# [ME5470] Introduction to Parallel Scientific Computing

Assignment - 5

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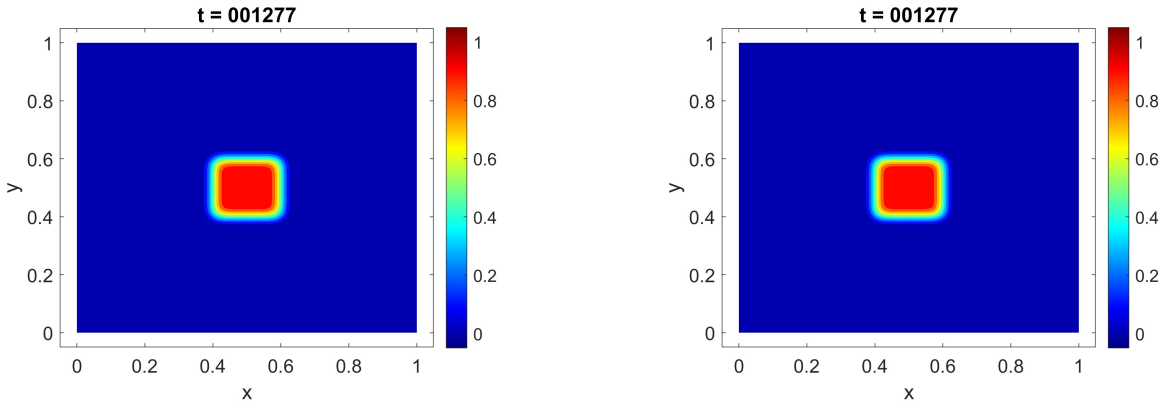
## Question 1: Part A

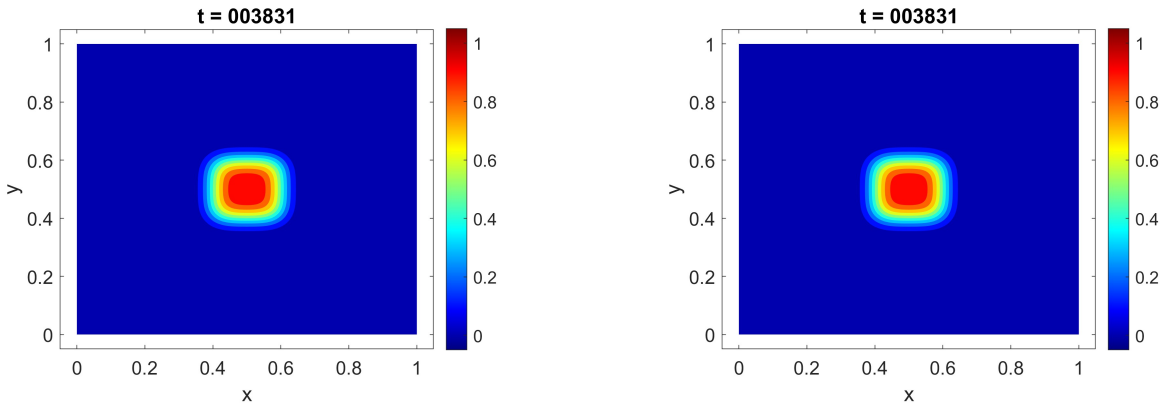
Sol: The contour plots for temperature profile for serial and MPI parallel code are plotted below.

