PHY407H1 Lab6

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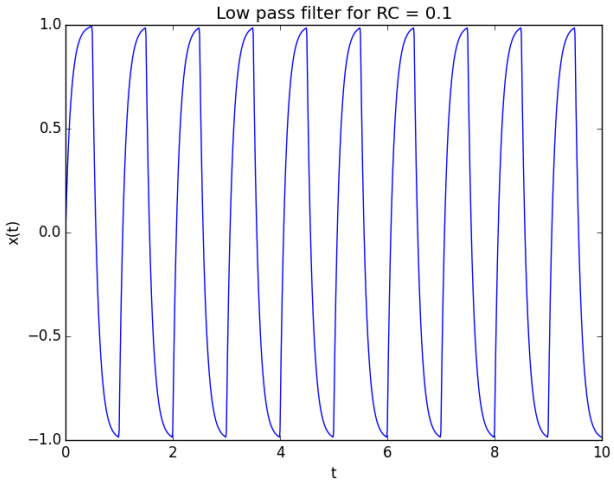
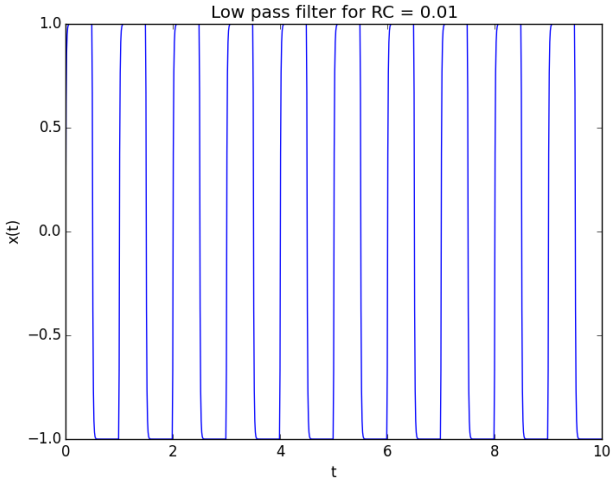
QUESTION 1

