Assignment #9 (*revised*)

Due Thursday, 5 December 2019, at the start of class

This Assignment is based on Chapter 11, a good introduction to solving ordinary differential equations on computers. Please read all of sections 11.1 and 11.2; the latter is very substantial! You can skip section 11.3, but read section 11.4 through page 289; you can skip the rest (pages 290–294). In addition to doing the exercises, I recommend playing with additional `ode45()` and Euler's method examples—the latter using codes you write yourself.

When you turn in homework problems involving MATLAB/OCTAVE, the following two expectations always apply:

1. The commands/code that you ran are shown, along with the results.
2. Minimal paper is used, while still fully answering the question.

Do the following exercises:

CHAPTER 11

- Exercise 1 on page 295.
- Exercise 3 on page 295.

  For Exercises 4 and 5, skip Heun's method, but indeed "do the same" for the (explicit) midpoint method defined in section 11.2.3.
- Exercise 4 on page 295.
- Exercise 5 on page 295.
- Exercise 6 on page 295.
- Exercise 15 on page 298.
- Exercise A. Consider the ODE IVP

$$y' = 1 + y^2, \qquad y(0) = 0.$$

  Note that $f(t,y) = 1 + y^2$ in this problem.

  (a) Apply the trapezoid method (11.18) to the above ODE, supposing $y_0 = 0$ and $h = 0.1$. (*You will write down a nonlinear equation for y_{k+1} at each time step, based on knowing y_k from the previous step.*)

  (b) For the same value of y_0 and h as in part (a), what equation must be solved to find y_1?

  (c) For the same value of y_0 and h as in parts (a), use Euler's method to give a first guess $y_1^{(0)}$ for the solution to the equation in part (b). Then do one step of Newton's method to get $y_1^{(1)}$.