Physics PH256 – HW Assignment 2 (due 9/08/2017)

1. Write python functions that can compute the sine, cosine, and tangent of any input value, x, using the Taylor series of each trigonometric function.
2. Create three plots, one for each trigonometric function, using matplotlib that show the convergence of your functions to the exact values as you increase the number of terms in the Taylor sum. Use $\frac{\pi}{4}$ for the x input value. In each plot, include a horizontal line that shows the exact value (use `matplotlib.pylab.axhline`). Make sure to label the axes and include a legend for each plot.
3. Create a second set of three plots, one for each trigonometric function, using matplotlib that show the percent error, $\% \text{ error} = \frac{\text{approx} - \text{exact}}{\text{exact}} \times 100$, of your functions compared to the exact values as you increase the number of terms in the Taylor sum. Use $\frac{\pi}{4}$ for the x input value. Make sure to label the axes and include a legend for each plot.

Additional questions for grad Students

4. Modify the three functions created in part 1 so that the code uses any number of terms needed to generate a result with a given tolerance that is an additional optional input to the function, e.g., `def sin(x, eps=1E-5):`. To do this, you will need to calculate the absolute relative error, $\epsilon(n)$, in the current value of the sum, $f(n)$, compared to the value of the previous term, $f(n-1)$.

$$\epsilon(n) = \left| \frac{f(n) - f(n-1)}{f(n)} \right|$$

5. Create a plot that shows the number of summation terms needed to reach a given tolerance (N vs ϵ) for each of the three trigonometric functions. For the plot you can use tolerances from 1E-1 to 1E-8.

Acceptable submission format:

To submit the homework to Blackboard, please upload a single Jupyter notebook that includes all your code, plots, and comments or alternatively, a single zipped file that includes your executable python code in a text file and a PDF file showing your plots and comments. Please name the file you upload as `Lastname_HWx.xxx`