[ME5470] Introduction to Parallel Scientific Computing

Assignment - 5

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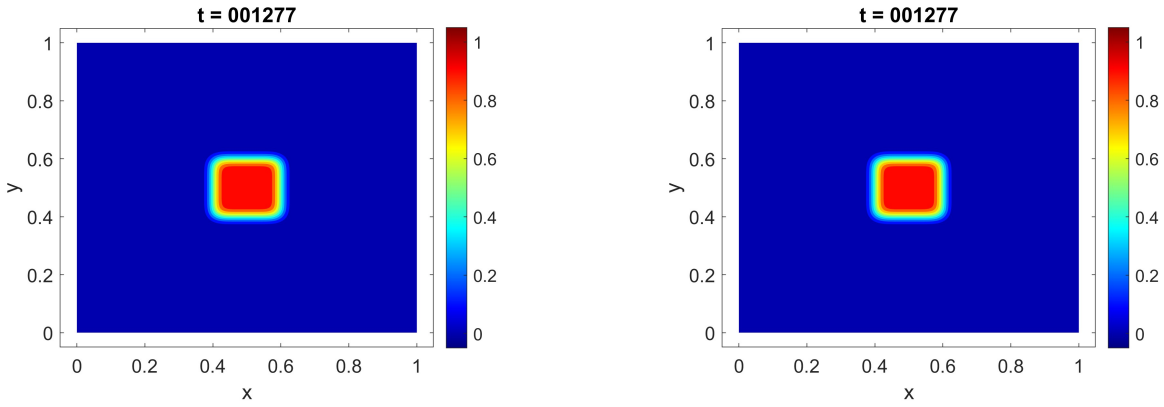
Question 1: Part A

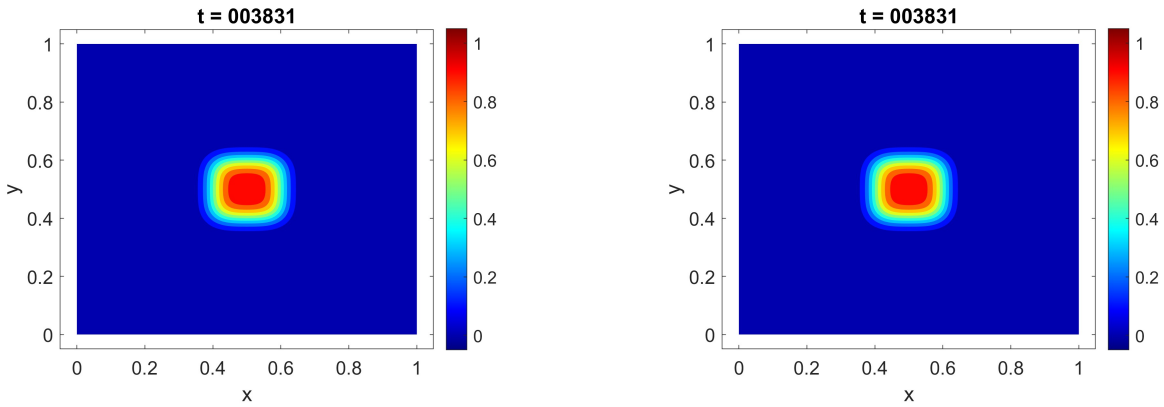
Sol: The contour plots for temperature profile for serial and MPI parallel code are plotted below.

..... For $p = 2 \times 2$ processor grid: .....



