APC 524 HW 4
Chase Perlen

Time Elapsed:

Serial	1
128	8.74524
256	147.784
512	2396.31

OMP	1	2	4	8
128	12.1969	6.49118	3.52839	2.17661
256	196.37	99.5768	50.9615	27.1689
512	3146.06	1572.8	792.293	404.108

MPI	1	2	4	8	16
128	11.7068	7.01953	4.19403	2.79002	2.42191
256	185.369	94.5112	48.5239	25.4644	13.7735
512	2963.82	1497.23	758.619	386.48	201.307

Volume Average Temperature:

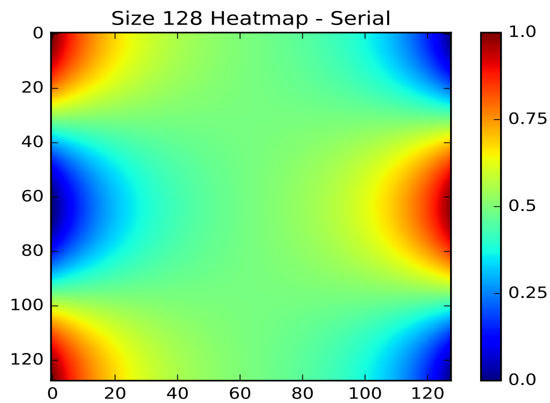
Serial	1
128	0.497325
256	0.497207
512	0.497147

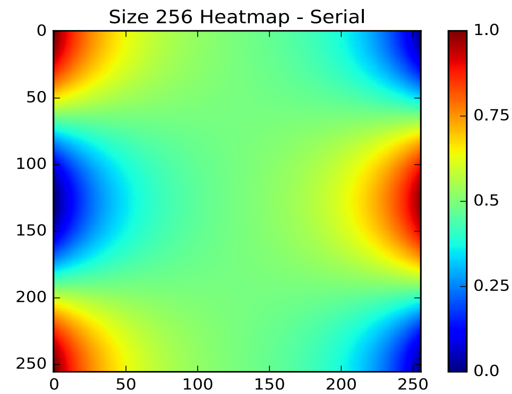
OMP	1	2	4	8
128	0.497325	0.497325	0.497325	0.497325
256	0.497207	0.497207	0.497207	0.497207
512	0.497147	0.497147	0.497147	0.497147

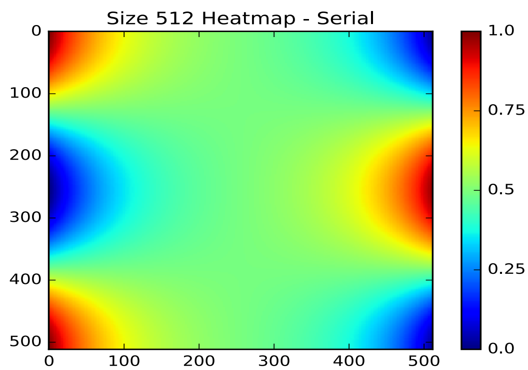
MPI	1	2	4	8	16
128	0.497325	0.497325	0.497325	0.497325	0.497325
256	0.497207	0.497207	0.497207	0.497207	0.497207
512	0.497147	0.497147	0.497147	0.497147	0.497147

Plots:

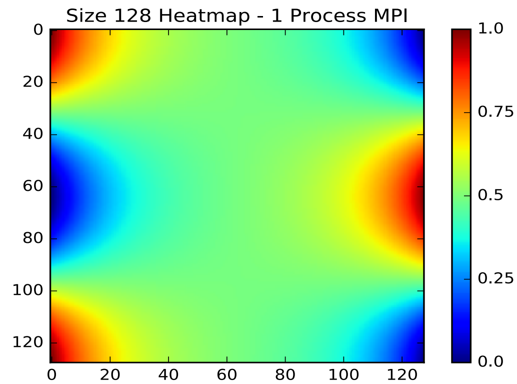
Serial:

