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% Topic      : Newton-Raphson Method - Roots of Equations
% Simulation : Simulation of the Method
% Language   : Matlab r12
% Authors    : Nathan Collier, Autar Kaw
% Date       : 21 August 2002
% Abstract   : This simulation illustrates the Newton-Raphson method of
%                finding roots of an equation f(x)=0.
%
clear all
% INPUTS: Enter the following
% Function in f(x)=0
syms x
f = x^3-0.165*x^2+3.993*10^(-4);
% Initial guess
x0 = 0.05;
% Lower bound of range of 'x' to be seen
lxrange = -0.02;
% Upper bound of range of 'x' to be seen
uxrange = 0.12;
%
% SOLUTION
g=diff(f);
% The following finds the upper and lower 'y' limits for the plot based on the given
%    'x' range in the input section.
maxi = subs(f,x,lxrange);
mini = subs(f,x,lxrange);
for i=lxrange:(uxrange-lxrange)/10:uxrange
   if subs(f,x,i) > maxi
      maxi = subs(f,x,i);
   end
   if subs(f,x,i) < mini
      mini = subs(f,x,i);
   end
end
tot=maxi-mini;
mini=mini-0.1*tot;
maxi=maxi+0.1*tot;

% This calculates window size to be used in figures
set(0,'Units','pixels')
scnsize = get(0,'ScreenSize');
wid = round(scnsize(3));
hei = round(0.95*scnsize(4));
wind = [1, 1, wid, hei];

% This graphs the function and the line representing the initial guess
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figure('Position',wind)
clf
ezplot(f,[lxrange,uxrange])
hold on
plot([x0,x0],[maxi,mini],'g','linewidth',2)
plot([lxrange,uxrange],[0,0],'k','linewidth',1)
title('Entered function on given interval with initial guess')
hold off

% ------------------------------------------------------------------------
% Iteration 1
figure('Position',wind)
x1=x0-subs(f,x,x0)/subs(g,x,x0);
ea=abs((x1-x0)/x1)*100;
m=-subs(f,x,x0)/(x1-x0);
b=subs(f,x,x0)*(1+x0/(x1-x0));