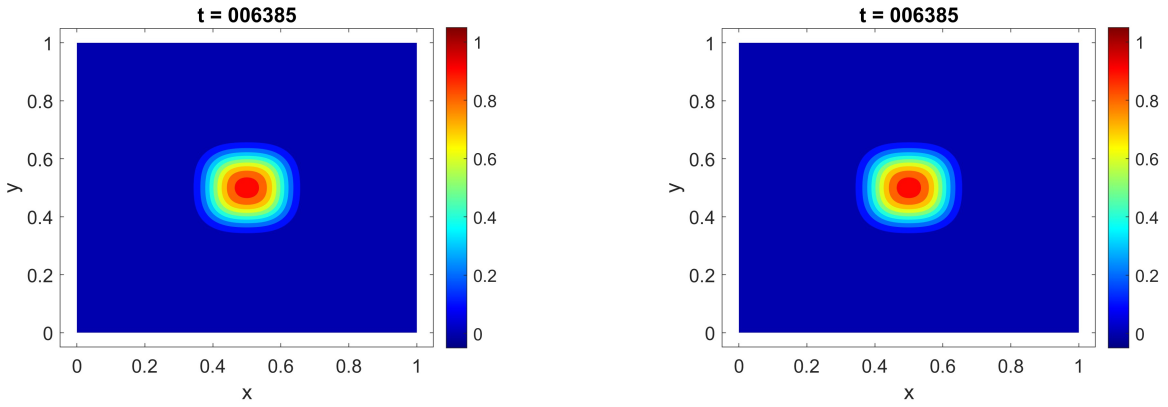
(a) Contour for Serial Code (b) Contour for MPI code

