Tufts University
Department of Mathematics
Fall 2018

MA 126: Numerical Analysis

Homework 11 (v1.1) [1]

Assigned Monday 3 December 2018
Due Monday 10 December 2018 at 5 pm

This assignment will require a computer.

1. Atkinson & Han, Section 8.2, Problem 1b

2. Atkinson & Han, Section 8.3, Problem 6

3. Use the unstable method presented in class

$$y_{n+1} = y_{n-1} + hf(x_n, y_n)$$

   to try to integrate the ODE $y' = -y$. Use the initial condition $y_0 = 1$, and figure out how to choose y_1 to delay the onset of the instability for as long as possible. Taking $h = 0.01$, for approximately how many iterations can you run this method before the unstable oscillation is manifest on a plot of the results?

4. Use the Crank-Nicolson (trapezoidal) method to perform the same integration. Compare y_{100} with e^{-1}, and y_{200} with e^{-2}. Can you use Richardson extrapolation to obtain additional accuracy.

5. Repeat the previous problem using the second-order Runge-Kutta method described in Eq. (8.8.1).