Homework 5

CSC-432

Due: 2/25/13

1. *This refers to the `simulation_techniques` notebook covered in class and section 5.3 in the book.*

    1. Write a function that computes the relative error of a number. (1 point)
    2. Write a function that implements the Runge Kutta 2 method. Call it `runge_kutta2`. The call signature should take a derivative function, *func*, an initial value, *initial*, the length of time you want to simulate, *ntime*, a time step, *dt*, and a tuple for any other args that might be passed to *func*, *args*. The call signature of *func* should be `func(P, t, growth_rate)`. (2 points)
    3. Use `runge_kutta2` to solve the differential equations for unconstrained growth.
    $$\frac{dP}{dt} = .10P$$
    with
    $$P_0 = 100$$
    from $t = 0$ to $t = 100$ for dt = [1, .5, .25] (1 point)
    4. Calculate the relative error for dt=[1, .5, .25]. (1 point)
    5. What is the percentage reduction in relative error for each subsequent dt? (1 point)

2. Using the Euler's method function that we constructed in class, complete Exercise 5.2.3 parts a, b, and c in the book. (3 points)

3. Using the Runge-Kutta 2 method from question 1, redo 5.2.3 parts a, b, and c. (3 points)

4. Write a function `runge_kutta4` method following the same steps as you did for the Euler and Runge-Kutta 2 functions and redo 5.2.3 parts a, b, and c. Don't overthink this. Your function should only be a few lines longer than `euler` and `runge_kutta2`. (2 points for runge_kutta4 function. 3 points for book problem.)