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% Topic : Secant Method - Roots of Equations
% Simulation : Pitfall – Division by zero
% Language : Matlab r12
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% Abstract : This simulation shows the pitfall of division by zero of the secant method
% of finding roots of an equation  $f(x)=0$ 
%
% INPUTS: Enter the following
% Function in  $f(x)=0$ 
f = inline('sin(x)');
% Initial guess 1
xguess1 = pi/4;
% Initial guess 2
xguess2 = pi*3/4;
% Lower bound of range of 'x' to be seen
lrange = 10.0;
% Upper bound of range of 'x' to be seen
urange = -10.0;
%
% SOLUTION

% The following finds the upper and lower 'y' limits for the plot based on the given
% 'x' range in the input section.
maxi = f(lrange);
mini = f(lrange);
for i=lrange:(urange-lrange)/10:urange
    if f(i) > maxi
        maxi = f(i);
    end
    if f(i) < mini
        mini = f(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];

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% This graphs the function and two lines representing the two guesses
figure('Position',wind)
clf
fplot(f,[lrange,urange])
hold on
plot([xguess1,xguess1],[maxi,mini],'g','linewidth',2)
plot([xguess2,xguess2],[maxi,mini],'g','linewidth',2)
plot([lrange,urange],[0,0],'k','linewidth',1)
title('Entered function on given interval with initial guesses')

hold off

% -----
% Iteration 1
figure('Position',wind)
x1 = xguess2-(f(xguess2)*(xguess1-xguess2))/(f(xguess1)-f(xguess2));
ea=abs((x1-xguess2)/x1)*100;
m=(f(xguess2)-f(xguess1))/(xguess2-xguess1);
b=f(xguess2)-m*xguess2;
lefty=(maxi-b)/m;
righty=(mini-b)/m;
% This graphs the function and two lines representing the two guesses
clf
subplot(2,1,2),fplot(f,[lrange,urange])
hold on
plot([x1,x1],[maxi,mini],'b','linewidth',2)
plot([xguess1,xguess1],[maxi,mini],'g','linewidth',2)
plot([xguess2,xguess2],[maxi,mini],'g','linewidth',2)
plot([lrange,urange],[0,0],'k','linewidth',1)
plot([lefty,righty],[maxi,mini],'r','linewidth',2)
title('Entered function on given interval with upper and lower guesses')

% 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 = xguess2-(f(xguess2)*(xguess1-xguess2))/(f(xguess1)-f(xguess2)) =
',num2str(x1)])
text(0,.4,['Absolute relative approximate error'])
text(0.1,.2,['ea = abs((x1 - xguess2) / x1)*100 = ',num2str(ea),'%'])
axis off
hold off

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