Assignment 8
Due: 6:00PM 11/10/23

Purpose: The purpose of this assignment is to gain experience in using multidimensional arrays.   You will also see how multi-dimensional arrays are used to solve areal-world physics problem.

Your goal: You will write a Fortran program that solves the Poisson equation for a 2-D steady state electromagnetics problem. Suppose there are two square charges located inside a 2-D $10cm \times 10cm$ grounded conducting box that has electrical potential *U*=0 everywhere on the boundary.   If the interior of the box is divided into 100 square cells in each direction (10^4 cells total) (each of size $0.1cm \times 0.1cm$) then that can be described by the partial differential equation for the potential, *U*,

$$\frac{\partial^2 U}{\partial x^2} + \frac{\partial^2 U}{\partial y^2} = 4\pi q$$

where *q* is the charge density. This can be discretized and solved via relaxation by the iterative equation

$$U_{i,j}^{new} = \frac{U_{i+1,j}^{old} + U_{i-1,j}^{old} + U_{i,j+1}^{old} + U_{i,j-1}^{old} - 4\pi h^2 q_{i,j}}{4}.$$

Assume that the charge density in cell (25,25) is -4 in CGS units and that the charge density in cell (75,75) is equal to +4 in CGS units.   Write a Fortran program that uses rank 2 arrays to solve this equation iteratively and which writes out the electrical potential data in Gnuplot form.   **You may modify the Poisson program in the notes.** What is the electrical potential of the cell (25,50)? (Indicate your answer in the header comment-block of the code). Save this code as you will need it to complete a later assignment.   For this assignment only you have my permission to modify the code I have placed in the lecture notes.

Hints: I suggest that you first try to solve the problem that is in the class notes for lecture 17, using a 6x4 grid of cells. Once you have that code working modify it to do the problem in this assignment.

Note: Make sure that your submission conforms to the **Instructions for Source Code Submission** instructions and that you have followed all of the **Good Programming Tips** in the notes!