

**PHYS 240 homework #3 – due Feb 5 2013, 5:25pm, upload to Canvas**

**Error analysis and using L<sup>A</sup>T<sub>E</sub>X**

1. Consider the Taylor expansion for the exponential

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots = \lim_{N \rightarrow \infty} S(x, N)$$

where  $S(x, N)$  is the partial sum with  $N + 1$  terms. (a) Write a program in Python that plots the absolute fractional error of the sum,  $|S(x, N) - e^x|/e^x$ , versus  $N$  (up to  $N = 60$ ) for a given value of  $x$ . Test your program for  $x = 10$ ,  $2$ ,  $-2$ , and  $-10$ . From the plots, explain why this is not a good way to evaluate  $e^x$  when  $x < 0$ . (b) Modify your program so that it uses the identity  $e^x = 1/e^{-x} = 1/S(-x, \infty)$  to evaluate the exponential when  $x$  is negative. Explain why this approach works better.

2. Submit your assignment using L<sup>A</sup>T<sub>E</sub>X, converting the final result to PDF. Also submit your Python code and `.tex` file separately. Include the first equation above, written using L<sup>A</sup>T<sub>E</sub>X, and also include the plots, imported by L<sup>A</sup>T<sub>E</sub>X.