

Harvey Mudd College
Parallel and Real-Time Computation
Spring 2011

Assignment 3
Using the SPMD Model and MPI

This is nominally a 2-week assignment:

Thurs. Feb. 10: Have a preliminary, sequential, version working

Thurs. Feb. 17, Have a parallel version working

Develop a parallel solver for the two-dimensional Laplace equation, where the boundary temperature is specified and the interior temperature is to be computed.

1. Use the CS cluster 'church' and MPI (mpich2, and any available language of your choice).
2. Keep your model parameterized in such a way that you will be able to scale the grid size and number of processes.
3. Initial Assumptions:

60 x 80 rectangular grid

boundary conditions:

temperature is 0 degrees on top and left-side

temperature is 100 degrees on bottom and right-side

Update formula (derived in class):

$$T[i, j] = (T[i-1, j] + T[i+1, j] + T[i, j-1] + T[i, j+1]) / 4;$$

4. Run until temperature converges to within 0.01 degrees. (For starters, consider just running some fixed number of iterations. Then worry about convergence.)

5. Plot your output in an array using the following character encoding:

a for temperature ≥ 0 and < 4

b for temperature ≥ 4 and < 8

c for temperature ≥ 8 and < 12

....

z for temperature ≥ 100

(Coding-wise, use an array or switch, not a bunch of 'if' tests.)

6. With this encoding, iso-temperature patterns on the array should be evident.

7. Turn in:

a. Narrative description of your approach and results.

b. Listing of code (with comments)

c. Display of final result, e.g. using ASCII "graphics"

d. Time and speedup curves for 1 to 48 MPI processes