Plots from the textbook,





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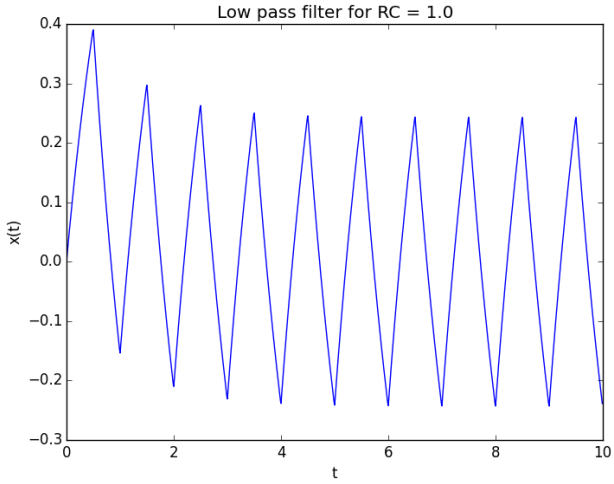
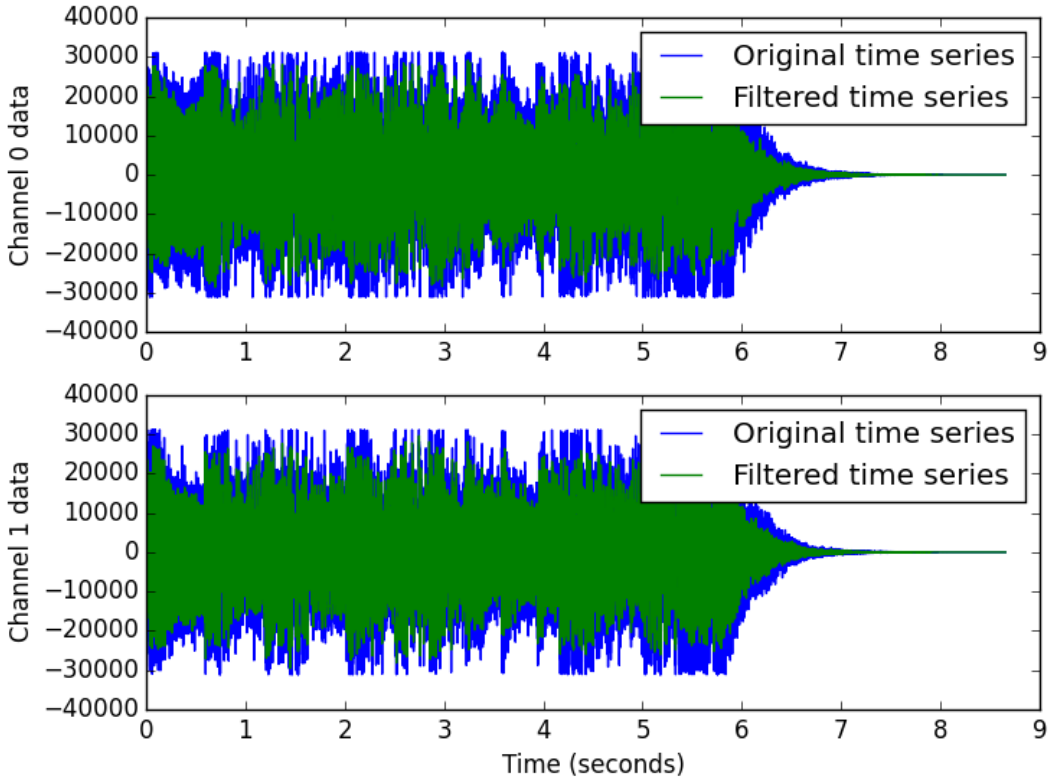
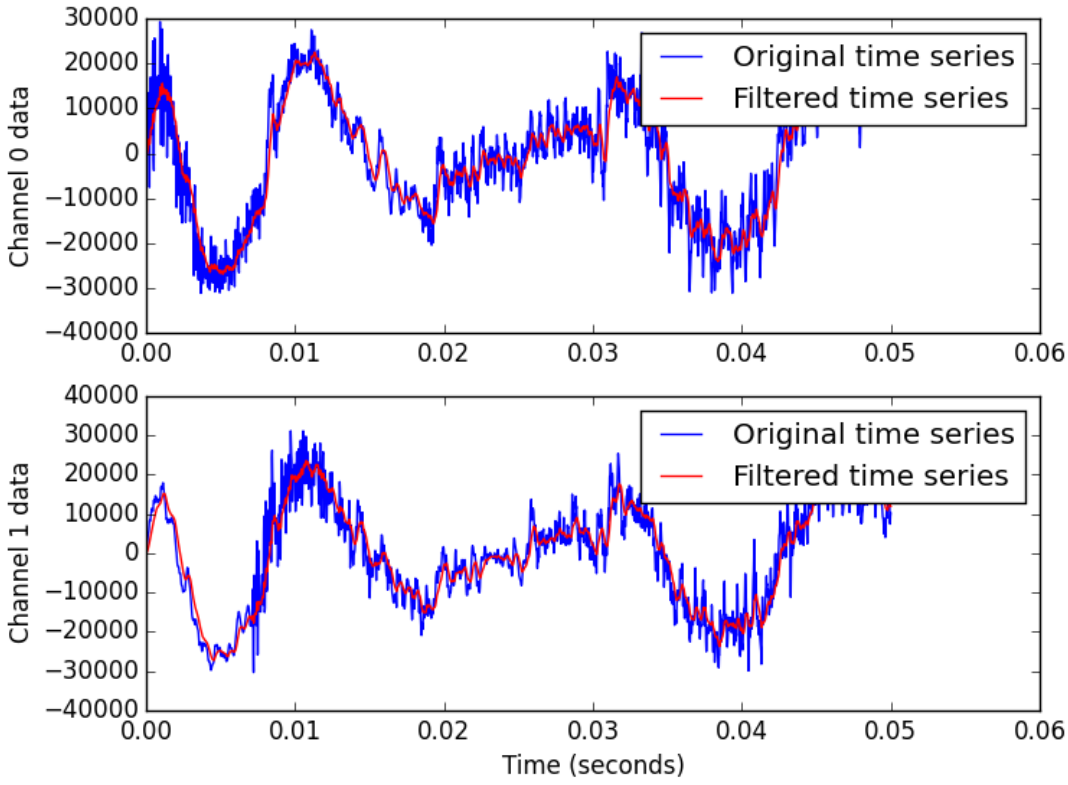

Low pass filter for RC = 1.0
x(t)
t
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
0
2
4
6
8
10

a) See Lab6_q1a.py by Chi.

