**FINAL PROJECT:**

**SOLVING POISSON’S EQUATION**

Submitted to

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# Problem Statement

In a great deal of scientific and mathematical research and discoveries, problems can be solved by using a partial differential equation to represent the current issue. Unfortunately, this means that there are also many independent variables that must be solved to determine the system’s state and solution. The software process described below attempts to simplify this process by estimating differential equations as systems of equations, which can then be solved quickly and effectively.

Although the mathematics behind this estimation will be discussed later, the idea to model a partial differential equation as a system of equations makes the problem easier not only for humans, but for computers as well. In fact, the speed of the algorithm matters so greatly that two different solvers for systems of equations have been implemented and analyzed in the software to test the efficiency of the differing methods. For the purpose of this report, the methods tested are Gaussian Elimination, a pivot method to find a single value to be used in backward substitution, and Gauss-Seidel, an iterative method that guesses and corrects itself ever more closely to the correct solution. These methods, the results of this analysis, and the subsequent comparisons resulting from the analysis are described in detail below.

The problem therefore, is to solve a partial differential equation and the method to be discussed involves defining a system of equations that approximate solutions close enough to the actual values to make the simulation worthwhile.

# Mathematical Background

Although the basics of the software were defined in the problem statement above, the underlying mathematics are somewhat deep and are further explained in the following section. In addition to the two methods used to solve the system of equations, this section also explains why our solution is feasible and how solving a system of equations can effectively provide estimates for the much more complex partial differential equation.

First, the Gauss-Seidel method, as mentioned above, is an iterative method used to solve systems of equations. Although the method is relatively quick, especially since it is already designed as an improvement over Jacobi Iteration, the one major drawback to using Gauss-Seidel is that the method can only be expected to work on a system of equations that is diagonally dominant, although it may work on systems that do not meet this requirement. To clarify, a system of equation is diagonally dominant if the absolute values of the coefficients of the main left-to-right diagonal in the system are greater than or equal to the absolute values of the coefficients of all other entries in the same row of the matrix defining the system.

After ensuring that the system meets this requirement,

# Methodologies

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# Mathematical Techniques

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# Parameters

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# Solution and Analysis

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# Viability

adf

# Conclusion

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