33. Alter the boundary condition for program duct at the minimum y boundary ($y = -1$) to $w(x,-1) = -a\cos^2(\pi x/2)$. Run the program with SOR and finite differences for the grid sequence 21^2, 41^2, 81^2, and 161^2 for $a = 0.1$ and $a = 1$. Plot the solutions for the 161^2 grid for $a = 0.1$ and $a = 1$. What are the changes for the solution? Do the iteration properties change, i.e., the scaling of N_{iter} with N and the value of λ_{opt} and compare these with the results from Problem 30?

34. The program duct solves an elliptic partial differential equation that is equivalent to the Poisson equation. Interpreting the problem as an electrostatic problem, w becomes the electric potential.

a) What is the physical meaning of $w = 0$ at the boundaries? How are contour lines of w related to the electric field?

b) Assume that the normal electric field is 0 at the boundary $x = -1$. Describe how you can implement this condition in the program duct. Alter the program according to this description and run the program for the 161×161 grid for FDM and FEM. Comment your results.

c) In the current version of duct the pressure gradient is constant and equivalent to a constant charge density. Detail the steps needed to alter the program to incorporate a varying charge density $n = n(x,y)$?

35. Report on the progress of your work on the project.

Please turn in the solutions to the homework on Monday, 4/15/2013