Project 1: Visualize ODE with SciPy

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CST-305: Principles of Modeling and Simulation

**Responsibilities and completed tasks by each team member**

In this project, Shelby and I completed equal parts on the code and documentation. We participated in group work through Zoom and screen sharing.

**System Performance Context**

For this project, we chose to model Amdahl’s Law. This is an important performance metric because it helps optimize computer performance with parallel processing. This law is a formula that is used to find the highest possible level of improvement for a component of processing. The formula is used as follows:

Where S represents speedup, f represents the fraction of work performed by a faster component, and k represents the number of processors used in the model.

**Specific Problem Solved**

A problem that many programmers face is measuring the effectiveness of their code structure. In this model, programmers and designers will be able to measure the speedup of their program as changes are made to the code structure. In this model, the number of processers used in parallel processing is compared with the time elapsed for the process and the amount of time that parallel processing is used to find the total speed up. For example, if 10 hours is spent computing, and 9 of those hours are parallelized on two processors, the speedup would be 10x.

**Mathematical Approach**

To begin with our approach, the derivative of Amdahl’s Law must be taken to evaluate the model. Evaluating the derivative with respect to f yields the derivative that is being used in this model:

Using this equation, the user has the opportunity to input how much time the process ran for, how long parallel processing was utilized, and how many processes are being used.

**Implementation in Code**

To implement this model into Python code, we first imported all the modules we would need. This includes numpy, matplotlib.pyplot, and scipy.integrate. After this, we needed to define each part of Amdahl’s Law’s function. We defined k and f by requiring user input as a float integer. Next, the model function was defined that will be evaluated as an ODE. Continuing, the plot needs to be built. The initial condition, time points, odeint function, and commands for the plot display and results are all built. When the program runs, the user is prompted for the number of processors being used in the execution of a program and what percentage of this program is processed in parallel. After the user enters the desired information the program produces a visual graph as well as numerical values to assist in the optimization of parallel processing.

**Screenshots**

Jupyter Screenshots:**A screenshot of a cell phone

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PyCharm Screenshots:

**A screenshot of a computer screen

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**A screenshot of a cell phone

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**References**

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