PHYS 240 homework #20 – due Apr 19 2013, 5:00pm, upload to Canvas

Faraday cage

1. Write a program that uses the SOR method to simulate a Faraday cage (see Figure, which does not use the same index-numbering convention as will be discussed below). Use a square geometry with $N_x = N_y = 60$. Set the left and right walls to $\Phi = 0$ and $\Phi = 100$, respectively. Fix the potential at the top and bottom walls but have it vary linearly across the system, consistently with the left/right constraints.

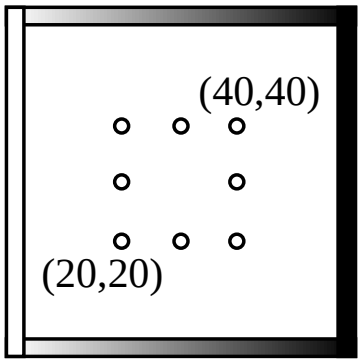

Figure 1: Faraday cage.

(a) The Faraday cage is represented by the following eight points: $(i, j) = (19, 19)$, $(29, 19)$, $(39, 19)$, $(19, 29)$, $(19, 39)$, $(29, 39)$, $(39, 29)$, and $(39, 39)$. The potential at these points is fixed at zero. Plot the potential $\Phi_{i,29}$ versus i (i.e., a horizontal cross section through the center), both with and without the cage.

(b) Try also a cage that has only the four corner points $(19, 19)$, $(19, 39)$, $(39, 19)$, $(39, 39)$, and compare with the results from part (a).

(c) Try a cage that has only the four side points $(19, 29)$, $(29, 19)$, $(39, 29)$, $(29, 39)$, and compare with the results from part (a).

2. Include any discussion and plots in a report generated in LaTeX and submitted in PDF format. Also submit your Python code separately.