APSC 607: Project 3

Submit date, time and method: 11/17/17 5pm (EST) electronically (i.e. email)

You need to submit a report (pdf format) and the individual matlab files. Please compress all the matlab files into one file before you send them.

Important general comments:
1) Be careful to make sure that when you use material you didn't generate yourself to include references. Failure to do so is consider **plagiarism** and will result in a **reduction of the final grade by 50% !!!**
2) Do not use "breaks" in your MATLAB functions. These are bad coding practices that make code illegible and I **will subtract half the points** on the MATLAB component if you use "breaks" or other ways to terminate a loop before exiting the loop.

Task
Write in Matlab an Euler method and a 4th order Runge-Kutta method to solve the following Initial Value Problems

a) $y' = -9y \qquad 0 \leqslant t \leqslant 1 \qquad y(0) = e$

b) $y' = -20\left(y - t^2\right) + 2t \qquad 0 \leqslant t \leqslant 1 \qquad y(0) = \frac{1}{3}$

- Choose h=0.1 and compare to the actual solution.
- These equations are known to be 'stiff'. Which means that the error grows more rapidly than the solution, when the steps increase. These equations are typical when studying vibrations, chemical reactions and electrical circuits. Discuss the stability of Euler and 4th order Runge-Kutta for both IVP. What impacts does a stiff system have on the step size?
- How can the stability for stiff IVP be improved?

BONUS points: Implement an implicit trapezoidal method (such as trapezoidal with Newton Iteration) and compare to the above methods.

- What does implicit mean?
- How does this affect stability?
- How does it affect the solution to the IVPs and the step size?

What to turn in
Turn in all the MATLAB code that you wrote to reach the final solution. Also turn in a report describing the methods, your results and discuss your findings. For those who do not know what a report is, please look up the general structure and/or talk to your classmates who have figured it out.