Yeash Patel

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Math 131-05D

Homework #4 1b

1. b) $f(x) = x^4 - 8 * x^3 + 24 * x^2 - 32 * x + 16$ on interval [-1,2]

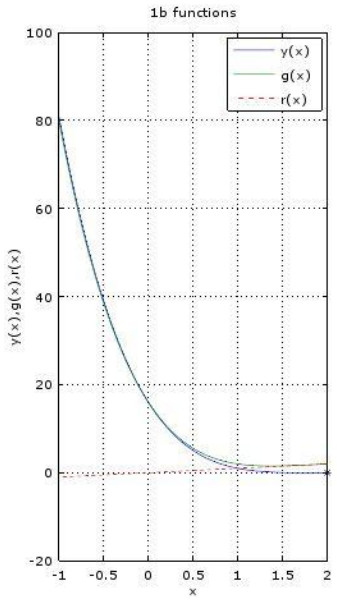
   To use fix point iteration method we need to find g(x) such that:

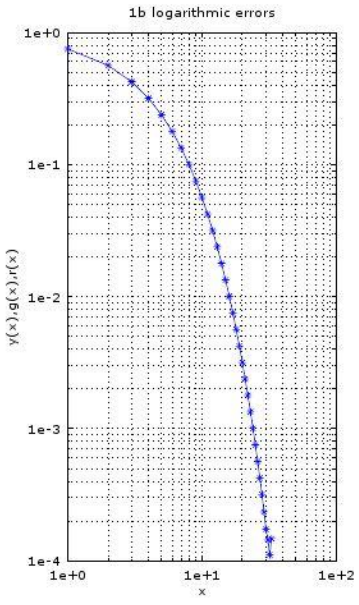
   1. it is continuous on the interval
   2. it is an element of [-1,2]
   3. $|g`(x)| \leq k < 1$

   In my code I used $g(x) = x - \frac{x^4 - 8*x^3 + 24*x^2 - 32*x + 16}{4*x^3 - 24*x^2 + 48*x - 32}$ for the numerical portion and for graphing portion of the problem I used $g(x) = x^4 - 8 * x^3 + 24 * x^2 - 32 * x + 16 + x$. One might notice that the g(x) used in the numerical portion is similar to Newton's method this should be okay since one can derive Newton's method from fixed point. My code takes about 34 iterations to reach a value of 1.9999 and return two graphs which is an accuracy of 10^{-6} . Graph 1 titled "1b functions" is the f(x), g(x), and r(x) (note r(x) = x). The intersection between r(x) and (x) is marked with '*'. Graph 2 titled "1b logarithmic errors" and was produced by $|P_1 - P|$ vs. n.

Output from Matlab:

```
>> oneb
number of iteration:
 34
value of function and x value
 1.9999
```





Matlab code used for this problem:

```
%=========================================================
%Name: Yeash Patel
%Class: Math131-Numerical Analysis-05D-SP17
%Title: HW4
%Fixed point method grapghically and anyliticaly
%problem 1 b
%=========================================================
%clear pervious values
close all
clc
clear all
x=linspace((-1),2,100);
y=x.^4-8*x.^3+24*x.^2-32*x+16
g=x.^4-8*x.^3+24*x.^2-32*x+16+x
r=x

i=1
l=-1
tol=10^-6
while (i<=100)
  z=l-(l^4-8*l^3+24*l^2-32*l+16)/(4*l^3-24*l^2+48*l-32)   %calculate P from Po[ld](note you can derive newtons method from fixed point)
 delP=abs(z-l)  %find diffrence btween P and Po record it in delp
 err(i)=delP
 if(delP<tol||delP==0) %check if delp= 0 or is within 0 + or - tolerance
    disp('number of iteration:')
    disp(i)
    disp('value of function and x value')
    disp(z)        % if so break (done)
```

```
    break;
  else              %else continue the loop with Po= P
   l=z
   i++
  end
end

%graph functions
subplot(1,2,1)
plot(x,y,x,g,x,r,'r--')

hold on;
plot(1.9999,0,'k*')
legend('y(x)','g(x)','r(x)')
title('1b functions')
xlabel('x')
ylabel('y(x),g(x),r(x)')
grid on
axis on

%graph errors
subplot(1,2,2)
n=length(err)-1
loglog(1:n,err(1:n),'*-')
title('1b logarithmic errors')
xlabel('x')
ylabel('y(x),g(x),r(x)')
grid on
axis on
```