

Pre-class assignment #8

PHY-905-005
Computational Astrophysics and Astrostatistics
Spring 2023

This assignment is due the evening of Monday, February 6, 2023 Turn in your code and all materials via the GitHub Classroom.

Reading:

1. Section 8.6 of *Computational Physics*, by Newman.
2. (optional) [Wikipedia article on the Shooting method](#)
3. (optional) [Wikipedia article on boundary value problems](#)
4. (optional) Methods of solving initial value ODEs: Sections 4.6-4.9 of *An Introduction to Computational Physics*, by T. Pang (PDF; provided)

Your assignment:

Consider the equation

$$y'' = 4y \quad (1)$$

over the interval of $[0, 2]$. It has the boundary conditions $y(0) = 5$ and $y'(2) = 218.282706$. Implement your own version of the Shooting Method described in Section 8.6.1 of Wilson (Section 4.7 of Pang), and verify that the solution over the given interval matches this expression for y :

$$y(x) = 2e^{2x} + 3e^{-2x} \quad (2)$$

Demonstrate agreement by plotting the numerical answer and the analytic one on the same plot. Re-use your code for the secant method and one of your better numerical integrators (midpoint/RK2 or RK4 - not Euler's method!) when creating this new method!

Separately, solve the problem using the SciPy `integrate.solve_bvp` method. Do you get the same answer?

Put your answers and observations, as well as any remaining questions that you might have, in the file `ANSWERS.md`. Commit that, as well as your code, plots, and related materials, to the repository.