M241-MATLAB (P. Staley) Project Four (revised 03-25-2007)

Diffusion and Function M-File

Diffusion problem background: A rod four feet long is taken from an ice bath and subjected to a heating/cooling at both ends. The heating/cooling is done in such a manner that the temperature at each end has its own prescribed fixed value. Our assignment is to compute the temperature at seven equally spaced interior nodes. Our description of the temperature distribution consists of the temperature measurements at each ½ foot mark. The heat conductivity of the rod is such that at each time interval the temperature goes a fraction r toward the average of the temperature at the adjacent nodes.

1. Produce a function M-File called relax1pt that will propagate the temperature one time step at one of the interior points. Inputs to relax1pt should be the three temperatures at time t: adjleft, now, and adjright; and the relaxation coefficient r. The output of relax1pt is later, the propagated temperature of the interior node corresponding to now only at time t+1. [Hints: 1.1 Compute the average of adjleft and adjright. 1.2 Compute the difference of average and now. 1.3 Compute later as now plus r times difference.]

2. Produce a script M-file for the main program that does the following:

2.1 Get the values of left, right, initial, and r from the user [Hint: use the input function four times.]

2.2 Instantiate an array to accommodate the temperatures at the nine nodes over twenty time steps [Hint: use the zeros function.]

2.3 Initialize the interior node temperatures at time zero [Hint: colon operator]

2.4 Set the node one and node nine temperatures [Hints: left, right, colon operator]

2.5 Compute the temperatures at time one for the seven interior nodes [Hint: make seven calls to the function relax1pt]

2.6 Repeat step 2.5 for the next 19 times.

3. Use nested loops to rewrite the code produced in steps 2.5 and 2.6.

4.1 Run your script produced in step 3 from the command window. Use the following input values: left = 100, right = 0, r = 1/4, initial interior = 0.

4.2 Plot the temperatures at times 0, 5, 10, 15 and 20. Make sure the figure is appropriately labeled.

5. Turn in a print out of the two M-files, your command window showing the run from step 4.1 and a print out of the graphical temperature profiles produced in step 4.2.