ME5470-Introduction to Parallel Scientific Computing

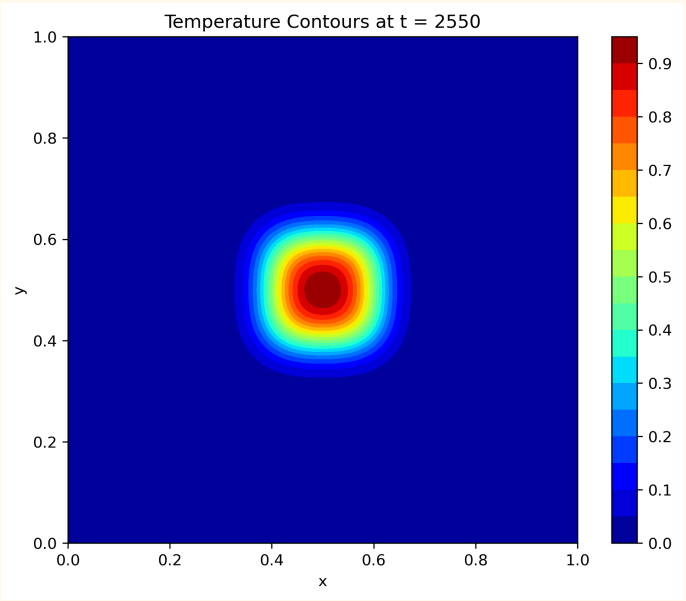
HW - 05 (Report)

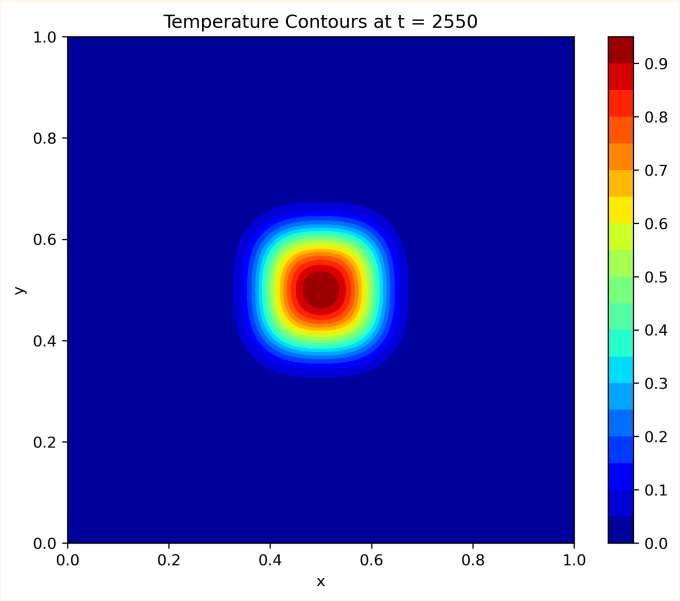
Parthib Ghosh CO22BTECH11007

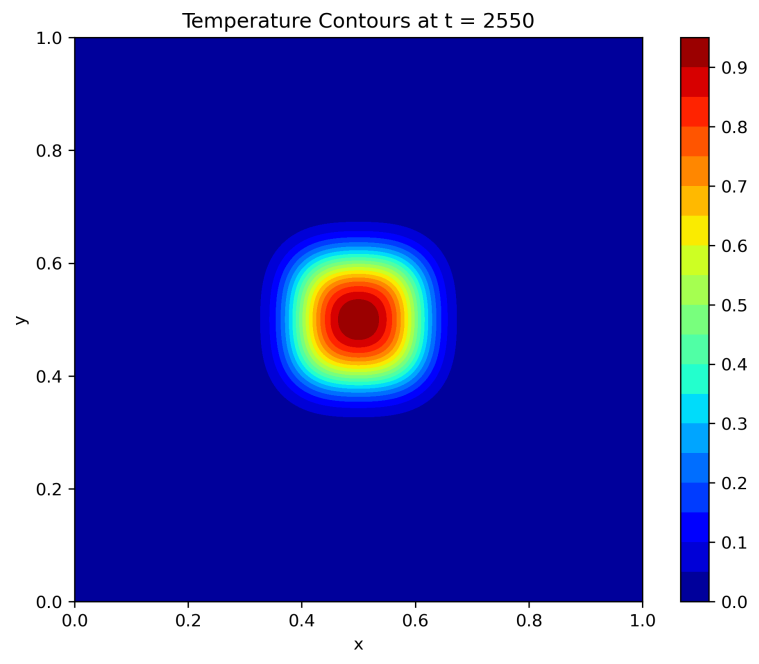
This report shows the implementation and results of the MPI-based parallel solver for 2D unsteady heat conduction using **FTCS** scheme. A **halo exchange** mechanism is used for inter process communication.