lefty=(maxi-b)/m;
righty=(mini-b)/m;
% This graphs the function and two lines representing the two guesses
clf
subplot(2,1,2),ezplot(f,[lxrange uxrange])
hold on
plot([x0,x0],[maxi,mini],'g','linewidth',2)
plot([x1,x1],[maxi,mini],'g','linewidth',2)
plot([lefty,righty],[maxi,mini],'r','linewidth',2)
plot([lxrange,uxrange],[0,0],'k','linewidth',1)
title('Entered function on given interval with current and next root and tangent line of the
curve at the current root')

% This portion adds the text and math to the top part of the figure window
subplot(2,1,1), text(0,1,['Iteration 1'])
text(0.1,.8,['x1 = x0 - (f(x0)/g(x0)) = ',num2str(x1)])
text(0,.4,['Absolute relative approximate error'])
text(0.1,.2,['ea = abs((x1 - x0) / x1)*100 = ',num2str(ea),'%'])
axis off
hold off

% ------------------------------------------------------------------------
% Iteration 2
figure('Position',wind)
x2=x1-subs(f,x,x1)/subs(g,x,x1);
ea=abs((x2-x1)/x2)*100;
m=-subs(f,x,x1)/(x2-x1);
b=subs(f,x,x1)*(1+x1/(x2-x1));
lefty=(maxi-b)/m;
righty=(mini-b)/m;
```

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% This graphs the function and two lines representing the two guesses
clf
subplot(2,1,2),ezplot(f,[lxrange,uxrange])
hold on
plot([x1,x1],[maxi,mini],'g','linewidth',2)
plot([x2,x2],[maxi,mini],'g','linewidth',2)
plot([lefty,righty],[maxi,mini],'r','linewidth',2)
plot([lxrange,uxrange],[0,0],'k','linewidth',1)
title('Entered function on given interval with current and next root and tangent line of the
curve at the current root')

% Calculate relative approximate error
ea=abs((x2-x1)/x2)*100;

% This portion adds the text and math to the bottom part of the figure window
subplot(2,1,1), text(0,1,['Iteration 2'])
text(0.1,.8,['x2 = x1 - (f(x1)/g(x1)) = ',num2str(x1)])
text(0,.4,['Absolute relative approximate error'])
