Assignment 8
Due: 2:00PM   11/1/19

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 look at the Poisson program in the notes as a guide to help you but write your own code, don't just copy mine! 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 to to complete Assignment 9!

Make sure that you code compiles (programs receive a zero if they are not able to be compiled on the Math SINC site machines) and make sure to test it by running it and observing that you get the correct answer! Submit only the source code file, i.e. the .f08 file containing the Fortran code, by uploading it into blackboard using the "attachments" button under the assignment.   **Do not submit the executable file.**
If you submit the executable file you will receive zero credit

 If you have any problems see the TAs or the instructor for help. Do not ask other students to help you debug your code. Submissions via email will not be accepted. **DO NOT WAIT UNTIL THE LAST MINUTE TO SUBMIT THE ASSIGNMENT! LATE ASSIGNMENTS WILL NOT BE ACCEPTED.**

Note:
1. **All Fortran programs must contain the implicit none statement or they will receive an automatic grade of zero.** There are no exceptions to this policy.

2. All programs should have a block of comment statements at the beginning of the code containing your name, **section number** (consult SOLAR if you are in doubt as to which section you are registered for), and a description of what the code does. Consult the lecture notes for examples.

3. Your file should be named in the form of *<yourlastname>_<yourIDNumber>_<hw#>*.f08 (Do not put the # sign in the file name!)

4. All programs must compile using the gfortran compiler on the Mathlab machines. **Programs that do not compile will receive an automatic grade of zero.** There are no exceptions to this policy

5. Programs must be uploaded into the blackboard assignment page. Programs may not be submitted via email or hardcopy. Programs that are not uploaded into the blackboard assignment page will not be graded.