Question 1 :

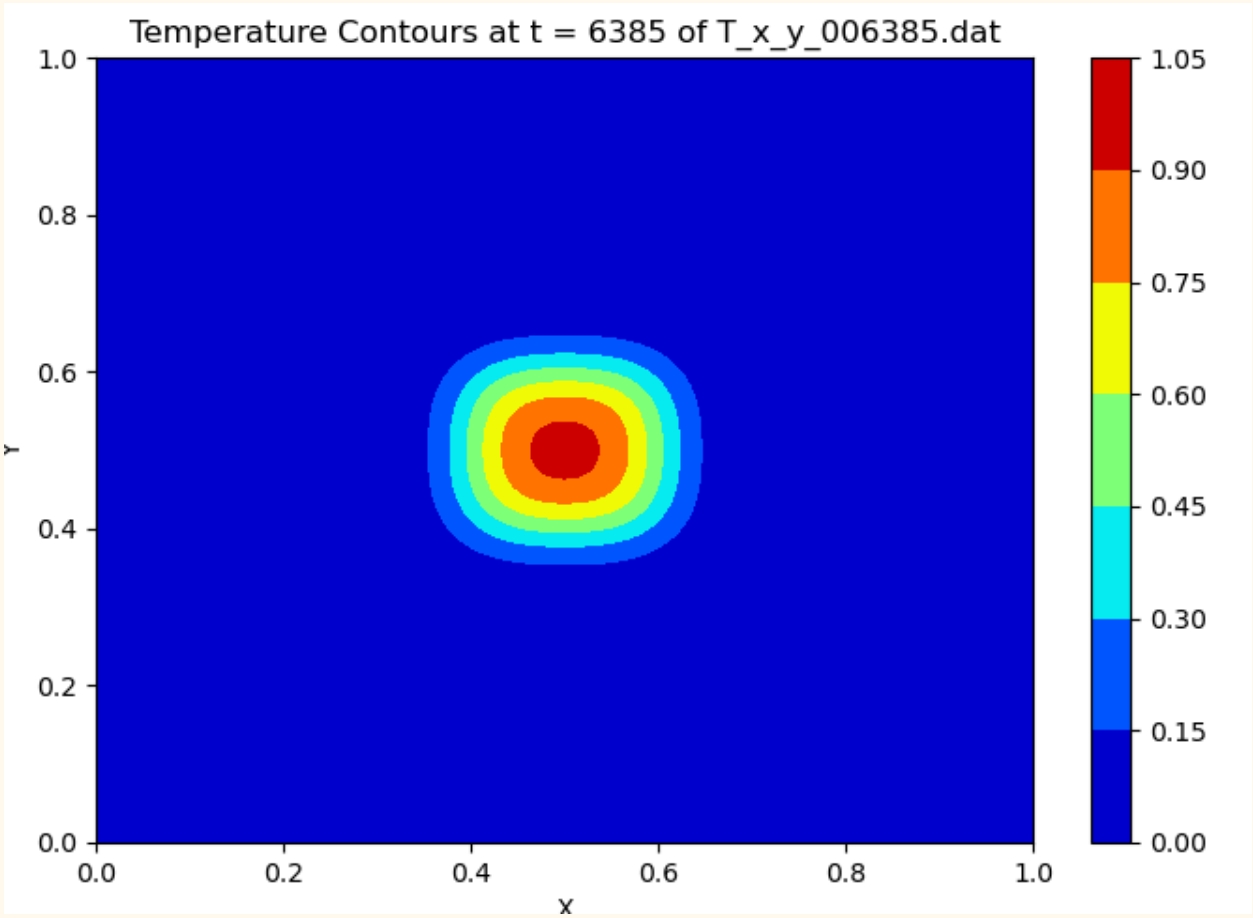
a) **Contour Plots** of the parallel code with 2x2, 2x4, 4x4 processors