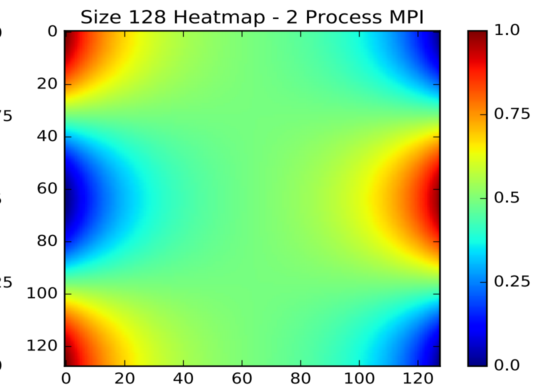

Size 128 Heatmap - Serial

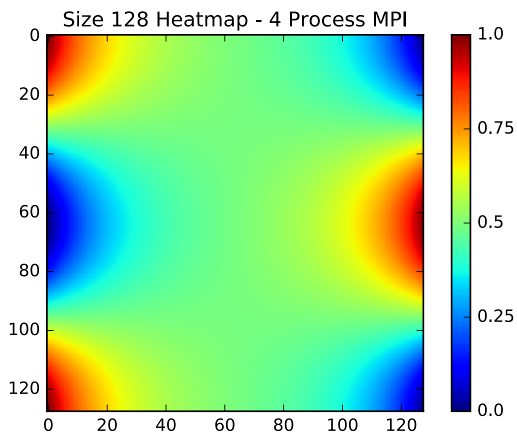

Size 256 Heatmap - Serial


Size 512 Heatmap - Serial

MPI:


Size 128 Heatmap - 1 Process MPI
0
20
40
60
80
100
120
0 20 40 60 80 100 120
1.0
0.75
0.5
0.25
0.0


Size 128 Heatmap - 2 Process MPI
0
20
40
60
80
100
120
0 20 40 60 80 100 120
1.0
0.75
0.5
0.25
0.0


Size 128 Heatmap - 4 Process MPI
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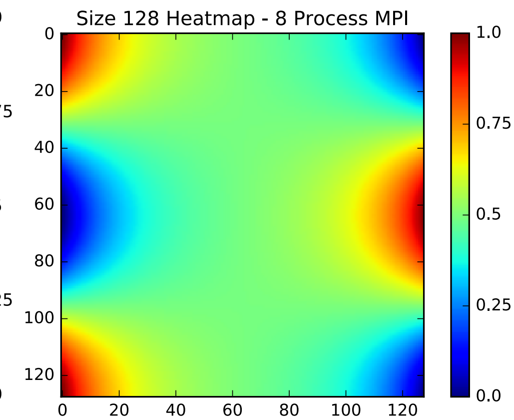
40
60
80
100
120
0 20 40 60 80 100 120
1.0
0.75
0.5
0.25
0.0


Size 128 Heatmap - 8 Process MPI
0
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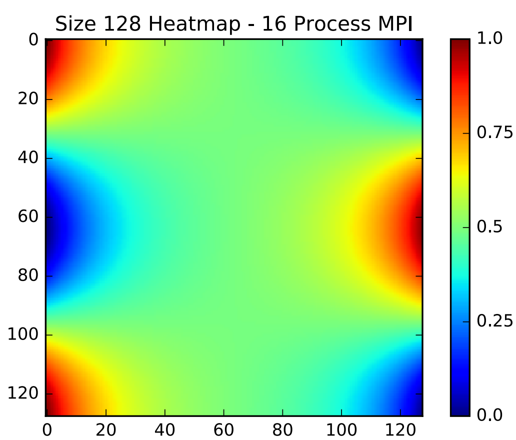
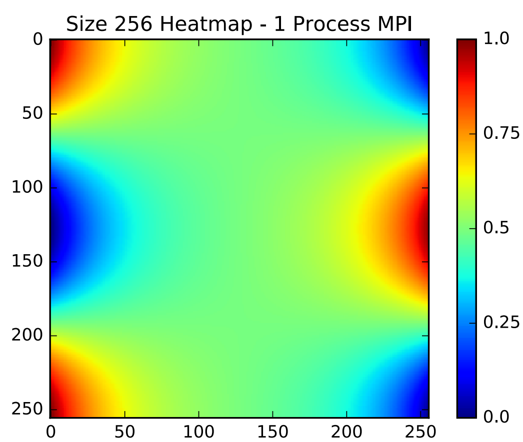
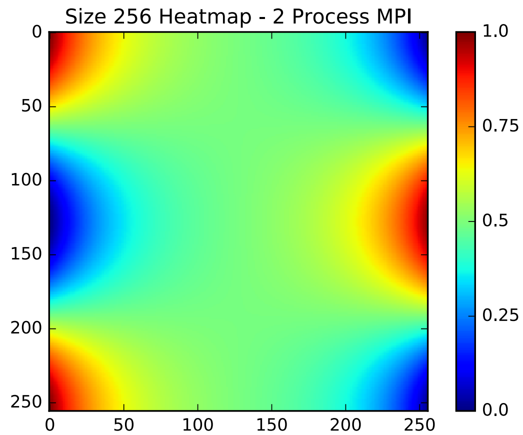
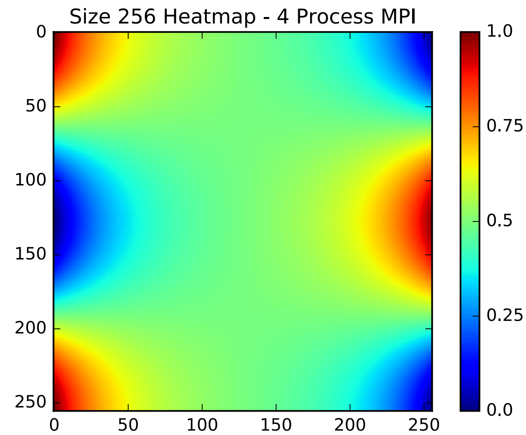
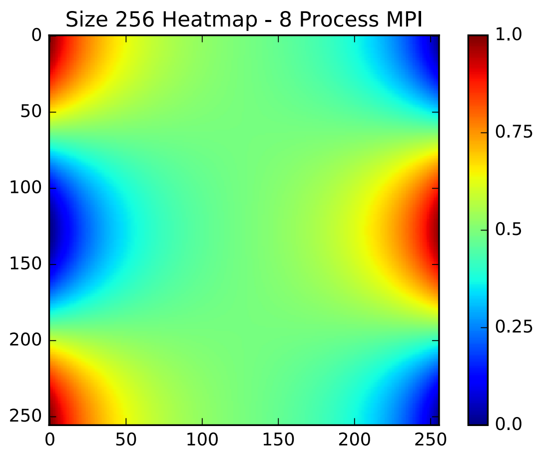
40
60
80
100
120
0 20 40 60 80 100 120
1.0
0.75
0.5
0.25
0.0

