MINI-PROJECT 3
MODELING WITH ODES

BRIEF SUMMARY

In this project, you will explore the numerical methods for solving ordinary differential equations (ODEs) in Python, focusing on one-dimensional ODEs and systems of ODEs. ODEs are vital in modeling a variety of real-world phenomena, including population dynamics, aerospace applications, infectious diseases, mechanical systems, pharmaco-kinetics, chemical reactions, and electrical circuits. This project will provide hands-on experience in implementing solutions using Python's scientific libraries, with an emphasis on both theoretical understanding and practical applications.

GOALS

- Develop a deep understanding of numerical methods used to solve ODEs, such as Euler's Method and Runge-Kutta methods.
- Apply Python libraries like scipy to solve and analyze one-dimensional ODEs and systems of ODEs.
- Explore real-world applications of ODEs in physics, biology, and engineering.
- Visualize the solutions and interpret their behavior in the context of the application.

WHERE TO START

We'll start by looking at basic commands in Python to solve one-dimensional ODEs and then move onto larger systems of nonlinear ODEs. We'll formulate linear and nonlinear equations with motivation from biology and physics. Some equations we'll solve by hand and compare the analytical solution to the numerical solution given by Python. We'll then work into more sophisticated ODE systems and explore wider reaching applications.

SKILLS NEEDED/GAINED:

- Formulating linear and nonlinear ODEs and systems of ODEs.
- Visualizing the effects of parameter variation on model output.
- Fitting ODE models to data.
- Document creation in LaTeX.