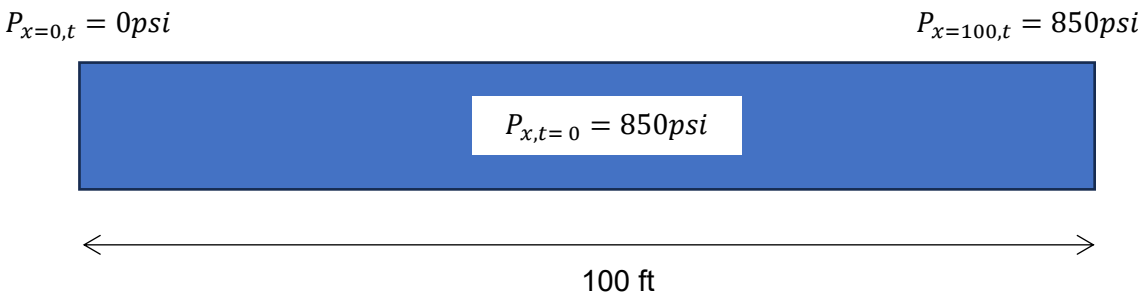
Mech 568 – Assignment 01 – Finite Difference

Please fully document your homework solution and submit via Gradescope, be sure to include any code written and adequately label and title plots.

Problem Statement: For this assignment you will solve the 1-D wave equation for an acoustic wave traveling through water using the finite difference method in both an implicit and explicit form. The wave equation is defined as

$$\frac{\partial^2 P}{\partial t^2} = c^2 \frac{\partial^2 P}{\partial x^2}$$

where c is the speed of sound (1,125 ft/s for water) and P is the acoustic pressure. Consider the 1-D case of water in a channel or pipe, the initial pressure in the pipe is set to a **steady-state** of 850psi, one end of the pipe fractures, creating an immediate pressure gradient of -850 psi (e.g. a boundary condition of 0psi at 1 end), consider the other end an infinite boundary condition (e.g. force the pressure to be 850 psi). Discretize the pipe into a finite difference mesh and solve for the pressure distribution in the pipe at time increments of 0.001s for 0<t<0.05s using both an implicit scheme and an explicit scheme. Provide plots of the pressure distribution (or a video).



In your homework solution, provide a comparison between the implicit and explicit schemes, did their solutions differ? Did you have to change the time step for each? Which one was more challenging for you to implement?