PHYSICS 204B, WINTER 2011
ASSIGNMENT FOUR

Due Friday, February 11.

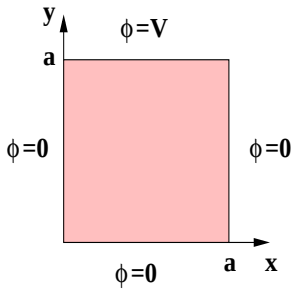
Do Problem 1 and, if you have time, try Problem 2. It should not be too bad a generalization, and, carries the important message that numerical solutions rather easily leap from where analytic solutions are possible to where they are not.

As I mentioned in class, on Friday we can build a code in C for this problem. I will discuss the general theory in room 416 at 2 pm. This will only take 20-30 minutes. Then we will go to room 106 and write the code together. You are of course also welcome to tackle it on your own.

[1.] Solve Laplace's equation $\nabla^2\phi = 0$ for the potential $\phi(x, y)$ for the square region in the figure, with the boundary conditions shown with $V = 3$. Use the iterative method discussed in class, whose generalization to $d = 2$ (with $\rho = 0$) is,

$$\phi(i, j) = \frac{1}{4}[\phi(i + 1, j) + \phi(i - 1, j) + \phi(i, j - 1) + \phi(i, j + 1)] \ .$$

Use $dx = 0.1$ and $a = 1$. Compare your solution with the analytic one obtained in class by plotting the two results for $\phi(x, y = a/2)$, $0 < x < a$ on the same graph. Make a second graph comparing the analytic and numeric solutions for a vertical cut, $\phi(x = a/2, y)$, $0 < y < a$.



[2.] Solve Laplace's equation in the same way as problem 1 except for the less symmetric region of Figure 2.