Student Name

Mini Project 1

This mini-project is intended to allow you to study, in detail, a system in which nonlinearity affects the dynamic behavior in an interesting way. In addition, the project is intended to have you exercise an interesting feature of Python in the process of performing the study. In the mini-project report, you must:

- Introduce the problem (Introduction section)
- Describe the method that you and the other investigators use to study it (Methods section)
- Show your results (Results section)
- Discuss what you have learned/discovered (Discussion section)

Assignment Tasks

You will be considering the following paper:

- J. M. Christian and H. A. J. Middleton Spencer, Chaos in the Magnetic Pendulum, Mathematics Today, April 2020. The paper is posted on Canvas.

You must do the following things for this paper:

1. Read the paper.
2. Walk through their solution, and fill in the gaps. Ideally, show me the work between steps. Sometimes, they skip steps in the explanations of how different equations come about. Make sure it is VERY CLEAR where everything is coming from. I suggest producing this either by hand, or using SymPy.
3. Numerically produce some results - you do not need to produce all of the results of the paper. For the *Chaos in the Magnetic Pendulum* paper, you should reproduce Figure 3.

You will be graded on:

- A 1.5 to 2 page summary of the paper, single space. Key points to make sure to include are: a.) assumptions made in modeling, b.) what approaches are used to solve different parts of the solution, c.) other items we have covered in class. I expect you to think back and consider most of the concepts we've seen and think about whether they relate. This should basically be the first two sections of the report as described above. I am happy to talk to you about this any time, or you can shoot me an email to see if you're heading down the right track. (25 pts)
- Walking through the solution and filling in the gaps. For this paper, discuss the model carefully and consider how it might be made more accurate. (25 pts)
- Numerical Part: Recreate their solutions or figures, in this case, Figure 3, in Python. (25 pts) Of this section, 5 points are specifically for doing a simple parallel implementation for the integration of the differential equations.