HW 10 Computational Physics

November 1, 2005 Due November 8

1. Use the method of separation of variables to analytically solve Laplace's equation

$$\nabla^2 f(x, y) = 0$$

on a 3×1 rectangle with boundary conditions

$$f(0,y) = 0 = f(x,0) = f(3,y), \quad f(x,1) = x(1-x).$$

- 2. Solve the above problem numerically using the Simultaneous Overrelaxation (SOR) method (see Garcia Eq. (8.24)). *Hints*:
 - Use an array f[i,j] with $0 \le i \le nx-1$ and $0 \le j \le ny-1$.
 - Choose h, nx, ny so that (nx-1)h=3 and (ny-1)h=1.
 - Initialize f as zero and then set f(i,-1) to the correct value for each i.

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• Make many sweeps over the interior points:
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- A good choice for ω is in Garcia Eqs. (8.25) and (8.26).
- A tolerance of about 0.005 is good enough.

Plot your results. One possibility is to make plots of f(x, y) vs. x for several fixed values of y (or maybe fix x and vary y). Another is to make a surface plot using, e.g., gplt.surf. A third is a contour plot, if you can find a way.

Evaluate your analytic solution from problem 1 on the same grid you use here and plot it together with your numeric results.