4/12 in Class – Euler's Method

1. Use Euler's Method to find a numerical solution for $\dot{x} = \frac{t^2}{3}$ from $t_0 = 0$, $x_0 = 0$ to t=3s. Start with at least 10 time steps, and try smaller intervals to see how your answer converges.
   (a) Do the first few by hand on the white board.
   (b) Write the equation you will use, $x(k+1) = \dots$
   (c) Then go back and write a MatLab program to do it for you.
   (d) Graph both your calculated x and the exact x as functions of time. Compare them.
   (e) Play around. Decrease the time step and/or increase the total time. What happens?
2. Use Euler's approximation to solve this DE: $\dot{x} = -x$. At $t = 0$, $x = 1$ For the first pass, go from t=0 to 3s with 0.1s time steps.
   (a) Do the first few by hand on the white board.
   (b) Write the equation you will use, $x(k+1) = \dots$
   (c) Then write a MatLab program to do it for you.
   (d) Graph both your calculated x and the exact x as functions of time. Compare them.
   (e) Play around. Decrease the time step and/or increase the total time. What happens?
3. Use Euler's approximation to solve a second order DE: solve $\ddot{y} = -g$. (This is actually a pretty bad idea since each estimate will compound the error.) Let the particle start from rest at the origin.
   (a) To do this, you will need to first find $v = \dot{y}$, then use that v to find y. Show how you will do this on the white board. You do not need to do any by hand.
   (b) Then write a MatLab program to do it for you.
   (c) Graph both your calculated v and the exact v as functions of time. Compare them.
   (d) Graph both your calculated y and the exact y as functions of time. Compare them.
   (e) Play around. Decrease the time step and/or increase the total time. What happens?