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% Topic : Newton-Raphson Method - Roots of Equations
% Simulation : Pitfall - Zero slope
% Language : Matlab r12
% Authors : Nathan Collier, Autar Kaw
% Date : 21 August 2002
% Abstract : This simulation illustrates the pitfall of root jumping in 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 = sin(x);
% Initial guess
x0 = 7.75;
% Lower bound of range of 'x' to be seen
lrange = -10;
% Upper bound of range of 'x' to be seen
urange = 10;
%
% 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,lrange);
mini = subs(f,x,lrange);
for i=lrange:(urange-lrange)/10:urange
    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 calculates window size to be used in figures

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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
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-subst(f,x,x0)/subst(g,x,x0);
ea=abs((x1-x0)/x1)*100;
m=-subst(f,x,x0)/(x1-x0);
b=subst(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

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