CS 590C: Introduction to Computational Science

Fall 1996

Problem Set 2

Due Date: Sept 27, 1996 in class

No late submissions will be accepted

1. **(25 Points)** During the discussion on Matlab in class, we had looked at the Jacobi iterative scheme for solving the heat equation using finite difference method. Write a Matlab program for solving the same equation using the conjugate gradient iterative method. The algorithm for the conjugate gradient is as follows:

   procedure CG (A, b, x, ϵ)
   begin
   $k := 0; x_0 := 0; r_0 = b; \rho_0 := ||r_0||^2;$
   while $(\sqrt{\rho_i} > \epsilon ||r_0||)$ **do**
   begin
   if $(k = 0)$ **then** $p_1 := r_0$
   else $p_{k+1} := r_k + \rho_k p_k / \rho_{k-1};$
   $k := k + 1;$
   $w_k := A p_k;$
   $\alpha_k := \rho_{k-1} / p_k^T w_k;$
   $x_k := x_{k-1} + \alpha_k p_k;$
   $r_k := r_{k-1} - \alpha_k w_k;$
   $\rho_k := ||r_k||^2;$
   endwhile;
   $x := x_k;$
   end CG;

2. **(25 Points)** Let us try to use tcl/tk to develop an interactive plotting program. You are required to define widgets for inputting x and y coordinates from the user. The program should also support save, plot and quit widgets. On pressing save, the data must be saved into a file (let us say the name of the file is inpdata). Now, to plot this data from the file, we can use gnuplot. For doing this, create another file in your directory called plotscript. This program is a gnuplot script that contains the following two lines:

   plot "inpdata" with lines
   pause -1 "Hit return to continue"

   To execute this program, you can type `gnuplot plotscript` from your UNIX shell. We want this to be executed from inside your tk script. So when the user clicks the plot widget, the computer should execute this (this will put up the desired plot on your screen).