

Assignment 7
Hyperbolic first order wave equation
Due/Viva: 2:30 pm, 15 Oct, 2025

Write the following hyperbolic equation solvers that solve the one-dimensional first order wave equation

$$\frac{\partial u}{\partial t} = -a \frac{\partial u}{\partial x}$$

- a. Lax-Wendroff (explicit)
- b. BTCS (implicit)

Solve the above equations for $a = 250$ m/s, Disturbance at $t=0$, such that

- i. $u = 0$ for $0 \leq x < 50$
 - ii. $u = 100 \sin\left(\frac{\pi(x-50)}{60}\right)$ for $50 \leq x \leq 110$
 - iii. $u = 0$ for $110 < x \leq 400$
- (this is a sine wave disturbance)

Boundary condition is $u = 0$ at both ends. Divide the domain using $\Delta x = 0.01$. Choose Δt such that $c = 0.1$ for the explicit scheme. Take $\Delta t = 0.1$ s for the implicit scheme.

Make a computer animation of wave motion with data at each time-step for both schemes.

Compare solution of u at $t = 0.5$ s for both schemes on the same plot.