FLORIDA INSTITUTE OF TECHNOLOGY
AEROSPACE, PHYSICS, AND SPACE SCIENCES DEPARTMENT

AEE 5150-E1: Computational Fluid Dynamics
Fall 2021

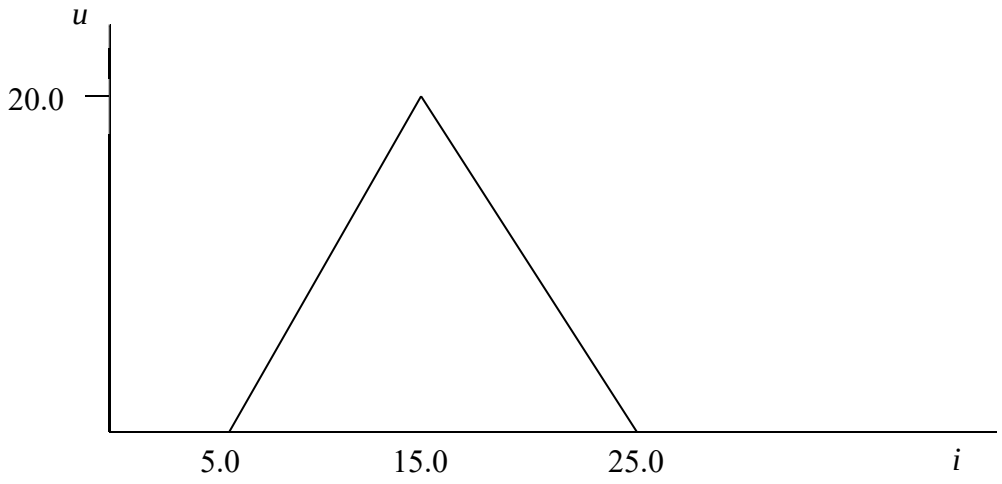
Coding Project 3

Due October 28, 2021

1. A wave is propagating in a closed-end tube. Compute the wave propagation up to $t = 0.15$ sec. by solving the first-order wave equation. Assume the speed of sound to be 200 m/s. The wave has a triangular shape (see figure) which is to be used as the initial condition at $t = 0.0$. You will need to determine the initial u values on the slopes of the triangle and specify them in your code. Solve the problem by the following methods:

FTBS Explicit
Lax-Wendroff
Euler's BTCS Implicit

Use a $\Delta x = 1.0$ and $IM = 71$ $(1 \le i \le 71)$. For each case, use a $\Delta t = 0.005$, 0.0025, 0.00125 seconds and compare solutions. Run the solution to $t = 0.15$ sec. Print and plot the solution for each method at the initial condition, the end condition, and at the half-way point.



2. Use MacCormack's explicit method to solve the Burgers equation. The initial condition is specified as

$$u(x,0) = 5.0 \qquad 0.0 \le x \le 20.0$$
$$u(x,0) = 0.0 \qquad 20.0 < x \le 40.0$$

Print the solution at intervals of 0.4 seconds up to t = 2.4 sec. Run the code twice, once for each of the following conditions:

$$\Delta x = 1.0 \qquad \Delta t = 0.1$$
$$\Delta x = 1.0 \qquad \Delta t = 0.2$$

Plot each solution at each print interval.