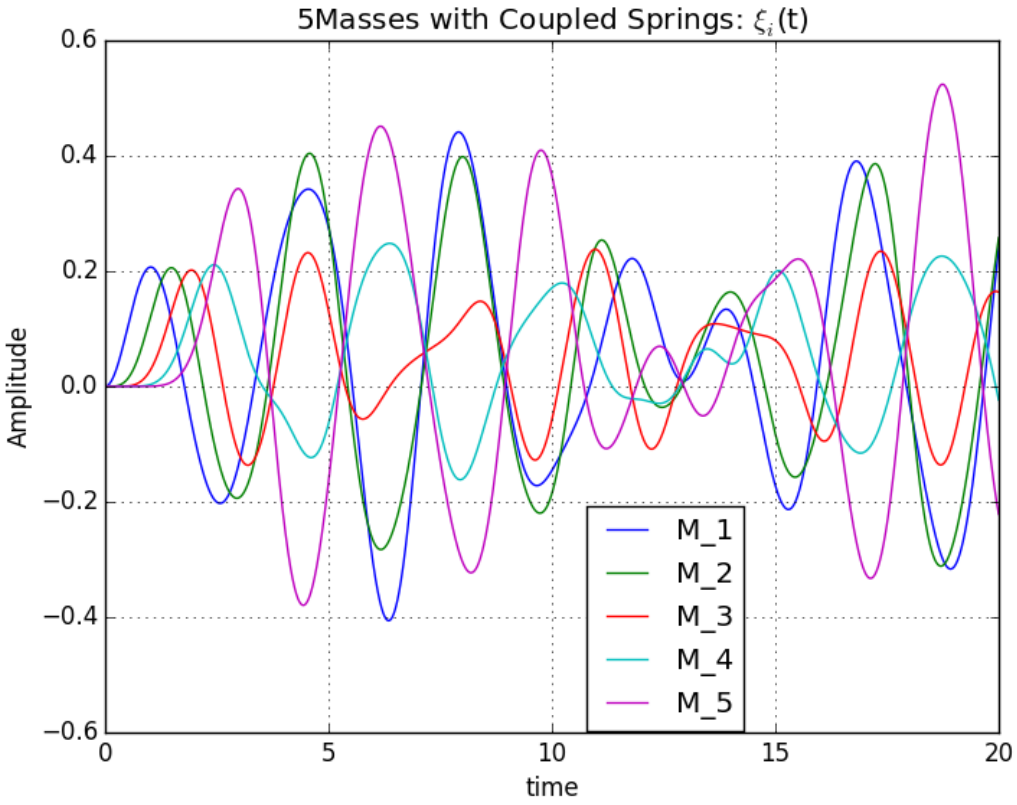


The graph below was for a shorter timescale (0, 0.05). The one above has a larger timescale. Advantages of this method is it is faster and it is relatively easier to code.


Channel 0 data
Original time series
Filtered time series
Channel 1 data
Original time series
Filtered time series
Time (seconds)

QUESTION 2

See Lab6_q2a.py by me. The animation was attempted but not submitted because I was told you do not need to hand in the animation.

