APC 524 HW 4

Brandon Hensley

November 19, 2012

1 Temperature Plots

The following are temperature maps generated for different grid sizes. These maps are identical across implementations (serial, OMP, MPI), and thus we present them only once here.

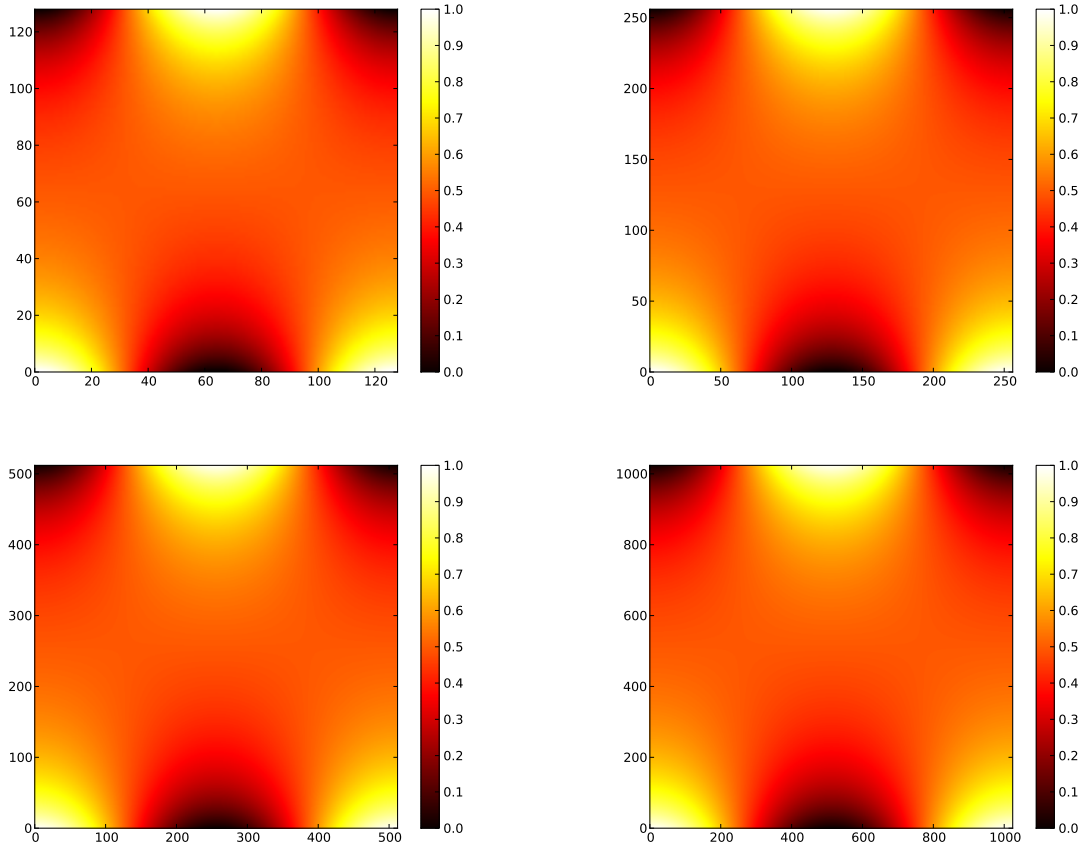

Figure 1: Temperature image plots for various grid sizes, with darker regions corresponding to lower temperatures.

2 Time Comparison

As expected, running the code on mutliple processors sped up execution by roughly the number of processors, with some penalty for the non-parallel portions of the code. The MPI code was significantly slower than the serial and OMP implementations only because the -O3 flag was mistakenly omitted at compile time, as it had been turned off for debugging purposes. The specific times are given in Table 1, as are the final temperatures.

3 I/O

To perform the I/O with MPI, each process wrote the contents of its chunk to a separate uniquely named file. The rank 0 process also wrote an additional file with the time and mean temperature. The files could then be stitched together with a script if needed.

4 OpenMP vs MPI

The OpenMP paradigm was far easier to implement than the MPI, and it did not require the creation of additional ghost cells. Unfortunately, a speed comparison is not possible for the reasons outlined above. MPI did have the advantage of having all processors firing at all times, with the exception of waiting for messages to be sent and received, whereas the OpenMP implementation had large chunks of serial code. Thus, had they been run with the same optimization, it is likely that MPI would have been the faster option.

Table 1: Comparison of Run Times

Resolution	Code Type	Processes	Time (s)	Average Temperature
128	Serial	1	14.48	0.497108
	OMP	1	7.41	
		2	4.93	
		4	?	
		8	?	
	MPI	1	32.06	
		2	17.39	
		4	9.37	
		8	?	
		16	?	
256	Serial	1	252.82	0.497097
	OMP	1	118.46	
		2	70.06	
		4	?	
		8	?	
	MPI	1	529.16	
		2	279.75	
		4	140.34	
		8	?	
		16	?	
512	Serial	1	8155.55	0.497091
	OMP	1	5024.94	
		2	2870.56	
		4	?	
		8	?	
	MPI	1	9146.86	
		2	5104.93	
		4	2456.39	
		8	?	
		16	?	
1024	Serial	1	?	0.497088
	OMP	1	?	
		2	43882.69	
		4	?	
		8	?	
	MPI	1	?	
		2	?	
		4	?	
		8	?	
		16	?	