Computational Physics

Problem Set 3, September 16, 2025

Due: Monday, September 22, 2025 **by 11:59 PM**

Link to join GitHub classroom to submit homework solution: **Click here**.

Submit to the TA a link to the repository checked into your GitHub account containing a Jupyter Notebook including solutions for homework problems. The directory tree of the repository should include a directory for "homework" with subdirectories for each individual homework assignment.

You *must* label all axes of all plots, including the units if applicable.

1 Round-Off Errors in the Quadratic Solver (25%)

Exercise 4.2 in *Newman* (pg. 133). For part B, make sure to assess the precision of the results for each case by inserting the solutions back into the quadratic equation and seeing which set best satisfies the equality.

2 Derivative Precision (25%)

Exercise 4.3 in *Newman* (pg. 133).

3 Exponential Approximation (30%)

A) Write a program that calculates $\exp(-x)$ as the finite sum

$$e^{-x} = \sum_{n=0}^{N} \frac{(-1)^n x^n}{n!} \,. \tag{1}$$

B) Calculate your series for $x \leq 1$ and compare it to the built-in function *numpy.exp(x)*. You may assume that the built-in function is exact. Stop your summation at an N value for which the next term in the series will be no more than 10^{-7} of the sum up to that point.

C) By progressively increasing x from 1 to 10, and then from 10 to 100, use your program to determine experimentally when the series starts to lose accuracy.

D) Make a series of plots of the error vs. N for 4 different values of x.

4 Object-oriented programming (20%)

Make up your own example of a class and code it in Python, similar to the "House" example I gave in the Jupyter notebook. Your class should have at least 4 attributes and

2 methods. Try to come up with something fun. Extra 10% credit will be given to the top 2 most creative classes presented.