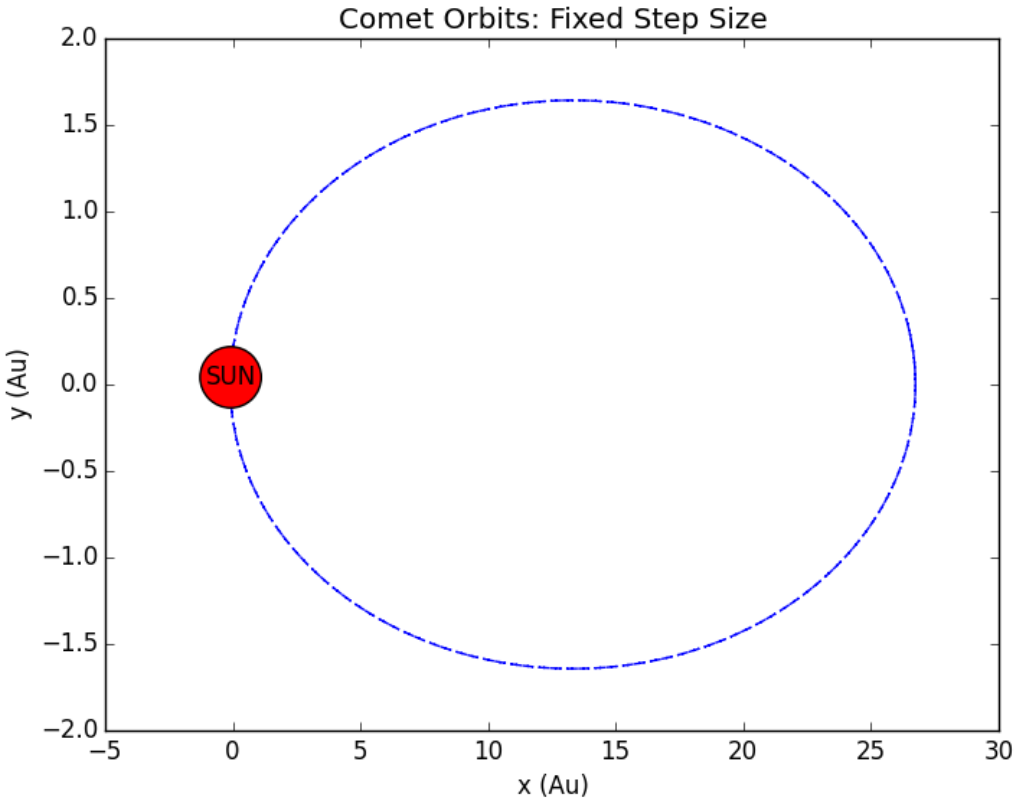


QUESTION 3

a) Reduced the order of the SODEs to ODEs.

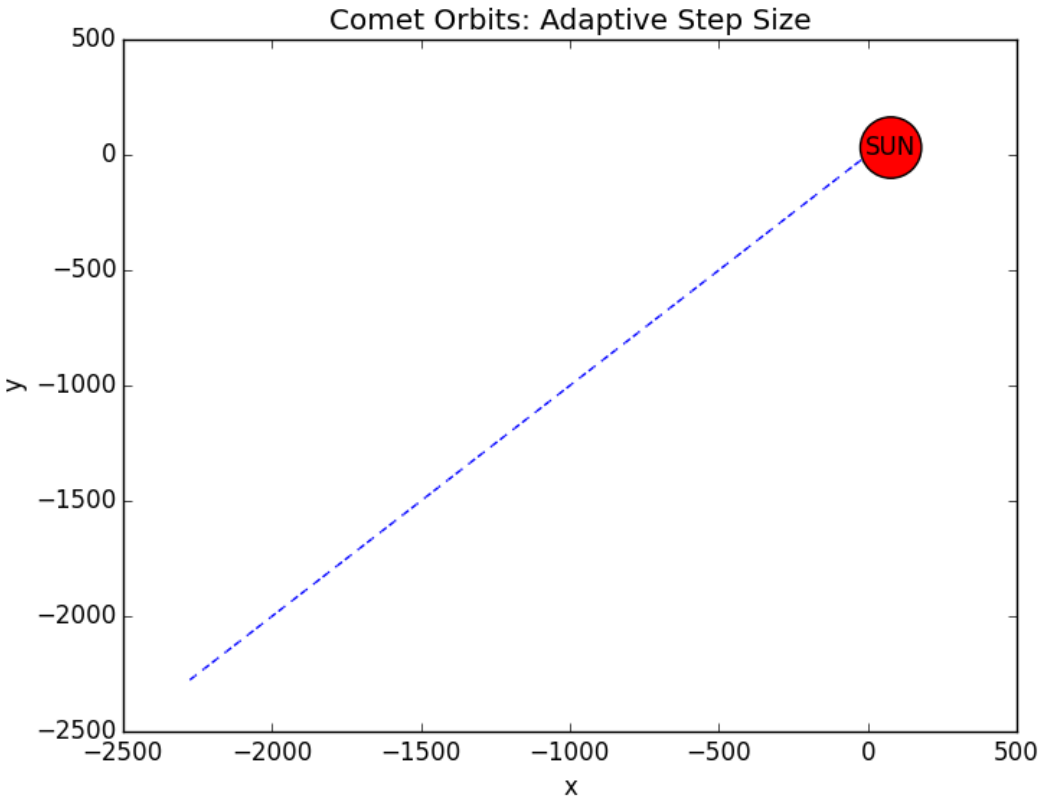
$$
\begin{aligned}
dx/dt &= v_x \\
dy/dt &= v_y \\
dv_x/dt &= -G * M * x/radius * *3 \\
dv_y/dt &= -G * M * y/radius * *3
\end{aligned}
$$

b) See Lab6_q3b.py by me.
I used h = 5e-4, and total time of 200 years. The program took 22.48 seconds to run, this was quite long.



c) See Lab6_q3c.py by me.

I couldn't get the adaptive code to work- because I ran out of time. After debugging, I found that rho kept on returning not a number. And this was because my two estimates at different time steps h and 2×h were the same. But I would expect it to look like my first graph but with bigger spaces near the aphelion and smaller spaces near the the perihelion. Below is the obviously incorrect plot.



d) As one can imagine, the steps get closer when the comet is near the perihelion (closet to sun), and farther apart when the comet is near the aphelion (furthest point from the sun)