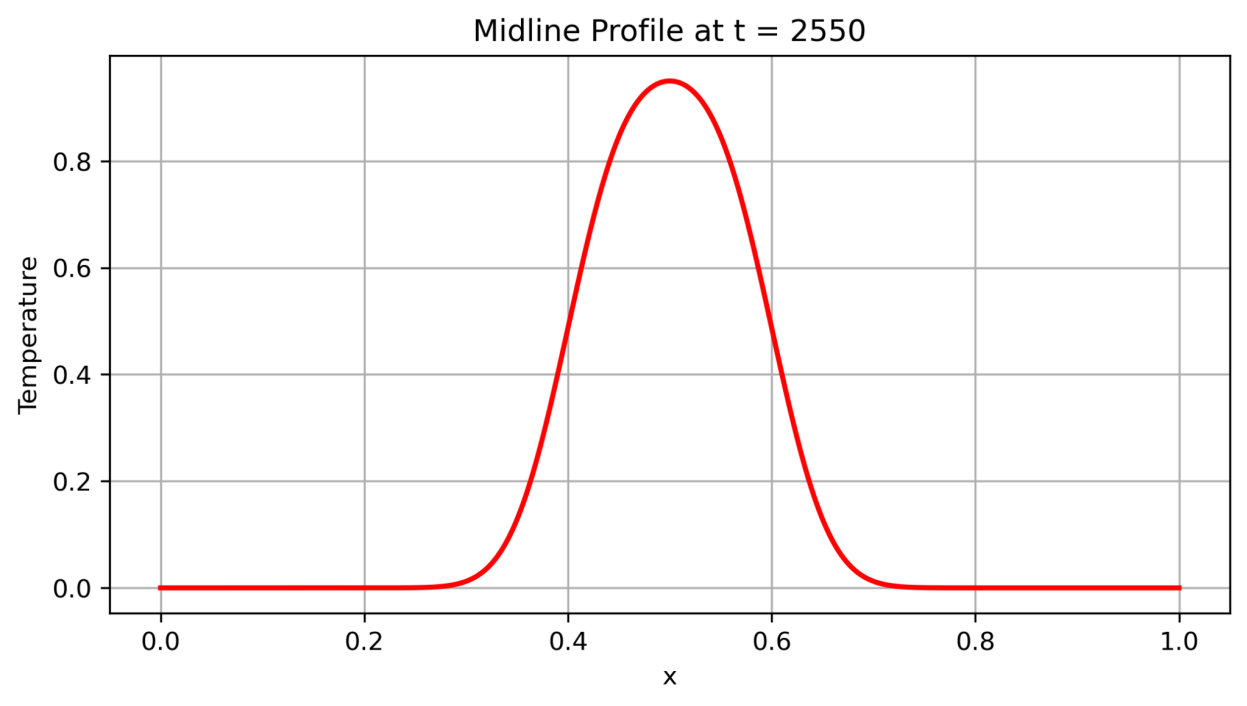


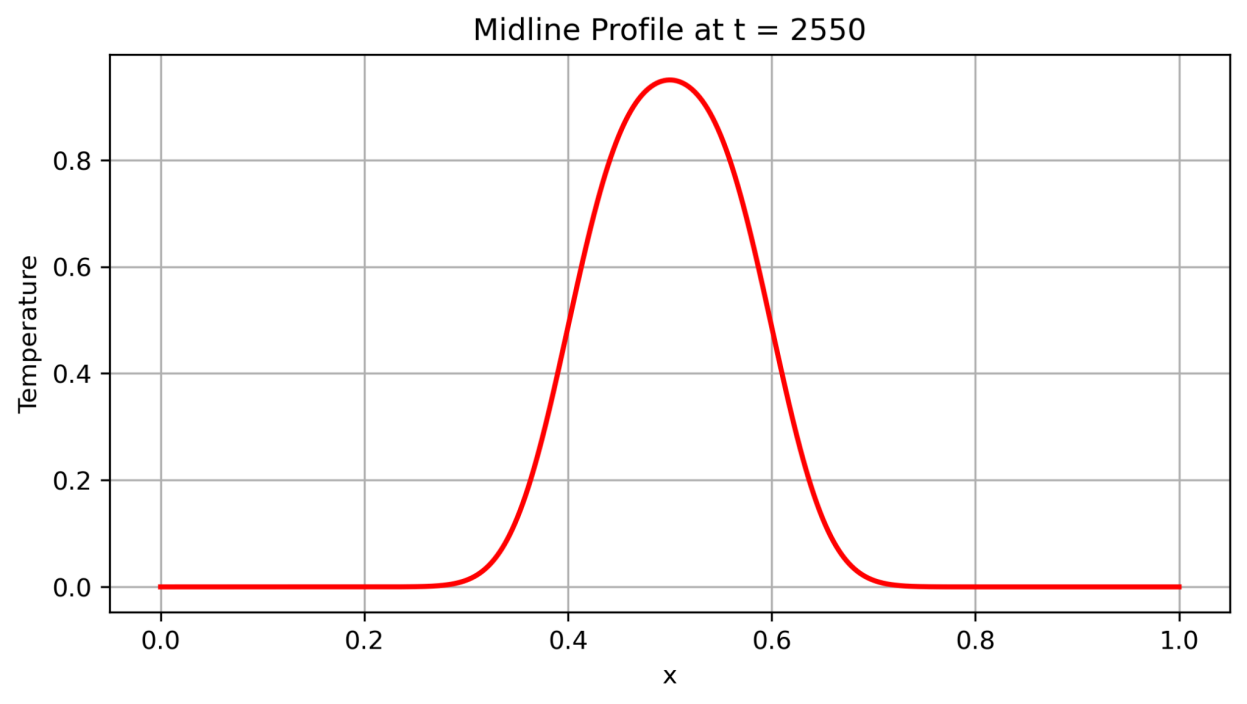


