Homework 2 18.086 Spring 2006

for FRIDAY 3/3/06

Combine numerical experiments with analysis for *ONE* of these PDE's:

1. $\boldsymbol{u_t = c\, u_x + d\, u_{xx}}$ Create the "Figure 5.12" described in the notes and test "implicit diffusion" with $d\Delta^2 U$ at time $n+1$.

2. $\boldsymbol{u_t = i\, u_{xx}}$ (*Schrödinger's equation*) Stability conditions for explicit and implicit; examples and code.

3. $\boldsymbol{u_t = c\, u_x}$ Use the website code or your own to compare upwind–LF–LW–leapfrog for different $r = c\Delta t/\Delta x$. How does the Lax-Wendroff oscillation depend on r? Does the solution from a step function approach a steady profile? What is width $W\Delta x$ of the discrete shock in each method?

4. $\boldsymbol{u_t = u u_x}$ (*Conservation law*) Write a code to test upwind vs. Lax-Wendroff on examples when shocks or fans form. Refer to 16.920 notes on `ocw.mit.edu`.