text(0.1,.2,['ea = abs((x2 - x1) / x2)*100 = ',num2str(ea),'%'])
axis off

% ------------------------------------------------------------------------
% Iteration 3
figure('Position',wind)
x3=x2-subs(f,x,x2)/subs(g,x,x2);
ea=abs((x3-x2)/x3)*100;
m=-subs(f,x,x2)/(x3-x2);
b=subs(f,x,x2)*(1+x2/(x3-x2));
lefty=(maxi-b)/m;
righty=(mini-b)/m;
% This graphs the function and two lines representing the two guesses
clf
subplot(2,1,2),ezplot(f,[lxrange,uxrange])
hold on
plot([x2,x2],[maxi,mini],'g','linewidth',2)
plot([x3,x3],[maxi,mini],'g','linewidth',2)
plot([lefty,righty],[maxi,mini],'r','linewidth',2)
plot([lxrange,uxrange],[0,0],'k','linewidth',1)
title('Entered function on given interval with current and next root and tangent line of the
curve at the current root')

% Calculate relative approximate error
ea=abs((x2-x1)/x2)*100;

% This portion adds the text and math to the bottom part of the figure window
subplot(2,1,1), text(0,1,['Iteration 3'])
```

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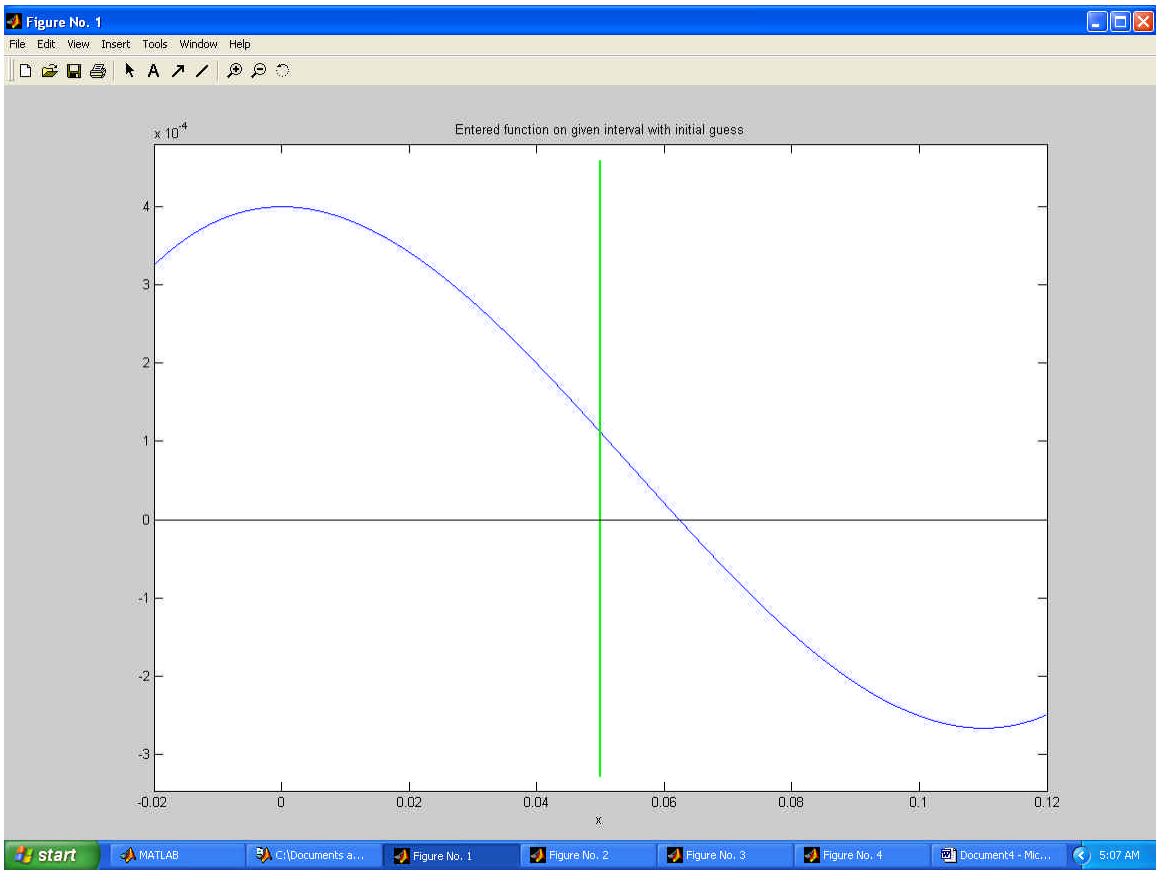
text(0.1,.8,['x3 = x2 - (f(x2)/g(x2)) = ',num2str(x3)])
text(0,.4,['Absolute relative approximate error'])
text(0.1,.2,['ea = abs((x3 - x2) / x3)*100 = ',num2str(ea),'%'])
axis off
```



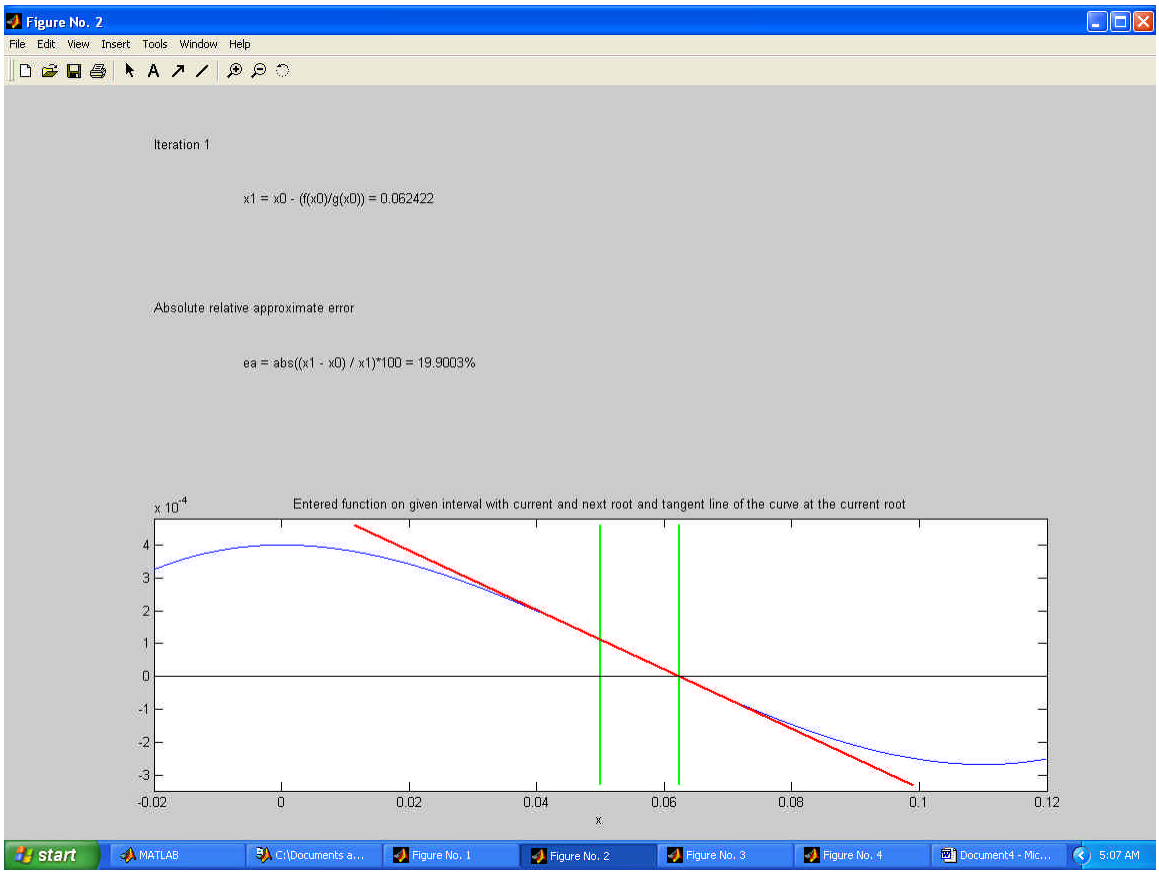


Figure No. 2
File Edit View Insert Tools Window Help
Iteration 1
x1 = x0 - (f(x0)/g(x0)) = 0.062422
Absolute relative approximate error
ea = abs((x1 - x0) / x1)*100 = 19.9003%
Entered function on given interval with current and next root and tangent line of the curve at the current root
x 10^-4
4
3
2
1
0
-1
-2
-3
-0.02
0
0.02
0.04
0.06
0.08
0.1
0.12
x
start
MATLAB
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Figure No. 1
Figure No. 2
Figure No. 3
Figure No. 4
Document4 - Mic...
