Matlab Exercises_Recitation 8 — 2.086 Spring 2012

Recitation 8: Wednesday, 4 April / Friday, 6 April
MATLAB Exercises_Recitation 8 due: *Monday, 9 April 2012 at 5 PM by upload to Stellar*

Format for upload: Students should upload to the course Stellar website a folder

`YOURNAME_MatlabExercises_Rec8`

which contains the completed scripts and functions for the assigned MATLAB Exercises_Recitation 8: all the scripts should be in a single file, with each script preceded by a comment line which indicates the exercise number; each function `.m` file should contain a comment line which indicates the exercise number.

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1. Consider the ordinary differential equation (ODE) initial value problem (IVP) for $u(t)$ given by

$$\begin{cases} \dfrac{du}{dt} = -2u + 1, \ 0 < t \leq 1 \ , \\ u(t=0) = 1 \ . \end{cases} \tag{1}$$

   Write a MATLAB script which

   (i) implements the Euler Forward scheme applied to equation (1) for $\Delta t = 0.01$ and $J = 100$: the script should compute $\tilde{u}^j = \tilde{u}(t^j = j\Delta t)$ (an approximation to $u(t^j)$) for $j = 0, 1, \ldots, J$, and display $\tilde{u}^J = \tilde{u}(t^J = 1)$;

   (ii) evaluates and displays the exact solution at time $t = 1, u(t = 1)$.

   Note in (ii) you should develop the expression for $u(t)$ analytically and then in your script just evaluate this expression for $t = 1$.

2. Repeat Question 1 but now (in a new script) for the Crank-Nicolson scheme rather than the Euler Forward scheme.

3. Consider the matrix `A = [0,1;-2,-0.01]`. Write a MATLAB script which computes and displays

   (i) `lamvec = eig(A);`

   (ii) a 2×1 array `lamvec_byhand` which contains the exact eigenvalues of `A`.

   Note in (ii) you should develop expressions for the eigenvalues analytically (from the characteristic polynomial) and then in your script just evaluate these expressions.

2.086 Numerical Computation for Mechanical Engineers
Fall 2012