Implementation

In this project I attempted to model the linear Advection-Diffusion equation by Implementing 4 finite difference schemes. the coding for this project was going very smoothly until I had to implement output.f90, advec_diff.f90 and plotter.py. I believe that most of my finite difference scheme implimentations are correct and if I had started earlier and given myself more time I would have been able to flesh out the output portion of the code better.

Questions

a

I was unable to figure out how to implement a way to only write the times when t/tmax = 0, 0.2, 0.5, 0.8, 0.1 I was able to write out the solution at every time step, but then when I pivoted to work on my solution to the advection portion, this part of the code broke and I didnt have time to look back to find out what's wrong.

b

at grid size N = 32, our solition reaches stability at tmax = 1.9184891327856113, at grid size N = 128, our solution reaches stability at tmax = 1.8369945275333388, however our run time is much longer this shows tells us that our grid size helps us determine when our solution will reach stability which can effect tmax

c

when tdiff fails to satisy the CFL condition our solution is unstable and we arent garunteed to ever reach stability

d

at grid size N = 32 and k = 1.156, our solition reaches stability at tmax = 1.9184891327856113. when we keep the grid size the same but increase k by a factor of 10 to k = 11.56 our solution reaches stability at tmax = 0.21326401654410712 which is much much faster, this is because our k value represents diffusivity which you can see from the units cm^3/s is a measurement of the rate that heat diffuses over a cubic centimeter, by increasing it we diffuse faster, and by decreasing it we diffuse slower which in turn causes us to reach stability earlier or later.

e

not super sure how to do this

f

these plots are using grid size n = 64, and a = 1, my code can produce other grid sizes but i did not have time to do this

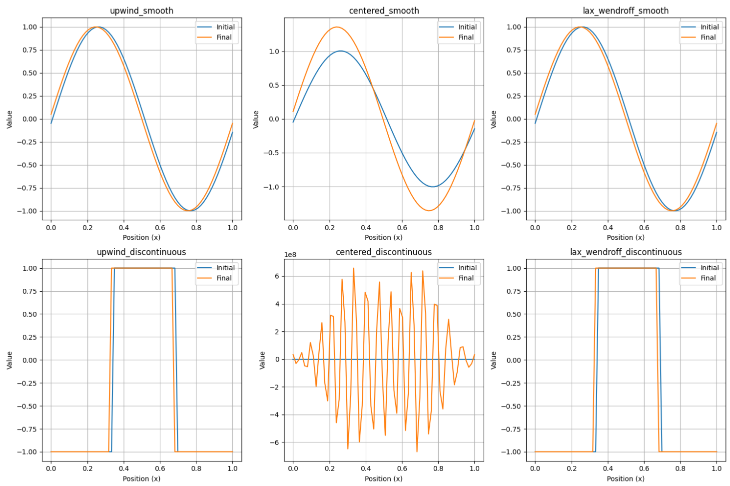

Figure 1: comparison between discrete and continuous advection schemes

it appears that the centered scheme is the least accurate over both continuous and discrete initial conidtions, it seems like there is minimal difference between the upwind and lax-wendroff schemes.

g

I did not have time to try g

conclusion

this was a very fun project and I should have started much sooner, I let it lull me into a false sense of security because everything up until the plotting seemed like smooth sailing I believe that all my code is operational and I would only need another day to fix the issues that I currently have.