Figure 1: Contour plots at $t = 1277$



(a) Contour for Serial Code (b) Contour for MPI code

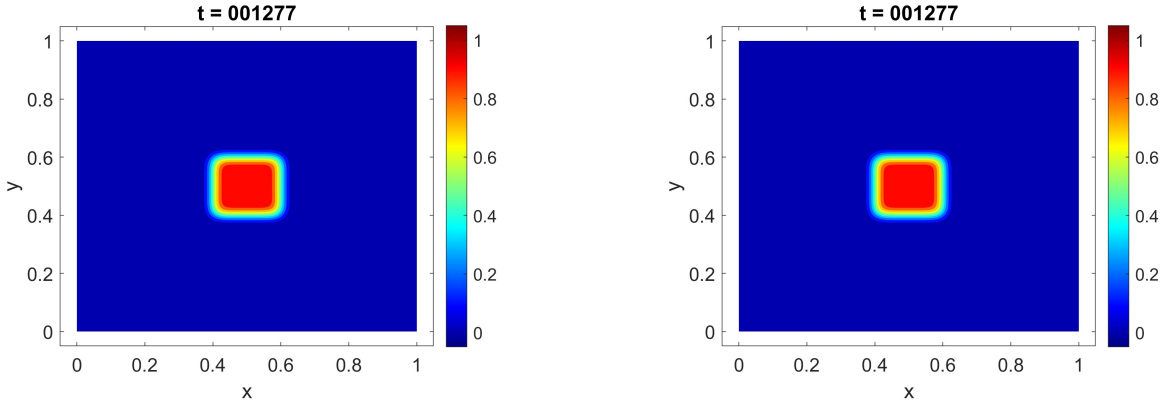
Figure 2: Contour plots at $t = 3831$



(a) Contour for Serial Code (b) Contour for MPI code

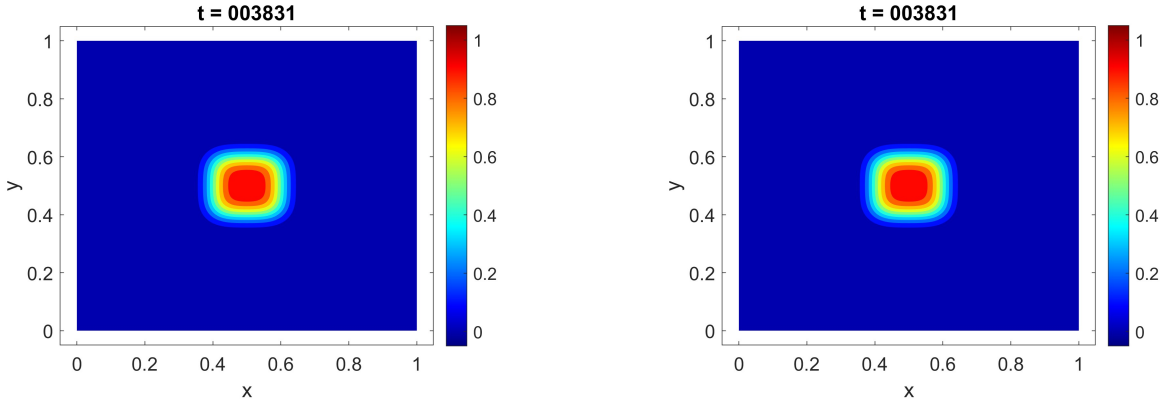
Figure 3: Contour plots at $t = 6385$

For $p = 2 \times 4$ processor grid:



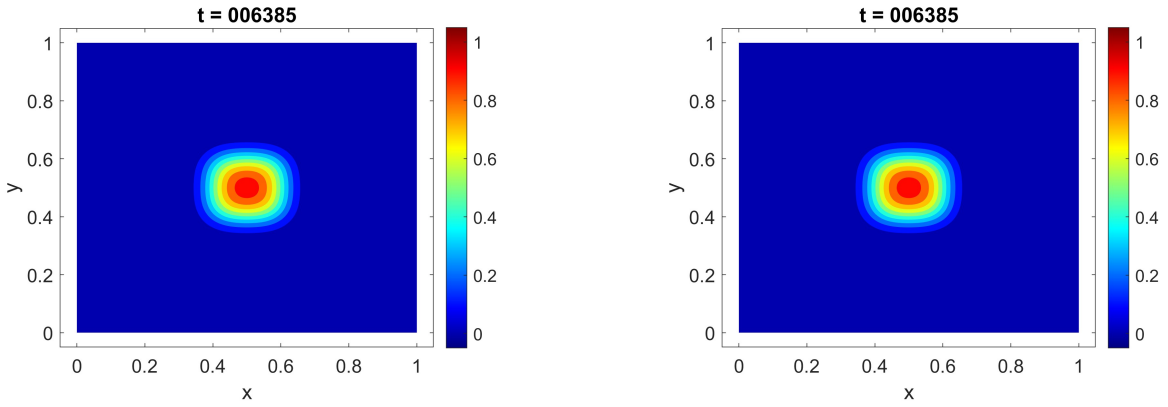
(a) Contour for Serial Code (b) Contour for MPI code