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



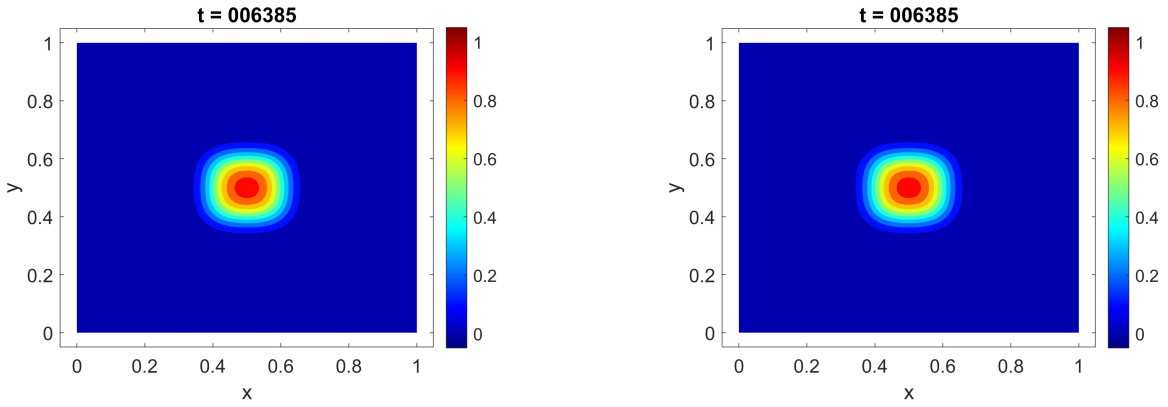

(a) Contour for Serial Code (b) Contour for MPI code

Figure 1: Contour plots at $t = 1277$




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

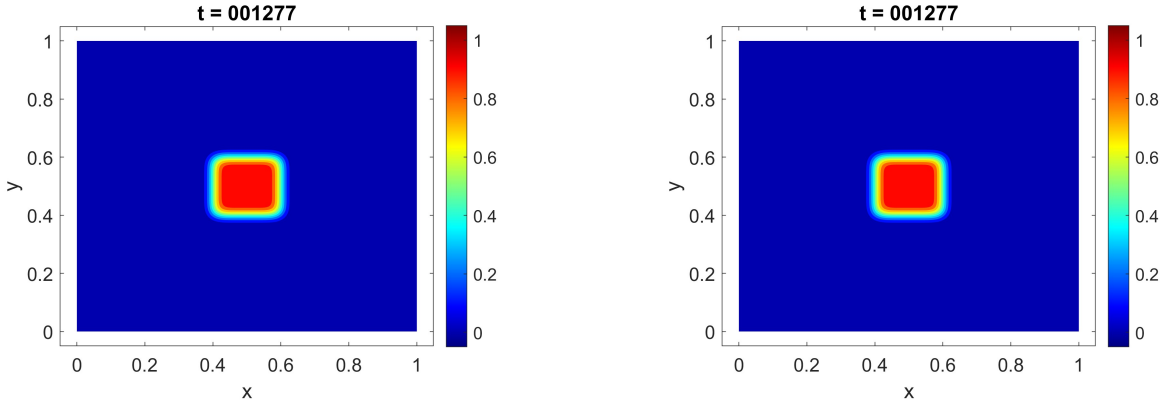
Figure 2: Contour plots at $t = 3831$




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

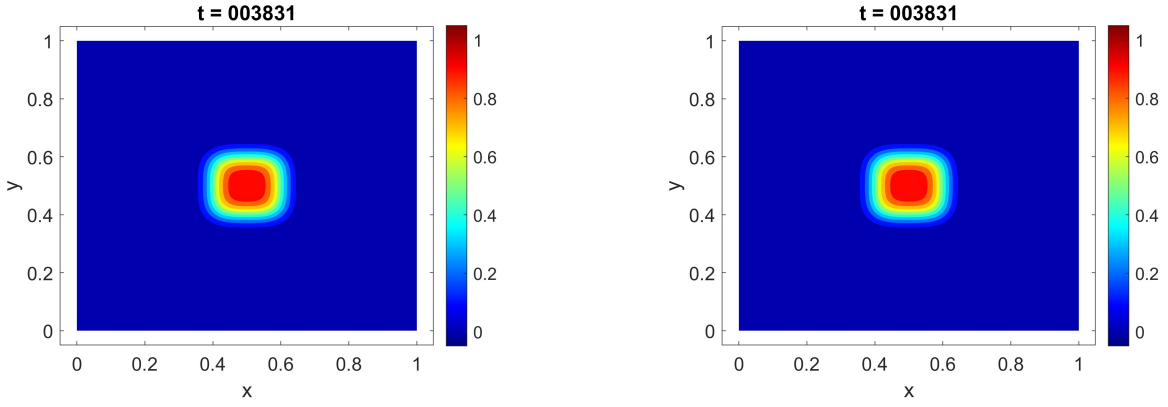
Figure 3: Contour plots at $t = 6385$

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



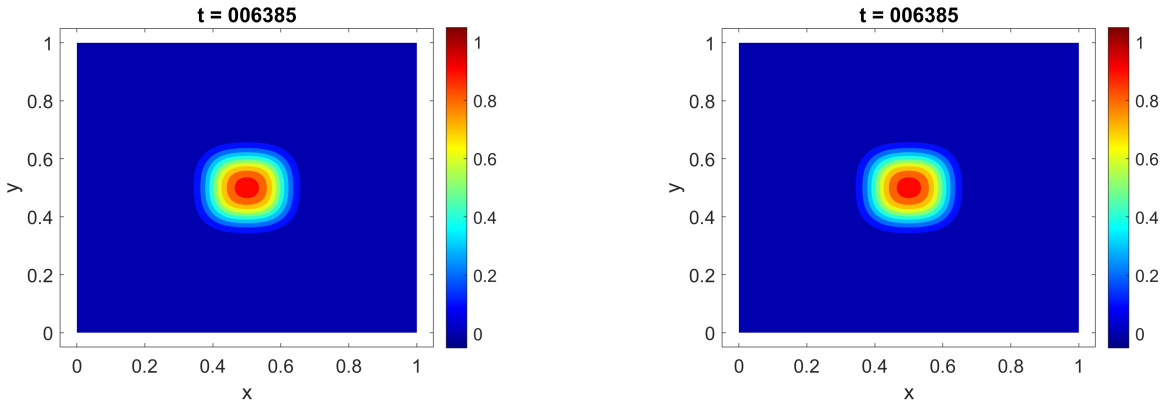

(a) Contour for Serial Code (b) Contour for MPI code

