Assignment-12

PHY617/473-Computational Physics
Instructor: Gopal Hazra
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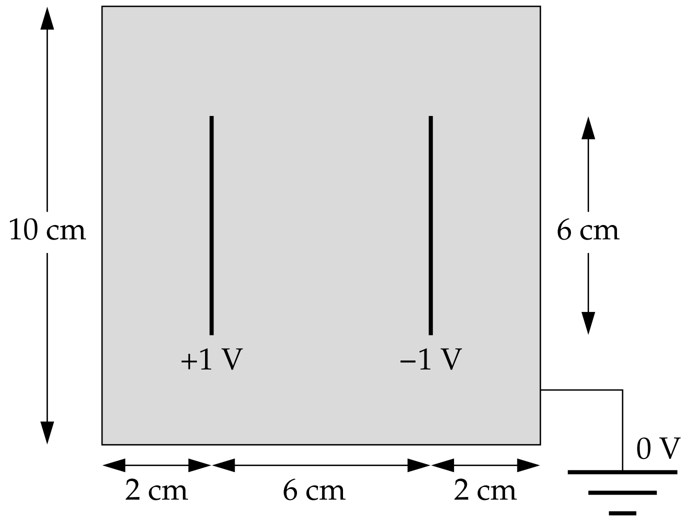
Question-1:
Consider the following simple model of an electronic capacitor, consisting of two flat metal plates enclosed in a square metal box:



For simplicity let us model the system in two dimensions. Using any of the methods we have studied, write a program to calculate the electrostatic potential in the box on a grid of 100×100 points, where the walls of the box are at voltage zero and the two plates (which are of negligible thickness) are at voltages $\pm 1\,\mathrm{V}$ as shown. Have your program calculate the value of the potential at each grid point to a precision of 10^{-6} volts and then make a density plot of the result.[**10 marks**]

Hint: Notice that the capacitor plates are at fixed *voltage*, and hence in effect, the capacitor plates are part of the boundary condition in this case: they behave the same way as the walls of the box, with potentials that are fixed at a certain value and cannot change.

Question-2: Relaxation method for Laplace's Equation:
Use the Gauss–Seidel method to solve Laplace's equation for the two-dimensional problem as done in the class—a square box 1 m on each side, at voltage $V = 1$ volt along the top wall and zero volts along the other three. Use a grid of spacing $a = 1\,\mathrm{cm}$, so that there are 100 grid points along each wall, or 101 if you count the points at both ends. Continue the iteration of the method until the value of the electric potential changes by no more than $\delta = 10^{-6}\,\mathrm{V}$ at any grid point on any step, then make a density plot of the final solution i.e., the 2D filled contour plot of potential ϕ using python's **imshow**. Experiment with different values of ω to find which value gives the fastest solution. You should find that a value around 1.9 does well. In general larger values cause the calculation to run faster, but

if you choose too large a value the speed drops off and for values above 2 the calculation becomes unstable. [**10 marks**]