Figure 4: Contour plots at $t = 1277$



(a) Contour for Serial Code (b) Contour for MPI code

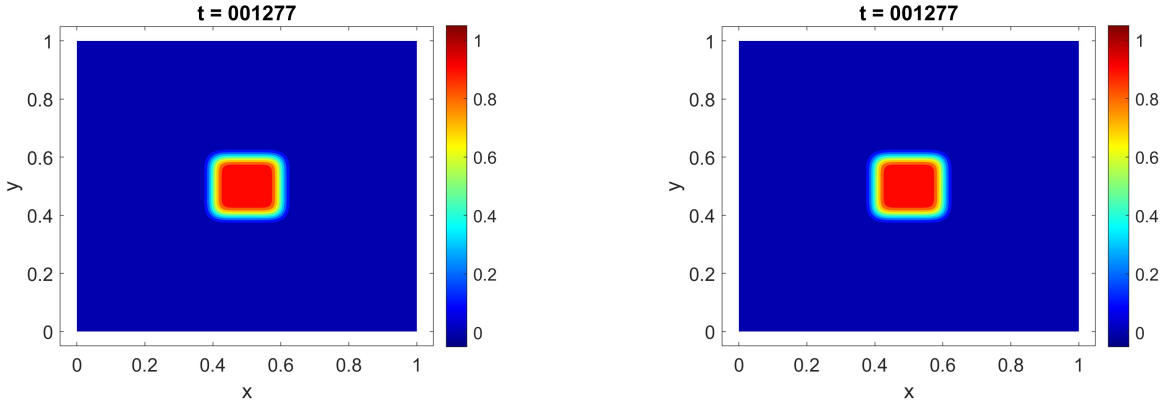
Figure 5: Contour plots at $t = 3831$



(a) Contour for Serial Code (b) Contour for MPI code

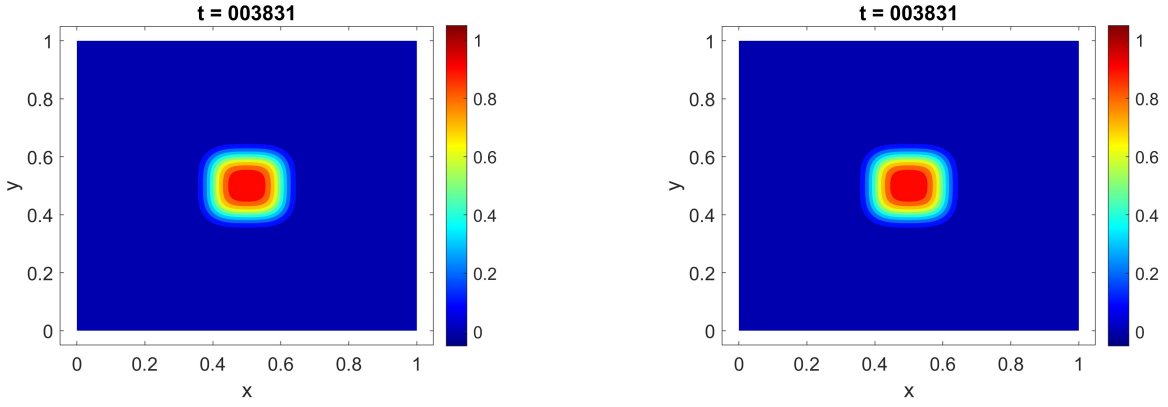
Figure 6: Contour plots at $t = 6385$

..... For $p = 4 \times 4$ processor grid: .....



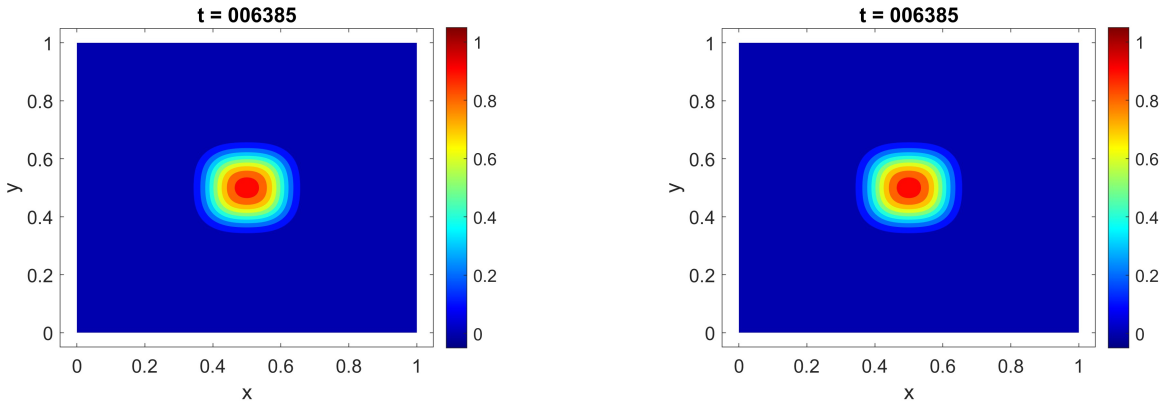
(a) Contour for Serial Code (b) Contour for MPI code

Figure 7: Contour plots at $t = 1277$



(a) Contour for Serial Code (b) Contour for MPI code

Figure 8: Contour plots at $t = 3831$



(a) Contour for Serial Code

(b) Contour for MPI code

Figure 9: Contour plots at $t = 6385$

The line plots for serial and MPI parallel code for temperature profile along mid-y centerline is plotted below:

..... **For** $t = 1277$**:** .....

