Applications in Scientific Computing
Assignment 8: Boundary-value problems

530.390.13

Due: Wednesday 20 January 2016

Submit all code by committing it to the directory `assignments/assignment5` in your `530.390.13` GitHub repository. For a reminder of how to use Git, refer to the repository file `notes/using-git`.

1. Consider the two-dimensional steady-state conduction equation,

$$\nabla^2 T = \nabla \cdot \nabla T = \frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2},$$

   where T is temperature. In a slab of size $L_x = 10$ and $L_y = 4$, numerically solve the equation above using the Jacobi method for $\Delta x = \Delta y = \Delta = 0.1$. The slab is held at a constant temperature $T = 0$ on the top, bottom, and right sides, with a constant temperature $T = 1$ on the left side. Plot the steady state solution.

2. Edit the code for the Jacobi solver that we wrote in class. Instead of terminating the relaxation after a prescribed number of iterations, compute the error at the end of each iteration and terminate when the error drops below some prescribed tolerance ε. For the problem above, apply the new code and report the number of iterations required to achieve an error of $\varepsilon < 1 \times 10^{-6}$.