

# Homework 3

## I. MODIFIED EQUATIONS

Consider the advection equation

$$u_t + au_x = 0.$$

The numerical methods below satisfy *modified equations* to higher order than the advection equation itself. See Leveque §8.6 for more on modified equations.

Assume  $\lambda = \frac{\Delta t}{\Delta x} = \text{constant}$ .

### A. Explicit central differencing

Find a modified equation for which explicit central differencing gives an  $O(\Delta t^2)$  approximation. What modification to the explicit central differencing scheme does this suggest to make it a stable numerical scheme for the advection equation? What is the resulting scheme called?

### B. Lax-Wendroff

Find a modified equation for which the Lax-Wendroff method gives an  $O(\Delta t^3)$  approximation.