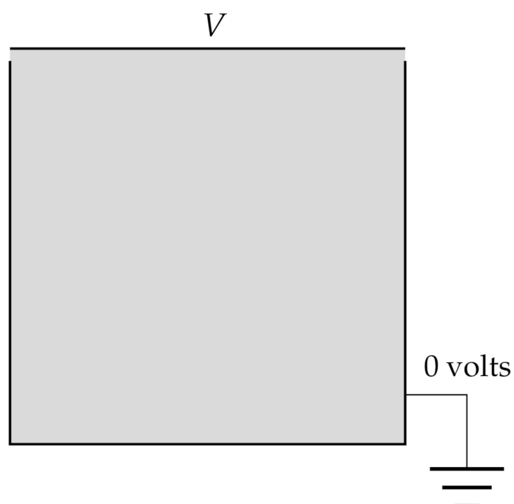
Spring 2021
PHYS 377 Advanced Computational Physics
HW # 6a

<u>Problem 1:</u> Simple electrostatics problem

An empty box has conducting walls, all of which are grounded at 0 volts except for the wall at the top, which is at some other voltage V. The small gaps between the top wall and the others show that they are insulated from one another. Assume that these gaps have negligible width.



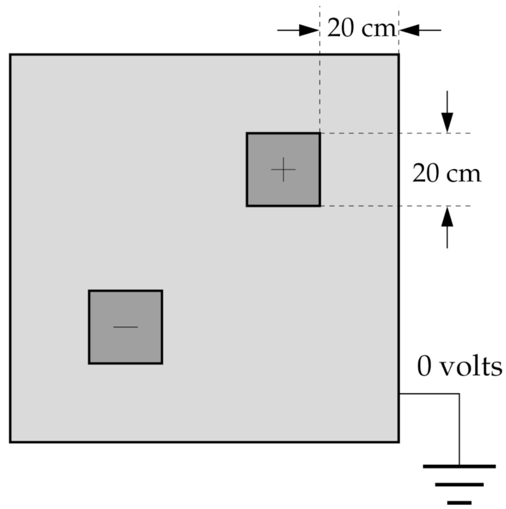
For the two-dimensional case, solve the ***Laplace's equation*** for the electrostatic potential ϕ, subject to boundary conditions that $\phi = V$ on the top wall and $\phi = 0$ on the other walls. **The framework is described in the lecture**.

(a) **Write a Program** to compute the solution to the two-dimensional electrostatics problem using the ***Jacobi method***. Take the following values: Box is 1 m along each sides, $V = 1$ volt, and the grid spacing $a = 1$ cm, so that there are 100 grid points on a side, or 101 if we count the points at both the beginning and the end.

<u>Note:</u> This program might take a while to run, so start with smaller grids to make sure the program is working. Only then use the large grid.

(b) **Make a density plot** of the result.

<u>Problem 2:</u> A bit more complicated electrostatics problem



Two square charges are placed inside a square two-dimensional box. The potential is zero at the walls and the charges have charge densities +1 cm^{-2} and -1 cm^{-2}.

(a) **Write a program**, or *modify the previous one*, to solve ***Poisson's equation*** of electrostatics for this system (two-dimensional), which is in presence of a charge density. **The framework is described in the lecture**.

Work in units where $\epsilon_0 = 1$ and continue the iteration until your solution for the electric potential changes by less than 10^{-6} V per step at every grid point.

(b) **Make a density plot** of the result.