Figure 4: Contour plots at $t = 1277$




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

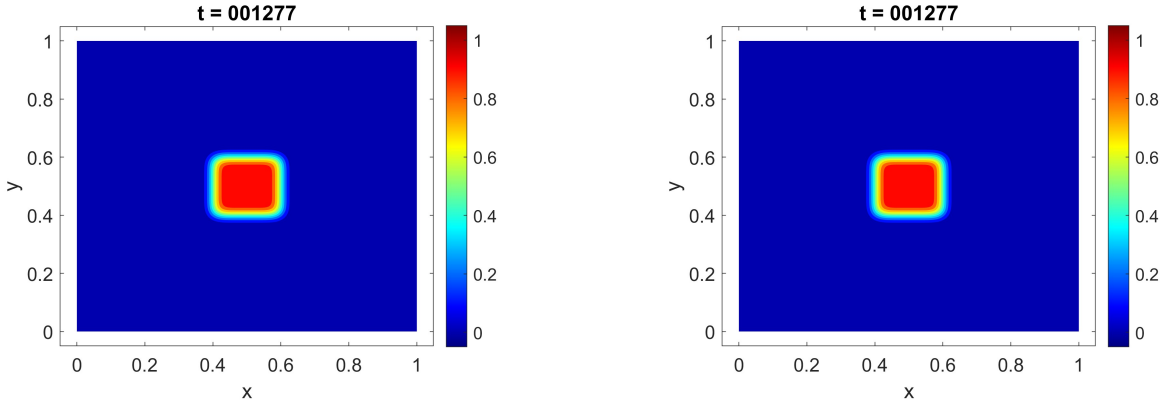
Figure 5: Contour plots at $t = 3831$




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

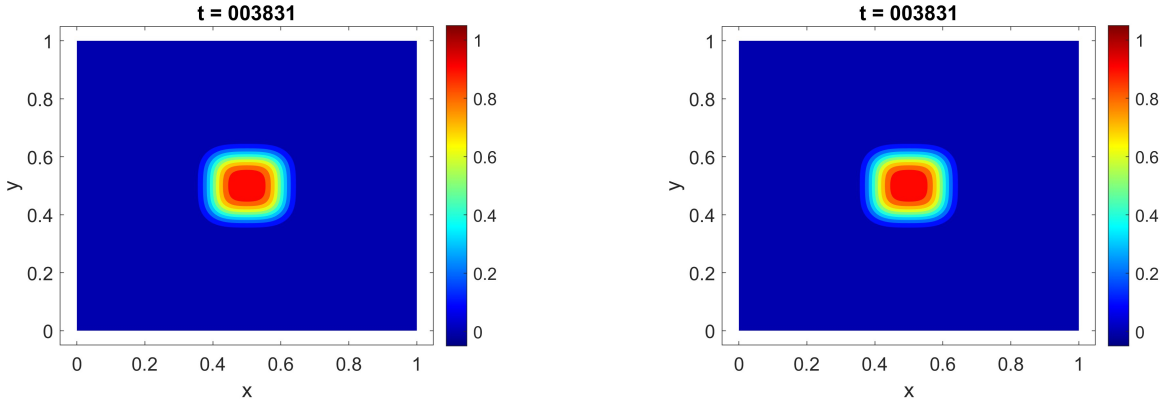
Figure 6: Contour plots at $t = 6385$

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



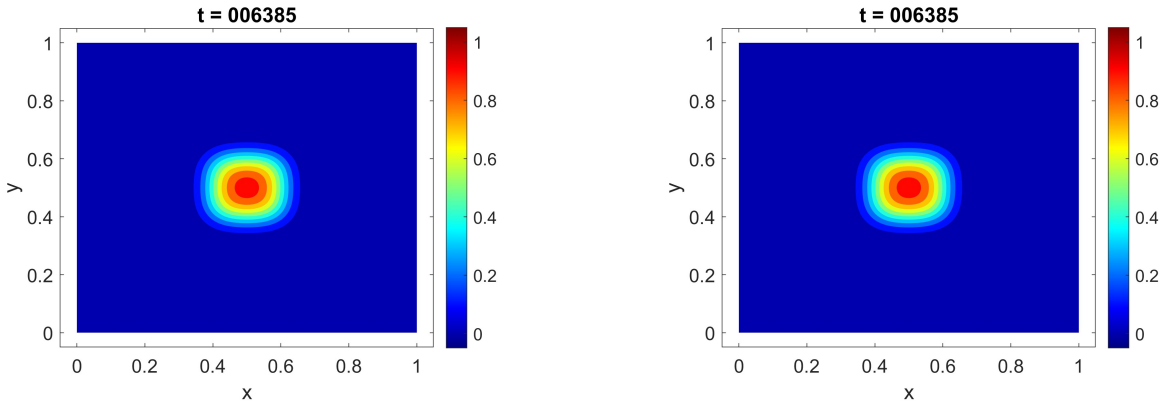

(a) Contour for Serial Code (b) Contour for MPI code

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

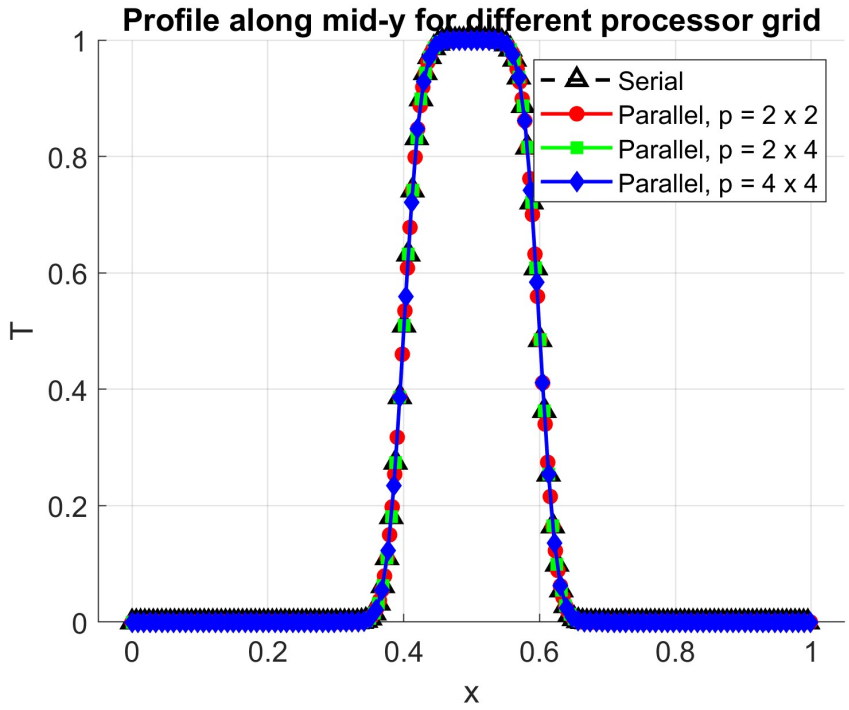



Figure 10: Y - Centerline plot at, $t = 1277$

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

