Assignment 5

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%Name: Jim Nguyen
%Date: 3/13/2021
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Part a

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%Estimate the derivative of the function at the point x = 1 using 3-
point midpoint formula for the
%following values of h: h = 10#n for n going from 16 by integers to 1
 (e.g., h = 10#1
%Plot the step size h versus the relative error in a loglog plot.
%On the same figure, plot the estimated truncation error for those
 same h values in red.
%(Hint: Try plotting the 3rd derivative to figure out for which #
 value the the third derivative will be maximum at! )

%the code for part a

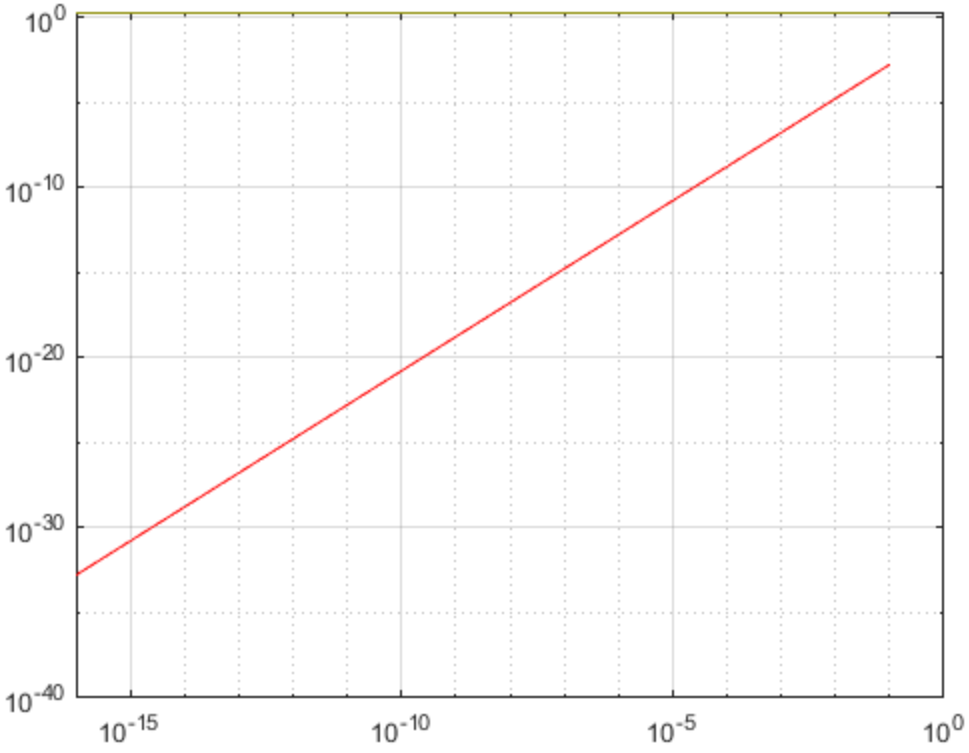
f = @(x) sin(x);
dddf = @(x) -cos(x); % the third derivative of sin(x) is -cos(x)
x = 1; % the pt we are estimating the derivative of the function
h =
 [10^-1,10^-2,10^-3,10^-4,10^-5,10^-6,10^-7,10^-8,10^-9,10^-10,10^-11,10^-12,10^-1
 the multiple values of h
CD3 = zeros(1,16);
CD3_truncation_error = zeros(1,16);
CD3_relative_error = zeros(1,16);

for i = 1:16
    CD3(i) = (1/(2*h(i)) * (f(x + h(i)) - f(x - h(i))));

    maxdddf = max(dddf(h(i))); % finds ths max value of all the
 elements
    indexOfFirstMax = find(dddf(h) == maxdddf,1,'first'); % gets the
 first element that is the max value
    E = h(indexOfFirstMax); % gets the x value at the index

    CD3_truncation_error(i) = -h(i)^2 / 6 * dddf(E);
    CD3_relative_error(i) = abs(dddf(x) - CD3(i)) / abs((dddf(x)));
end

loglog(h,CD3_relative_error,'y'); % this is plotting the step size h
 verus relative error in a loglog plot
hold on
loglog(h,CD3_truncation_error,'r'); % this is just plotting the
 estimated truncation error for same h in red.
hold off
grid on
```



Part b We can see that as h grows smaller, then the error decreases. This can be seen in the red line. The yellow line at the very top of the graph shows the truncation error with this formula. As you can see, it looks really good since the truncation error isn't moving around and in general a horizontal line. The actual error does follow the truncation error estimate I would assume since the truncation error isn't moving around and is just mainly a straight line.

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