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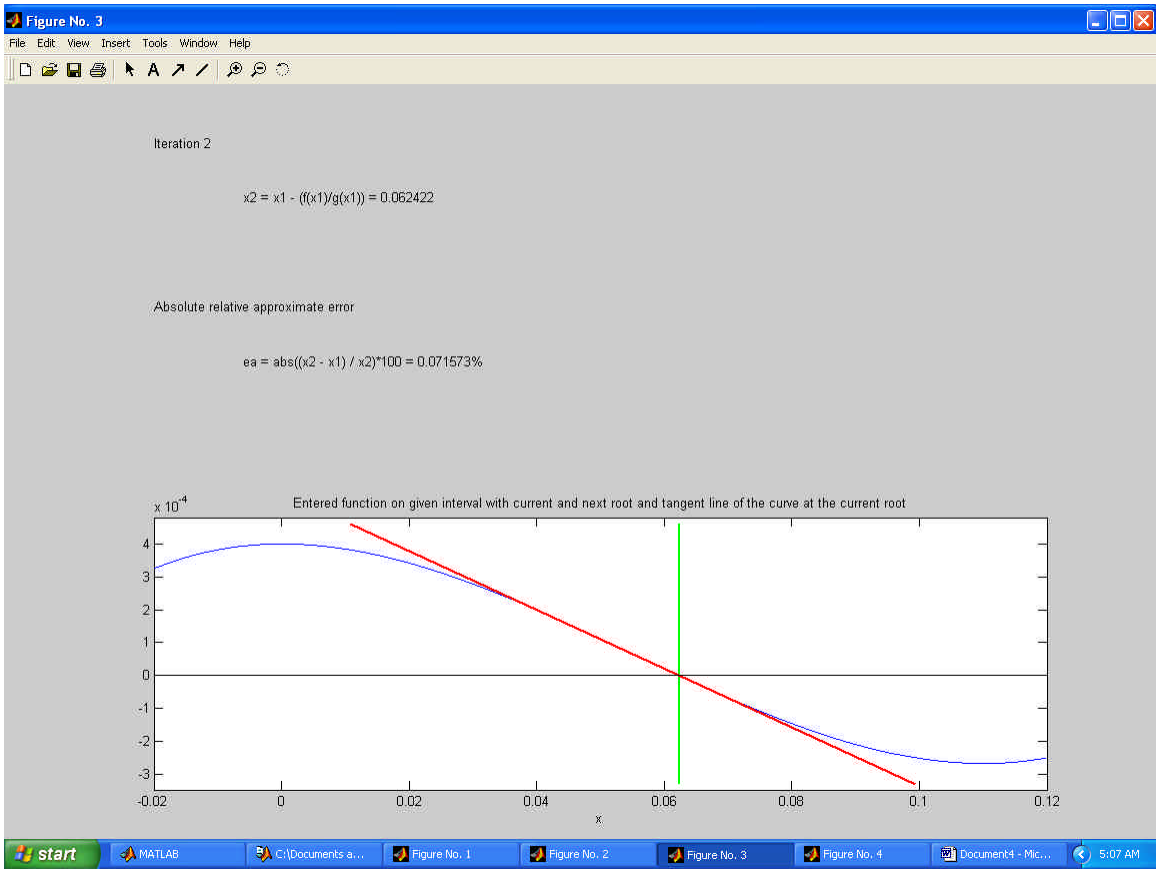
Figure No. 3
File Edit View Insert Tools Window Help
Iteration 2
x2 = x1 - (f(x1)/g(x1)) = 0.062422
Absolute relative approximate error
ea = abs((x2 - x1) / x2)*100 = 0.071573%
Entered function on given interval with current and next root and tangent line of the curve at the current root
x 10^-4
4
3
2
1
0
-1
-2
-3
-0.02
0
0.02
0.04
0.06
0.08
0.1
0.12
x
start
MATLAB
C:\Documents a...