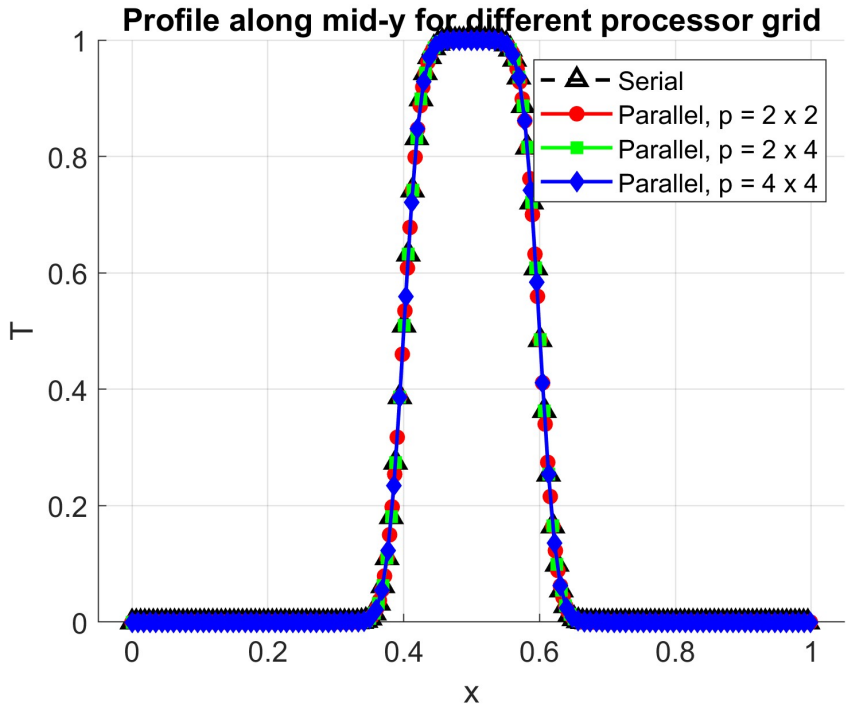


Figure 10: Y - Centerline plot at, $t = 1277$

..... **For** $t = 3831$**:** .....

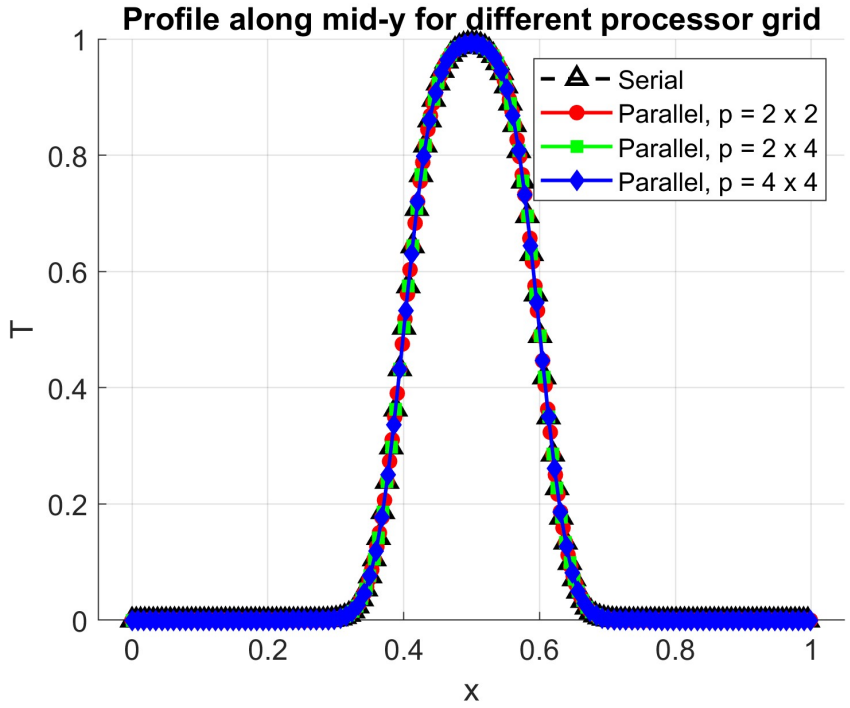


Figure 11: Y - Centerline plot at, $t = 3831$

..... **For** $t = 6385$ .....

