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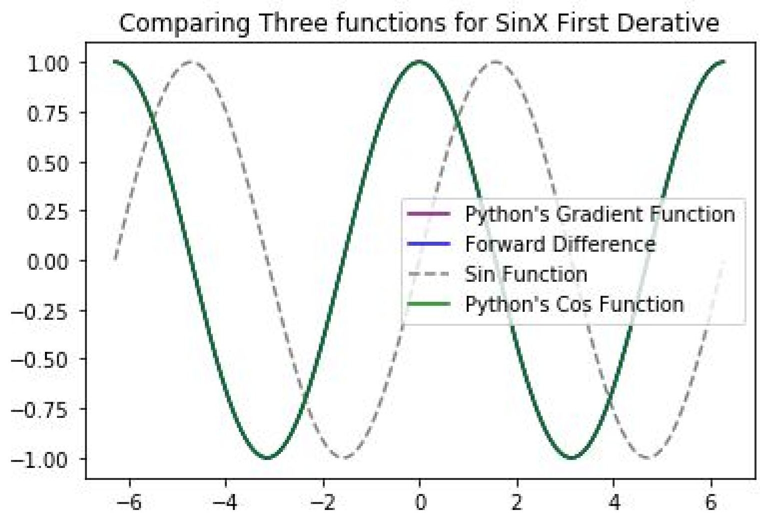
Exercise08
Difference Algorithms

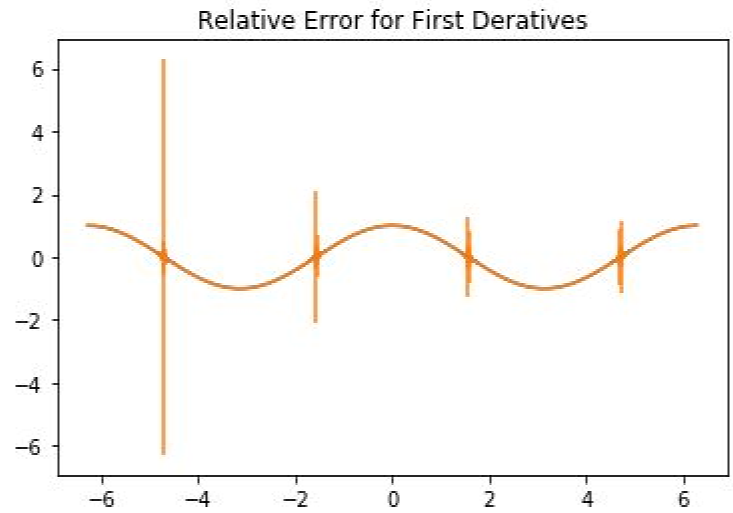
Derive the definition of the derivative by expanding: $f(x+h)$

$$f(x+h) \ = \ f(x) \ + \ f^{'}(x)(x-h) \ - \frac{f^{''}(x)}{2!}(x-h)^2 - \frac{f^{'''}(x)}{3!}(x-h)^3 \ldots - \frac{f^{n}(x)}{n!}(x-h)^n$$

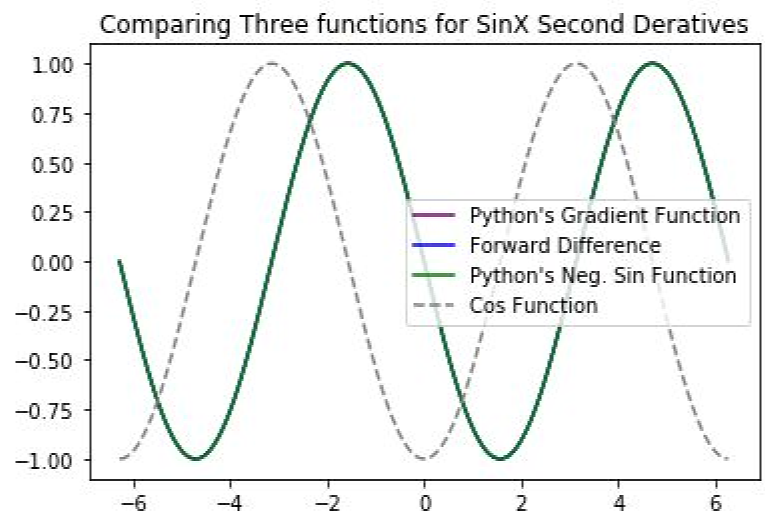
When looking at all the functions, the resultant function, the forward difference scheme and the gradient function, the results are the same. You can see this when looking at the graph below and how the lines combine with the cos function to create a more blue/green type color.



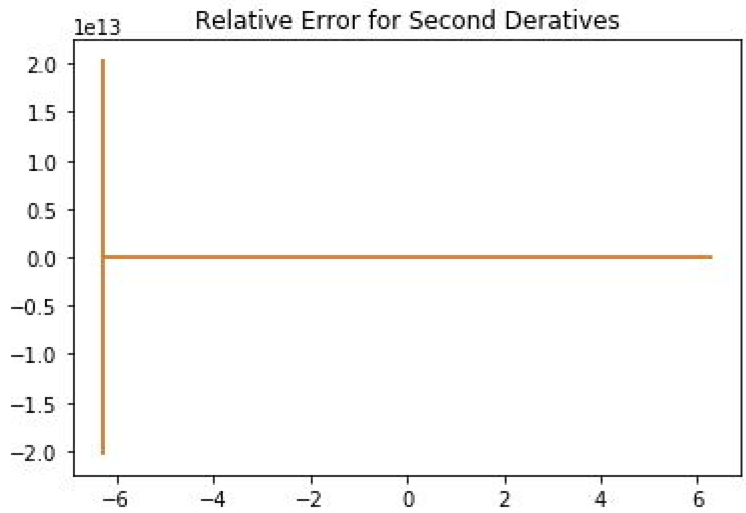
When looking at the error plot, it looks rather weird and it seems the error is very small for most values, but some really throw off the plot and extend very far. I am not quite sure why the error plot results look as they do below. With the results from the graph above, it would seen that all the error would lie very close to zero.



When looking at the second derivative we see that the different methods are able to produce similar results again as they did for the first derivative. You can see this in the graph below when the functions for the forward difference and the gradient functions combine with the negative sin function to create that same blue-green color.



When viewing the error plot for the second derivative, there is a similar result as before but this time only one major spike. You can see in the graph below that most of the values are around zero but there is one spike negative 6. Again, I am not quite sure why, when looking at the scaling, it seems that there are some values that are extremely off, but in viewing the graph above or the values, they seem to all be in agreement.


Relative Error for Second Deratives
1e13
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−6
−4
−2
0
2
4
6