18.085 Computational Science and Engineering I
Fall 2008

18.085 MATLAB 1

This homework is about convection-diffusion, an important equation. There will be a boundary layer of rapid change at one endpoint when the conditions are $u(0) = u(1) = 0$ and the u' convection term dominates. The exact solution to $-Du'' + u' = 1$ is $u = x - (\exp(x/D) - 1)/(\exp(1/D) - 1)$.

1) Graph that exact solution for $D = 1/25$

2) Approximate $-Du''$ as usual by DK/h^2 (try 3 different values of h)

3) Approximate u' by centered and forward and backward differences (same h)

4) With `f = ones(n,1)` solve the matrix equations and label graphs of u

5) Write a SHORT conclusion from your tests—which method(s) to use?