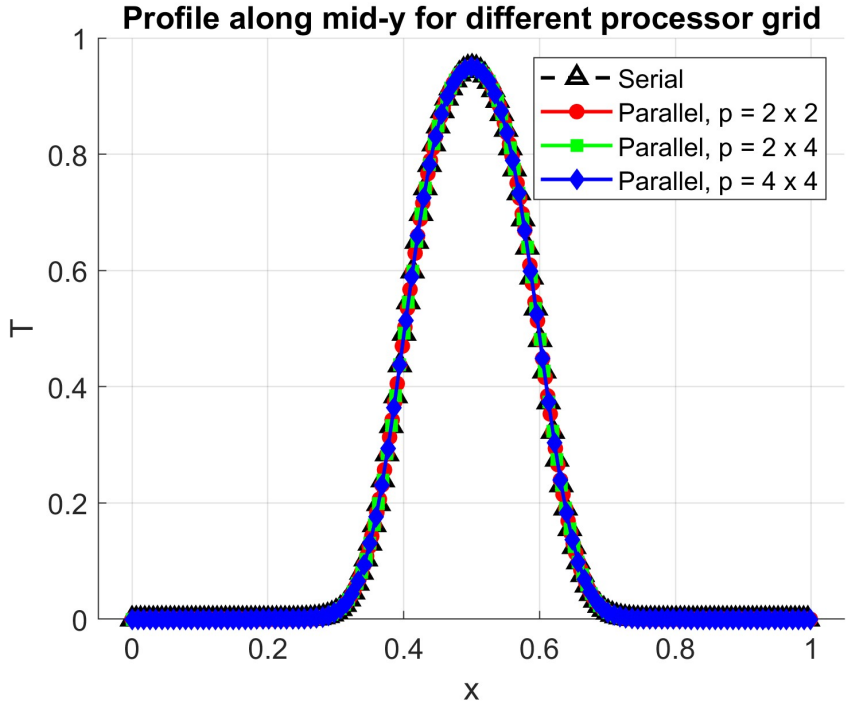


Figure 12: Y - Centerline plot at, $t = 6385$

Question 1: Part B

The tabulation for the difference between serial and parallel runs at end of 10 time steps is plotted below. We see that the value differ only on the machine precision level.

..... **For** $p = 2 \times 2$**:** .....

Difference Type	Value
Maximum Difference	$5.551115123125782702 12e - 17$
Minimum Difference	$0.000000000000000000 00e + 00$
Average Difference	$3.411704065638869218 39e - 20$

Table 1: Comparison of Serial and Parallel Runs After 10 Time Steps

..... **For** $p = 2 \times 4$**:** .....

Difference Type	Value
Maximum Difference	$5.551115123125782702 12e - 17$
Minimum Difference	$0.000000000000000000 00e + 00$
Average Difference	$3.411704065638849959 09e - 20$

Table 2: Comparison of Serial and Parallel Runs After 10 Time Steps

..... **For** $p = 4 \times 4$**:** .....

Difference Type	Value
Maximum Difference	$5.551115123125782702 12e - 17$
Minimum Difference	$0.000000000000000000 00e + 00$
Average Difference	$3.411704065638849959 09e - 20$

Table 3: Comparison of Serial and Parallel Runs After 10 Time Steps

Question 1: Part C

The time taken for serial and parallel run per time step is plotted below:

Processor ($p = p_x \times p_y$)	**Time Taken per time step (s)**
Serial	0.018452
2×2	0.005374
2×4	0.006525
4×4	0.007444

Table 4: Execution time for different processor grids