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Math 131-05D

Homework #4 2a Newton's method

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]

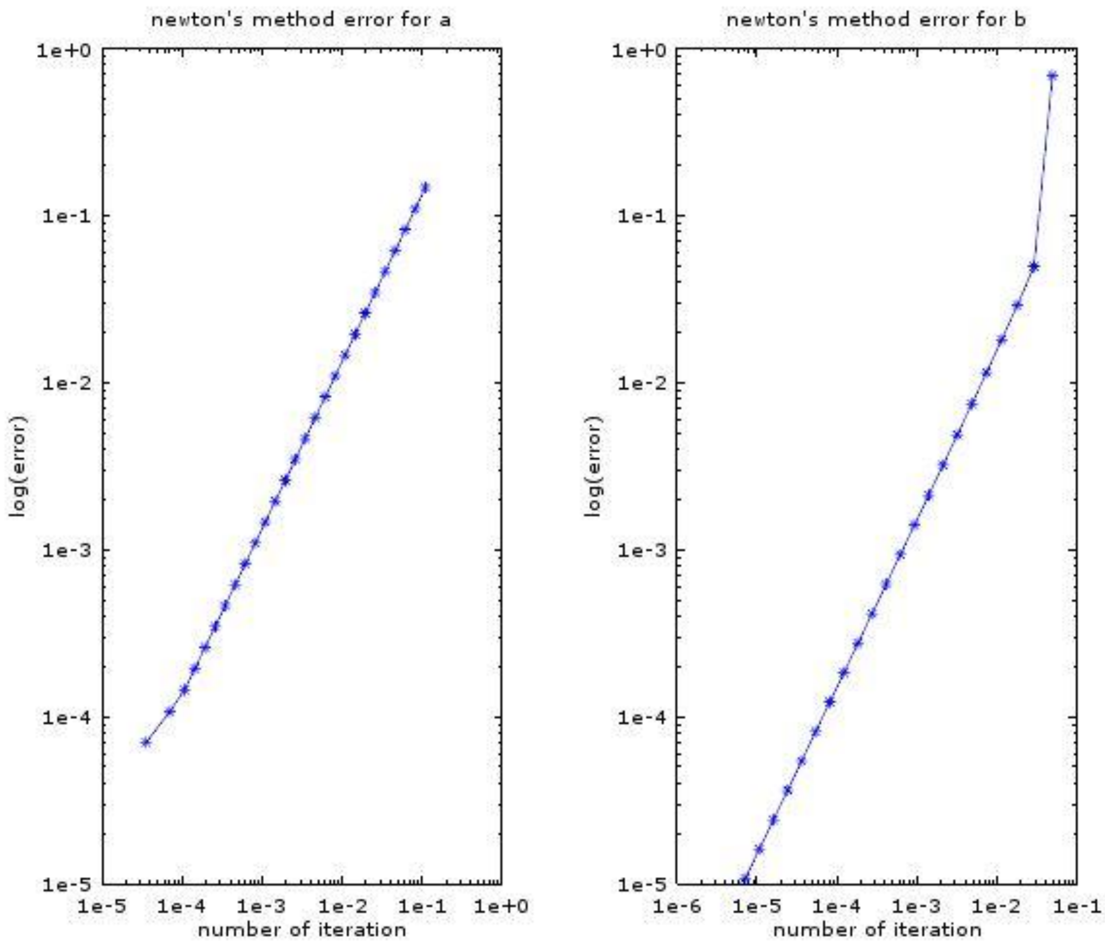
The code uses Newton's method [$x_{n+1} = x_n - \frac{f(x)}{f`(x)}$] to find roots of a function up to a tolerance of 10^{-5}within 100 iterations and graph the logarithmic error. For function (a) the code found the root to be at -1.4144 with 29 iterations and an order of convergence of 1.0714. For function (b) the root was found to be -0.18328 this was found with 23 iterations with an order of convergence of 1.0357.

Matlab Output:

```
>> newtonmethod

=======

number of iterations to solve function a:

 29

the root for function a is located at:

-1.4144

the order of convergence for function a is:

 1.0714

=======

number of iterations to solve function b:

 23

the root for function b is located at:

-0.18328
```

the order of convergence for function b is:

1.0357



Matlab code used for this problem:

```
%==========================================================
%Name: Yeash Patel
%Class: Math131-Numerical Analysis-05D-SP17
%Title: HW4
%problem 2 newtons method for a and b
%==========================================================
close all
```

```
clc

clear all

a=@(x)cos(x+sqrt(2))+x*(x/2+sqrt(2));

da=@(x)x-sin(x+sqrt(2))+sqrt(2);


b=@(z)exp(6*z)+3*((log(2))^2)*exp(2*z)-log(8)*exp(4*z)-(log(2))^3

db=@(z)6*exp(6*z)-4*log(8)*exp(4*z)+6*log(2)^2*exp(2*z)


i=1;

x=-2;

N=100;

TOL=10^-5;

t=1;

z=-1;

err=[];

errb=[];


while(i<=N)

  xn(i)=x-(a(x)/da(x))

  err(i)=abs(xn(i)-x)

  if(err(i)<=TOL||err(i)==0)

    disp(i)

    disp(x)

    break;

  end
```

```
  x=xn(i)
  i++
end

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

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


subplot(1,2,1)

loglog(err(2:n),(err(1:n-1)),'*-')

axis on

title("newton's method error for a")

xlabel('number of iteration')

ylabel('log(error)')


subplot(1,2,2)

loglog(errb(2:k),(errb(1:k-1)),'*-')

axis on

title("newton's method error for b")

xlabel('number of iteration')

ylabel('log(error)')
```