1. Modify *diff1.m* or write your own program to solve numerically the following diffusion equation

\[ u_t = u_{xx}, \quad x \in [0, 1], t > 0, \]

with the initial condition \( u(x, 0) = 4(1 - x)x \) and the Neumann boundary conditions such as

\[ u_x(0, t) = 0, \quad u_x(1, t) = 0, \]

or

\[ u(0, t) = 1/2, \quad u_x(1, t) = 0. \]

2. Derive the CFL condition for the diffusion equation (verify the result from our class).

3. Solve the following advection equation numerically

\[ u_t + u_x = 0, \quad x \in [0, 1], t > 0, \]

with the initial condition

\[ u(x, 0) = \sin(\pi x), \]

and the boundary condition

\[ u(0, t) = \sin(\pi(0 - t)). \]