Figure No. 1
Figure No. 2
Figure No. 3
Figure No. 4
Document4 - Mic...
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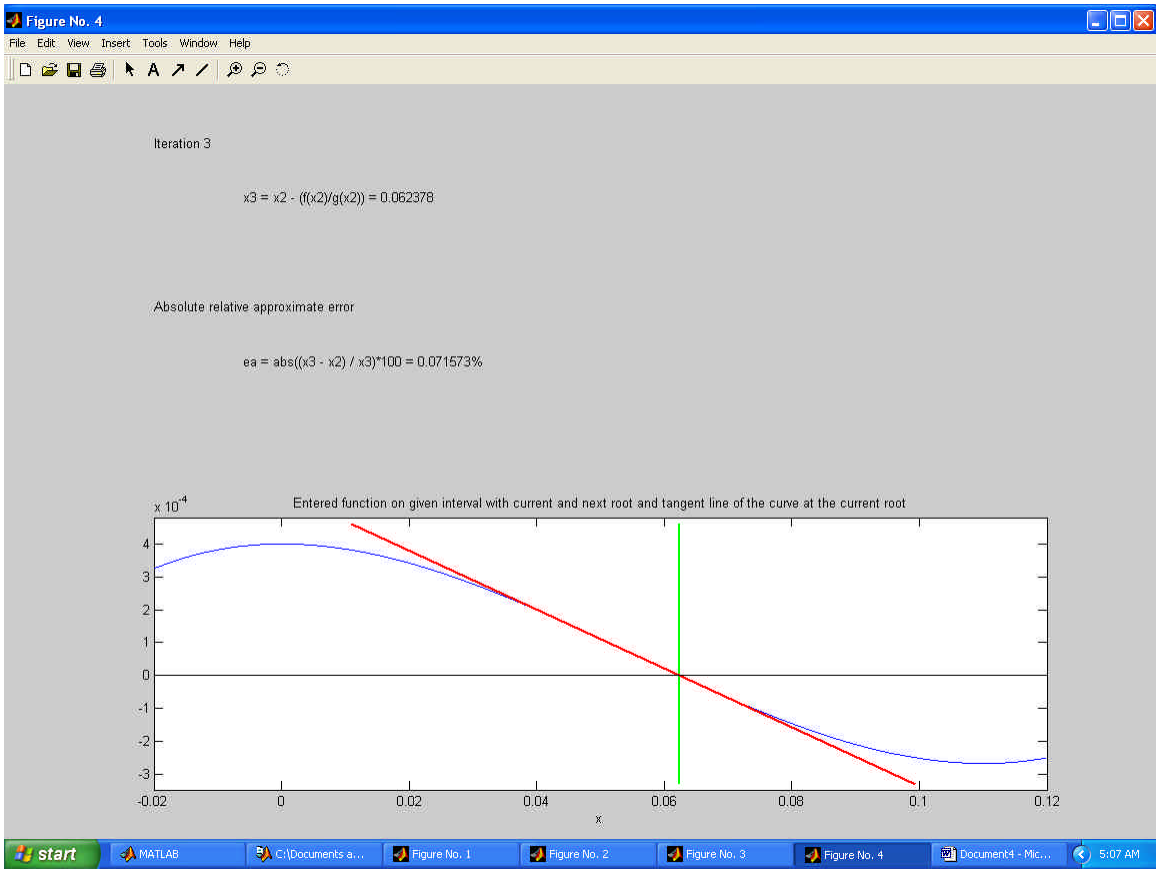
Figure No. 4
File Edit View Insert Tools Window Help
Iteration 3
x3 = x2 - (f(x2)/g(x2)) = 0.062378
Absolute relative approximate error
ea = abs((x3 - x2) / x3)*100 = 0.071573%
Entered function on given interval with current and next root and tangent line of the curve at the current root
x 10^-4
4
3
2
1
0
-1
-2
-3
-0.02
0
0.02
0.04
0.06
0.08
0.1
0.12
x
start
MATLAB
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Figure No. 1
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