CDA6530: Performance Models of Computers and Networks (Fall 2012)

Project 2: Using Matlab Simulink to derive numerical solution for differential equations
(assigned 09/27; due: 10/7 midnight via webCourse)

You have learned matlab simulink from the example of the simple worm propagation modeling in class. Now you are asked to derive the numerical solutions for more complicated differential equations.

If you cannot access Matlab Simulink, you can use an equivalent free software 'Xcos' (similar to Simulink), which comes with the free software package 'Scilab' (similar to Matlab). The website is:
http://www.scilab.org/products/scilab

Submission: please submit this project assignment via webcourse. You should attach a Winzip file containing a document (such as word) containing experiment figures and simulink model figures, and a simulink model file (.mdl), and a matlab script file (.m file), so that I can test by myself. If you use 'Xcos', please explicitly show how the teacher can test your simulation model.

1. 2nd-order mass-spring-damper system.

You are requested to solve the ODE: $m\ddot{x} + c\dot{x} + kx = f(t)$

With initial conditions: $x(0) = 0, \dot{x}(0) = 0, \ddot{x}(0) = 0$ and parameters $m = 0.2$, $c = 0.4$, $k = 1.7$. The input $f(t)$ is a step function with magnitude 5.

The experiment output can use a "scope" figure to represent in your report.

2. Two-factor worm propagation model (Zou's CCS'02 paper)

As you learned the simple worm propagation model simulation, here you are requested to simulate the two-factor worm propagation model, which is:

$$\begin{cases} dS(t)/dt = & -\beta(t)S(t)I(t) - dQ(t)/dt \\ dR(t)/dt = & \gamma I(t) \\ dQ(t)/dt = & \mu S(t)J(t) \\ \beta(t) = & \beta_0[1 - I(t)/N]^\eta \\ N = & S(t) + I(t) + R(t) + Q(t) \\ I(0) = & I_0 \ll N; S(0) = N - I_0; R(0) = Q(0) = 0; \end{cases}$$

Where $J(t) = I(t) + R(t)$

The simulation parameters are: N=1,000,000, $I_0 = 1$, $\eta = 3$, $\gamma = 0.05$, $\mu = 0.06/N$, $\beta_0 = 0.8/N$.

This model is introduced in the page 8 of the paper:
http://www.cs.ucf.edu/~czou/research/codered.pdf

You are requested to draw the J(t), I(t), Q(t) by using plot() command in workspace (similar to the figure 7 in the paper). The three curves should be on a single figure for comparison purpose. That means you have to save the simulation results into workspace variable and then plot them out.

In your submission, please provide the model .mdl file and also the matlab script file (in which you call the simulink model and plot the results).