EP501: NUMERICAL METHODS FOR ENGINEERS AND SCIENTISTS
Fall 2016, J. B. Snively

ERAU Daytona Beach
Homework Assignment Project #7, Due: Friday 5PM, 12/2.

For this assignment... Understand and implement numerical methods for ODEs.

Submission Instructions: Submit to my mailbox, on paper, your work done by hand and printouts of the results with discussion ("Publish", in as few pages as possible).
Email your .m file to **snivelyj@erau.edu**, with the subject "EP501: HW7 Last Name, First Name".

1) We discussed Runge-Kutta methods in class, however we did not complete a derivation of the basis for the second order method (simply, we demonstrated how it worked, and that it could reproduce the modified midpoint and modified Euler methods). Here, work problem 80, to complete the steps that we omitted.

2) Problem 81 outlines a third-order Runge-Kutta (RK3) method that is not consistent. Fix it by letting $y_{n+1}=y_n+(1/4)*k_1+(3/4)*k_3$. Starting with our example for the RK4 method, implement this third-order method for the same problem and demonstrate clearly that their error agrees with expectations (i.e., for a third-order method).

3) Derive the "amplification factor" (Gain) G for this RK3 method and determine the constraint for conditional stability. How does this compare with stability criteria for RK2 and RK4?

4) Example 8.1 demonstrates a "shooting method" solutions to a simple ODE boundary value problem. Implement in Matlab the numerical solution for this approach, for a grid spacing Δx=0.0625 cm. Calculate your resulting error with the exact solution (see introductory material in Section 8.1, p. 436-437) and quantitatively compare your "high-resolution" solution with those in Figures 8.7.

5) Example 8.4 demonstrates "equilibrium" solutions to a simple ODE boundary value problem. Implement in Matlab numerical solutions for this approach, for a grid spacing Δx=0.0625 cm. Calculate your resulting error with the exact solution (see introductory material in Section 8.1, p. 436-437) and quantitatively compare your "high-resolution" solution with those in Figures 8.9. (Certainly expect similar results to problem, 5, too!)