ME 350 Lab Exercise 9 — Introduction to ODEs

Winter 2017

Download the `odeEuler.m`, `demoEuler.m` and `demoEulerPlot.m` files from the class web site.

1. Determine whether $y = \frac{1}{4}\left[2t - 1 + 5e^{-2t}\right]$ is the exact solution to $\frac{dy}{dt} = t - 2y$ with the initial condition $y(0) = 1$. *Hint*: Take the easy way by evaluating the derivative and testing the initial condition.

2. Determine whether $y = \frac{1}{2}\left[64 - 12t^2\right]^{1/3}$ is the exact solution to

$$\frac{dy}{dt} = \frac{t}{y^2} \qquad y(0) = 2 \tag{1}$$

3. Download the `demoEuler.m` file from the class web site and rename the file as `demoEuler2.m`. Make the necessary modifications to `demoEuler2.m` in order to find the numerical solution to Equation (1) for $0 \le t \le 2$. Test your solution with $h = 0.2$ and $h = 0.05$.

4. (a) Modify your `demoEuler2` function so that it computes and returns the global error

$$e_h = \|y - y_{\text{exact}}\|_\infty$$

   where the subscript h reminds us that the error is a function of the stepsize, h.

   (b) Create another m-file, say `eulerErrorPlot`, that calls your modified `demoEuler2` function for a sequence of steps sizes, $h = 0.2$, 0.1, 0.05, 0.025, 0.0125, 0.00625, and stores the global error in a vector, say `errh`. Create a log-log plot of `errh` as a function of `h`.