**Abstract**

For the semester project I chose to implement Poisson’s equation in two dimensions for a rectangle. This equation is a partial differential equation that is used for finding electric potentials or gravitational fields. This equation is also commonly used by mechanical engineers and physicists. For the version of the Poisson equation that I covered for the project, there are four boundary conditions that surround the entire rectangle and consist of mixed conditions. The boundary conditions consisted of three Dirichlet boundaries and one Neuman boundary condition. The Neuman condition occurred at the top of the rectangle when y was at the maximum distance 2π and required a ghost node to solve for the values at the boundary. The boundaries at surrounding the left, bottom, and right side of the rectangle where Dirichlet boundaries and were governed by functions that changed as your position changed along the boundary.

**Mathematical Statement of the Problem**

The problem I solved with my code was the two-dimensional Poisson equation with the form . The function on the right is The domain for the problem is and . The boundary conditions for the problem on the y domain are , and , and the boundary conditions for the x domain are , and . The two additional functions in this problem that govern the boundary conditions, and , are and .

**Discretized Version of the Problem**

To successfully compute this problem using Poisson’s equation the problem needed to be discretized so that a numerical method could be applied to solve. The discretized equation for the problem is . Since x and y both have the same domain, , we can say that where and n is equal to the number of steps from 0 to. Based on these conditions we can simplify the discretized equation even further to be .