

In-class assignment #8

PHY-905-003

Computational Astrophysics and Astrostatistics
Spring 2023

Instructions: We're going to re-use the code for your pre-class assignment, where you used the shooting method to solve a boundary value problem. Given the equation:

$$\nabla^2 u = -\pi^2(u - 3) \tag{1}$$

whose analytic solution has the form

$$u(x) = \cos(\pi x) + 2\sin(\pi x) + 3, \tag{2}$$

Show that you can calculate the solution using the shooting method on the interval $[0, 1]$ for the initial conditions $u(0) = 4$, $u'(1) = -2\pi$ as well as the initial conditions $u(1) = 2$, $u'(0) = 2\pi$. Can you write a general version of the shooting method code that can take in any arbitrary pair of $u(x)$ and $u'(x)$ values at the boundaries (one on each side of the interval - either u or u' on each side, and could be u on both sides, u' on both sides, or a mixed pair of u and u') and get the correct solution? Test it by coming up with a few different few different expressions for u and verify that it works correctly. Can you find any analytic expressions for u that are unsolvable with the shooting method?

What to turn in: Turn in `ANSWERS.md`, any source code you wrote, any plots you created (and the scripts you used to create them). **Do not** turn in object files or executables!