Homework 4

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1. INTRODUCTION

This homework involved solving differential equations using runge kutta 4th order methods .

2. 8.4

For this problem we had to model the position theta of a pendulum when it was dropped from a 179 degree angle see 1. We did this by converting the second order differential equation into a system of first order differential equations, which we then fed into runge kutta 4 algorithm. RK4, as runge kutta 4th order is normally called, uses an average of function evaluations between the time steps to improve each time step. We also determined the position with a given driving force $Ccos(\theta)sin(\Omega t)$ where C=2 and $\Omega = 5$. The resonance frequency of this system would be the frequency that the pendulum naturally swings at $\sqrt{\frac{g}{l}}$, and indeed when we set omega to this value after dividing by 2π to convert it into a frequency we can see the pendulum beating from left to right 3.

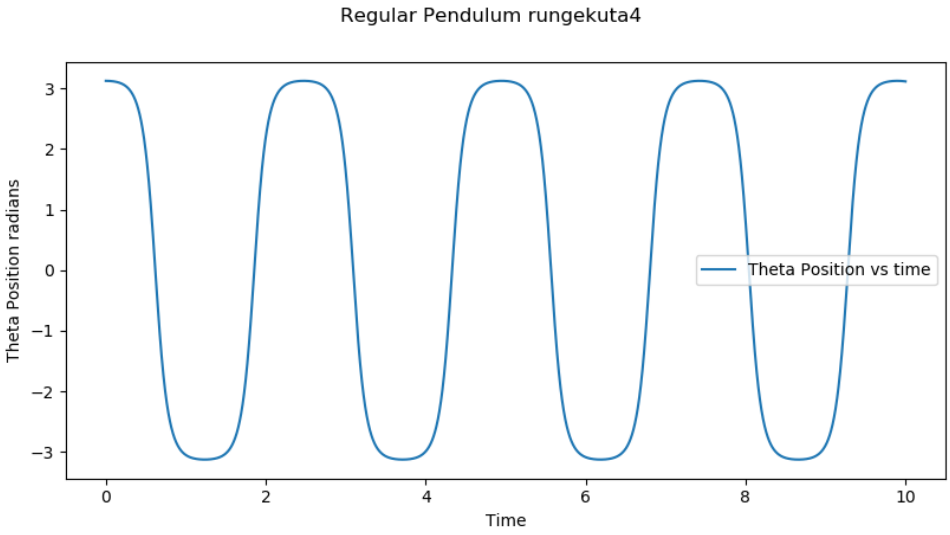

FIG. 1: Pendulum dropped from 179 degree angle

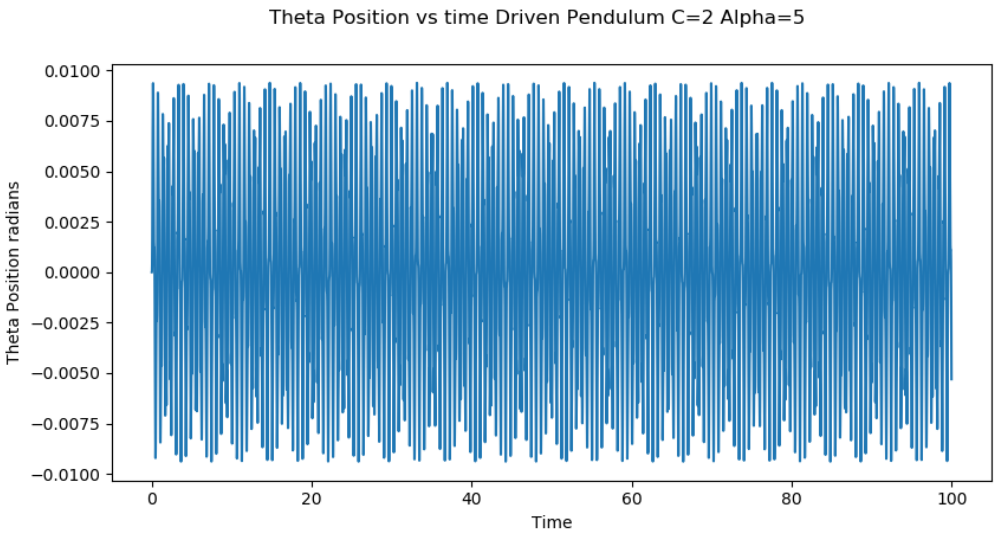

FIG. 2: Pendulum dropped from 179 degree angle

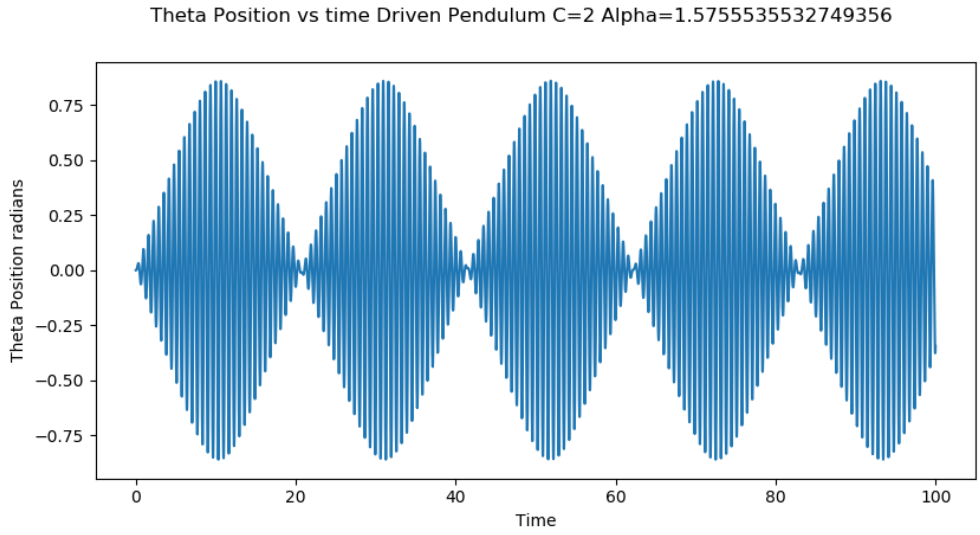

FIG. 3: Pendulum dropped from 179 degree angle

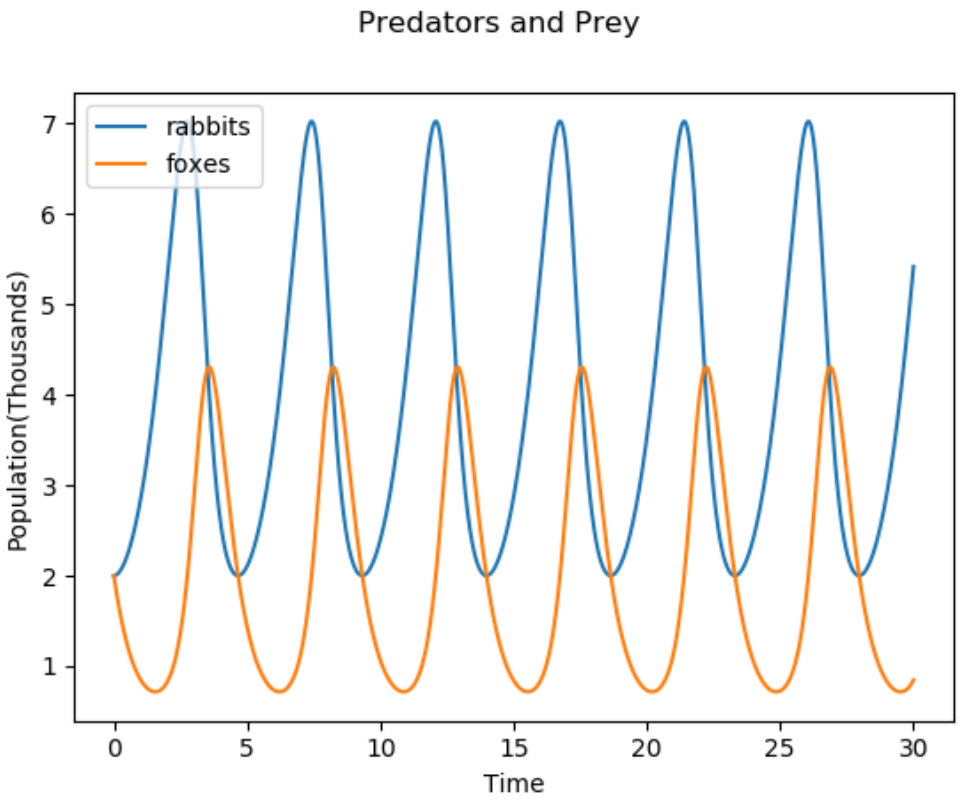

FIG. 4: Rabbit and Fox population

3. 8.2

We are concerned with modeling the population of rabbits and foxes. We model this equation using $\frac{dx}{dt} = \alpha x - \beta xy$ and $\frac{dy}{dt} = \gamma xy - \Delta y$ where x represents the rabbit population and y the fox population. Solving this differential equation using RK4 we get 4.

This graph makes sense because a spike in rabbit population leads to a spike in foxes which in turn leads to a decline in rabbits and therefore a decline in foxes. This decline in foxes allows rabbits to spike again and so on and so forth.

4. CONCLUSION

This problem set was a nice length. The hardest part was figuring out how to implement RK4 for a system.