Project 5: Self-Organized Critically

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CST-305: Principles of Modeling and Simulation

**Required Technology**

The required packages and technology imported include:

* Numpy – for scientific computing
* Odeint – to calculate ordinary differential equations
* Matplotlib.pyplot – Plotting data generated by odeint
* Axes3D from mpl.toolkits.mplot3d – Used to create 3D data plots with x, y, and z axes.

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**Program Script Execution**

Script execution is clean and concise. The compiler requests three pieces of data from the user as file sizes. These file sizes are implemented into the differential equation to be plotted. A picture containing drawing

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**Mathematical Methods in Code**

**Program Output**

The output of the program includes input prompts to be finished by the user and the output of a graph generated from the data provided by the user after the evaluation of the ODE. Below are a couple of screenshots of the output of the program.

Graph:

![A close up of a logo

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Text Output:

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**Programming Style Explanation**

The programming style of this project is direct, organized, and fairly simple. The code is well-commented and easy to understand. The code begins with requesting input from the user. After this, the inputs are used in a Lorenz function that returns 3 points. Then, these points are used to construct a 3D graph that predicts the next moves of the ODE’s point at the x, y, and z points.

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**Mathematical Methods**

In the Lorenz equation there are certain parameters than can be changed to view chaotic behavior in the Lorenz equation. Sigma is represented as 10 and beta as 8/3 throughout the experiment. In the first experiment, the parameter r is changed while the file size of the theoretical data stays the same. The changes can be seen through Figure 1, 2, and 3. Figure 1 has an r value of 10 meaning the origin is non-stable. Figure 2 has an r value of 0.5 giving a globally stable origin. Figure 3 has an r value of -100 to show the contrast of a negative parameter.

A close up of a map

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Figure 1

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Figure 2

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Figure 3

The next experiment is showing the difference in change of file size while the parameters all remain the same with a constant r value of 10. Figure 4 shows the file sizes to compare the changes to. Figure 5 changes the file size of the theoretical x file, while Figure 6 changes the z file.

A close up of a map

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Figure 4

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Figure 5

A close up of a map

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Figure 6

**Screenshot of Execution**

**A screenshot of a cell phone

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