CIEG 675
Homework #9 Due **Wednesday May 13, 2009**

1) Solve $\frac{dy}{dx} = -y(x)$ subject to initial condition y(0)=1. Note the real answer is e^{-x}. Do this solution in matlab 2 ways. FIRST do it using a forward difference. SECOND, do it using a central difference. For each, use 3 different dx values and make a table showing the root-mean-square error (compared to real answer) as a function of dx and numerical scheme. Also show a plot of your solutions.

2) Solve the heat equation $\frac{\partial T}{\partial t} - \alpha \frac{\partial^2 T}{\partial x^2} =$ on a rod from 0 to 1 subject to the boundary conditions T(0,x)=0, T(0,t)=100, $\frac{\partial T}{\partial x}(1,t) = 0$. Do this problem using a forward time centered space solution (except at right boundary). You choose the value for thermal diffusivity. Make a movie showing the change in T as a function of x and t. Choose any method you wish to do this (aviobject, or output numerous images and do in quicktime or similar, can also use screen for movie function). Make it purty! HINT: choose small time steps and dx so the model does not blow up)

3) Solve the 1D transport equation given by $\frac{\partial T}{\partial t} + u\frac{\partial T}{\partial x} - \alpha \frac{\partial^2 T}{\partial x^2} = 0$ on the domain from 0 to 1 subject to the same boundary conditions as in problem 2. you select *u* (the transport speed); make it small because scheme can become unstable if

$C^2 \leq 2s \leq 1$ for

$$C = u\frac{\Delta t}{\Delta x} \quad (currant\#)$$
$$s = \alpha \frac{\Delta t}{\Delta x^2} \quad (like\ a\ diffusion\ \#)$$

Similar to 2 make a cool movie of the results.