COMP 6361

Numerical Analysis of Nonlinear Equations

Assignment 1

Due Thursday February 11.

Fully implement the algorithm for the time-integration of a scalar nonlinear time-dependent diffusion problem, as described on Pages 417-424 of the posted Background Notes. Apply your implementation to the Fisher Equation and the time-dependent Gelfand-Bratu problem, as described in the Background Notes. Also apply it to at least one nonlinear time-dependent diffusion problem of your choice.

Instead of using the Crank-Nicolson scheme, which uses the Trapezoidal Rule for the discretization in time, you may use Implicit Euler for this purpose. Use Newton's method to solve the nonlinear equations that arise at each step in time. The tridiagonal matrices that arise in Newton's method must be solved efficiently, using the algorithm on Pages 37-39 of the Background Notes. Make sure not to use full, square matrices for storing the tridiagonal matrices.

For full credit all programming must be your own. If you use library routines that this must be acknowledged.

Experiment with different grid-sizes in space and different step sizes in time, so that you are confident that the results you report are indeed accurate. Also experiment with different initial conditions. Describe your results in a concise way, and include representative Figures and Tables, where useful.

General requirements for the assignments can be found in the "*Guidelines for the Preparation of the Assignments*" posted on the course web page

`http://users.encs.concordia.ca/~doedel/courses/comp-6361/`