Assignment #03 – due Tuesday, February 7, 2022 by 12:30 pm

Instructions

- At the end of each question, rank your confidence in the answer from 1 to 5; 5 being very confident and 1 being 'a guess'. Try not to forget!
- Please include "CFD:" in the subject line of any email correspondence.
- Upload a *formatted* PDF version of your assignment to Canvas.
- Append any code into the pdf as *text*.
- Questions labeled **EGFD 6037** are for graduate students only.

Questions

1. Write a program that computes the smallest value of α that satisfies the expression: 2 pts

$$1 + \alpha > 1$$

Does the answer agree with your expectation? Is the answer machine dependant? Is the answer different for single and double precision variables?

2. Consider the non-linear Burger's equation 4 pts

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} = 0 \quad \text{where} \quad -\infty \leq x \leq \infty \quad \text{and} \quad t \geq 0$$

with the following initial condition

$$u(x, 0) = f(x)$$

where

$$f(x) = \begin{cases} u_0 + A \cdot \sin(x) & \text{for} \quad 0 \leq x \leq 2\pi \\ u_0 & \text{otherwise} \end{cases}$$

It can be shown that the exact solution to this problem is

$$u = f(x - ut)$$

Use $u_0 = 1.0$ and $A = 1.0$ to find u at $t = 0.25, 0.5, 1.0, 2.0, 4.0, 8.0$, and 10.0.

3. Find x in the following expression: 4 pts

$$cos(x) - x = 0$$

   (a) analytically

   (b) graphically

   (c) using any root finding method. Aim for 8 decimal places accuracy. Keep track of the value of x in every iteration. Plot x vs # of iterations. Discuss your observations.

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4. Solve question #3 using the hybrid root finding method. Compare and contrast the result. 2 pts