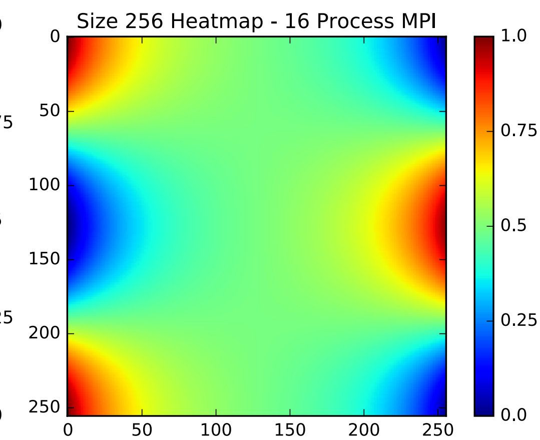

Size 128 Heatmap - 16 Process MPI
0
20
40
60
80
100
120
0 20 40 60 80 100 120
1.0
0.75
0.5
0.25
0.0

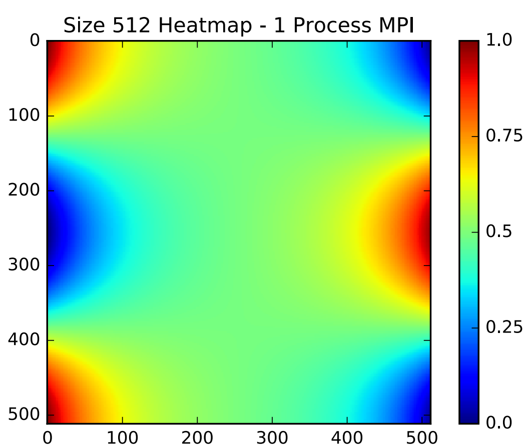

Size 256 Heatmap - 1 Process MPI
0
50
100
150
200
250
0 50 100 150 200 250
1.0
0.75
0.5
0.25
0.0

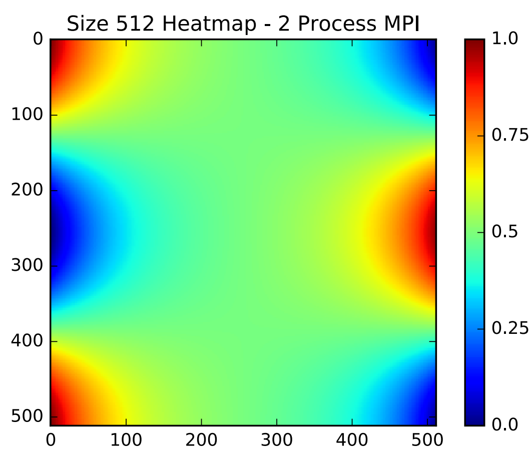

Size 256 Heatmap - 2 Process MPI
0
50
100
150
200
250
0 50 100 150 200 250
1.0
0.75
0.5
0.25
0.0