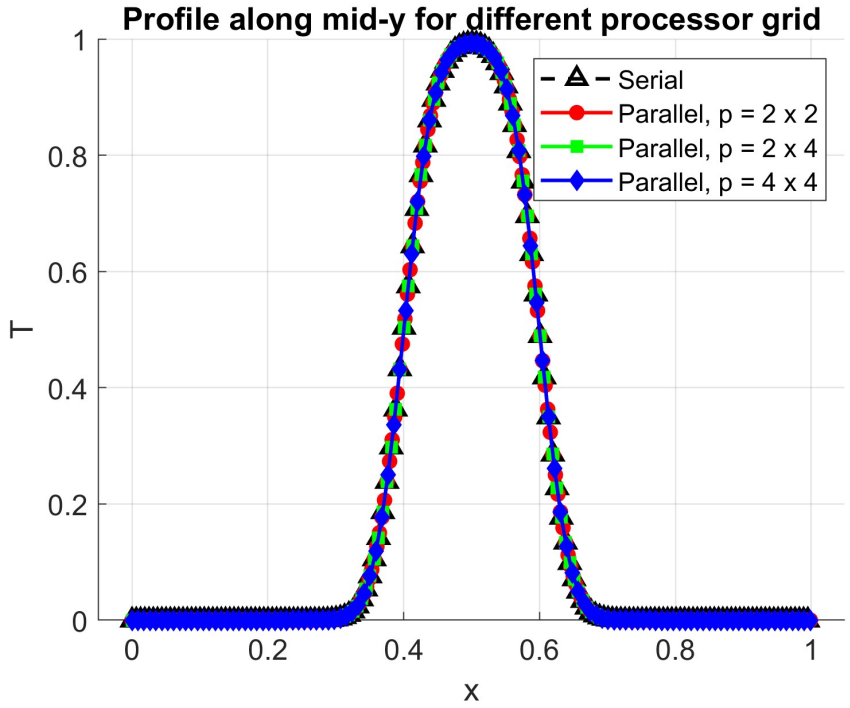



Figure 11: Y - Centerline plot at, $t = 3831$

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

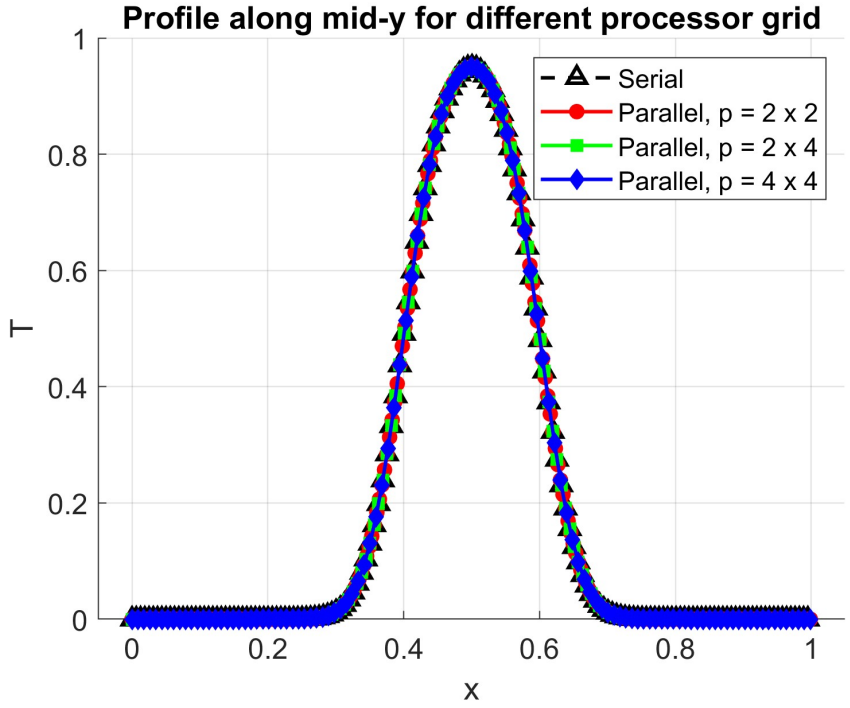



Figure 12: Y - Centerline plot at, $t = 6385$

## 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 | $0.0000000000000000000e+00$ |
| Minimum Difference | $0.0000000000000000000e+00$ |
| Average Difference | $0.0000000000000000000e+00$ |

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

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

| Difference Type | Value |
|---|---|
| Maximum Difference | $0.0000000000000000000e+00$ |
| Minimum Difference | $0.0000000000000000000e+00$ |
| Average Difference | $0.0000000000000000000e+00$ |

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

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

| Difference Type | Value |
|---|---|
| Maximum Difference | $0.0000000000000000000e+00$ |
| Minimum Difference | $0.0000000000000000000e+00$ |
| Average Difference | $0.0000000000000000000e+00$ |

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 |
| $2 \times 2$ | 0.005374 |
| $2 \times 4$ | 0.006525 |
| $4 \times 4$ | 0.007444 |

Table 4: Execution time for different processor grids