")
xlabel('number of iteration')
ylabel('log(error)')
```