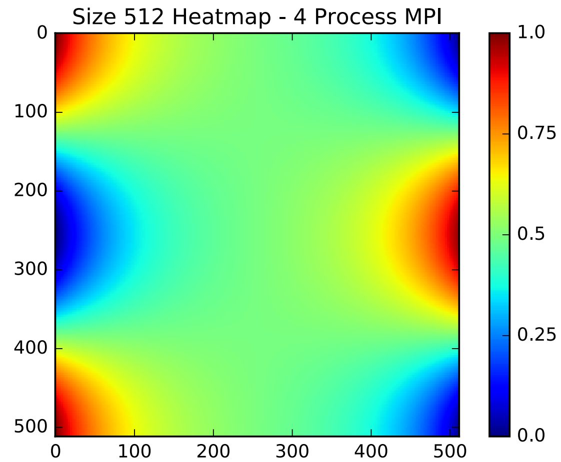

Size 256 Heatmap - 4 Process MPI
0
50
100
150
200
250
0 50 100 150 200 250
1.0
0.75
0.5
0.25
0.0

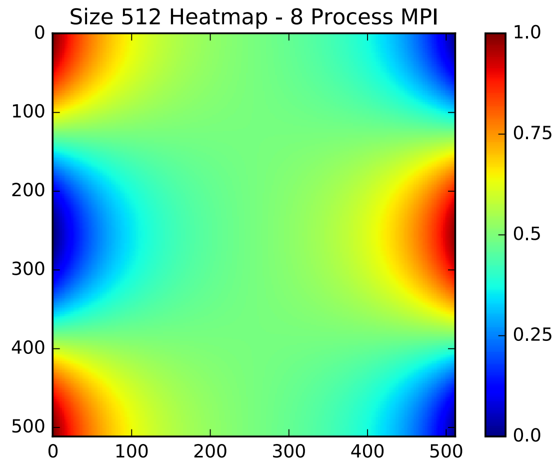

Size 256 Heatmap - 8 Process MPI
0
50
100
150
200
250
0 50 100 150 200 250
1.0
0.75
0.5
0.25
0.0

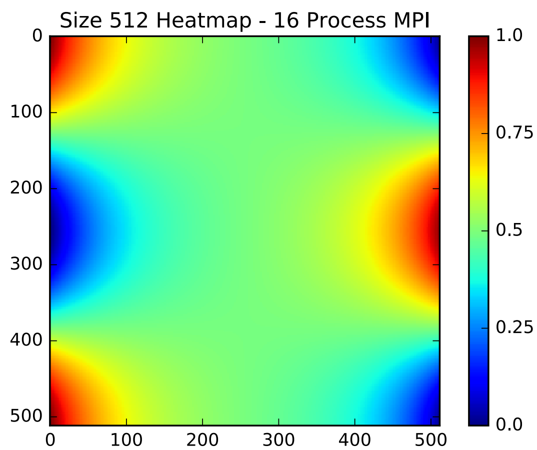

Size 256 Heatmap - 16 Process MPI
0
50
100
150
200
250
0 50 100 150 200 250
1.0
0.75
0.5
0.25
0.0


Size 512 Heatmap - 1 Process MPI
0
100
200
300
400
500
0 100 200 300 400 500
1.0
0.75
0.5
0.25
0.0


Size 512 Heatmap - 2 Process MPI
0
100
200
300
400
500
0 100 200 300 400 500
1.0
0.75
0.5
0.25
0.0







OpenMP vs MPI: Advantages and Disadvantages

Although both are used to parallelize code, OpenMP and MPI are quite different to use. In OpenMP, threads have access to both private and shared variables, so there is no need to manage message sending between threads. It falls on the programmer to decide what needs to be private, which in our case was nothing so it required little work. MPI, on the other hand, uses distributed memory, so each thread has its own private memory and there is no shared memory. This complicated the problem, necessitating us to divide the grid and pass messages containing "ghost rows" to enable the update process for other threads. Moreover, the programmer is required to manage the timing of the transfer of information in order to ensure all the threads are updating in the same step. As a result, it was much easier to adapt my serial code to OpenMPI as compared to MPI, which required a fundamental change in the organization of the data. However, this effort was certainly justified, as MPI, especially on the larger grid sizes, ran significantly faster.