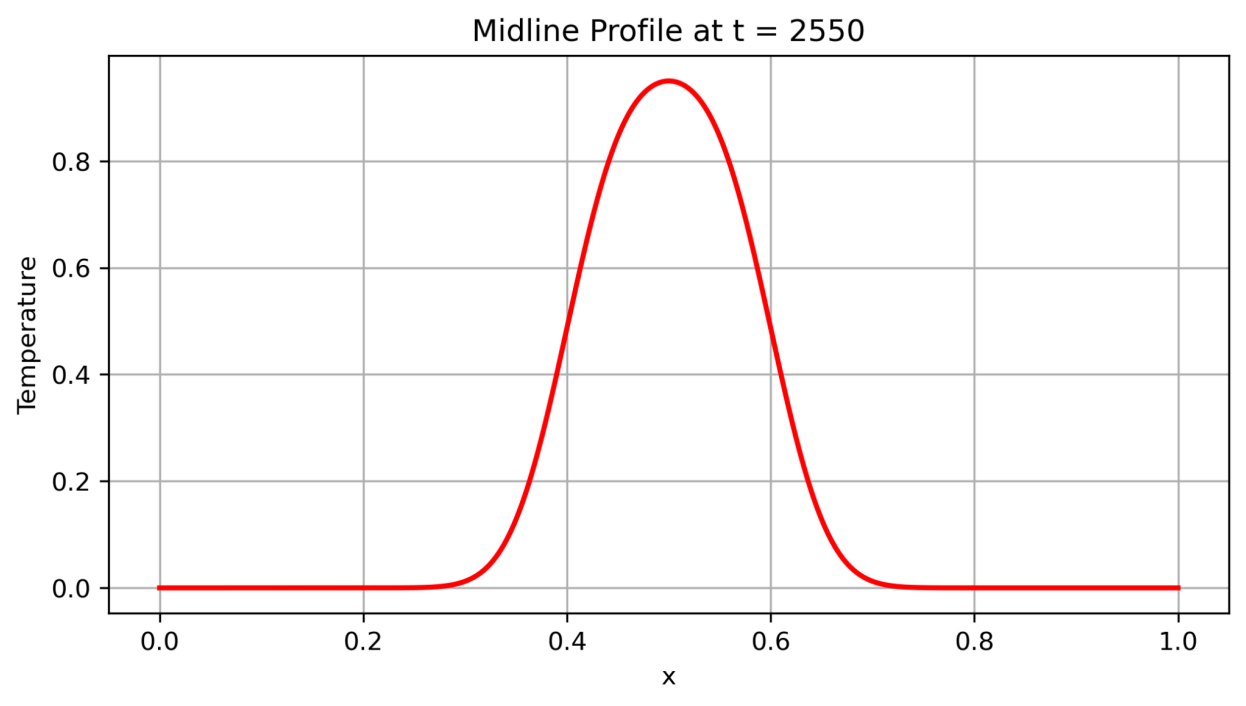
Contour Plots of the serial code



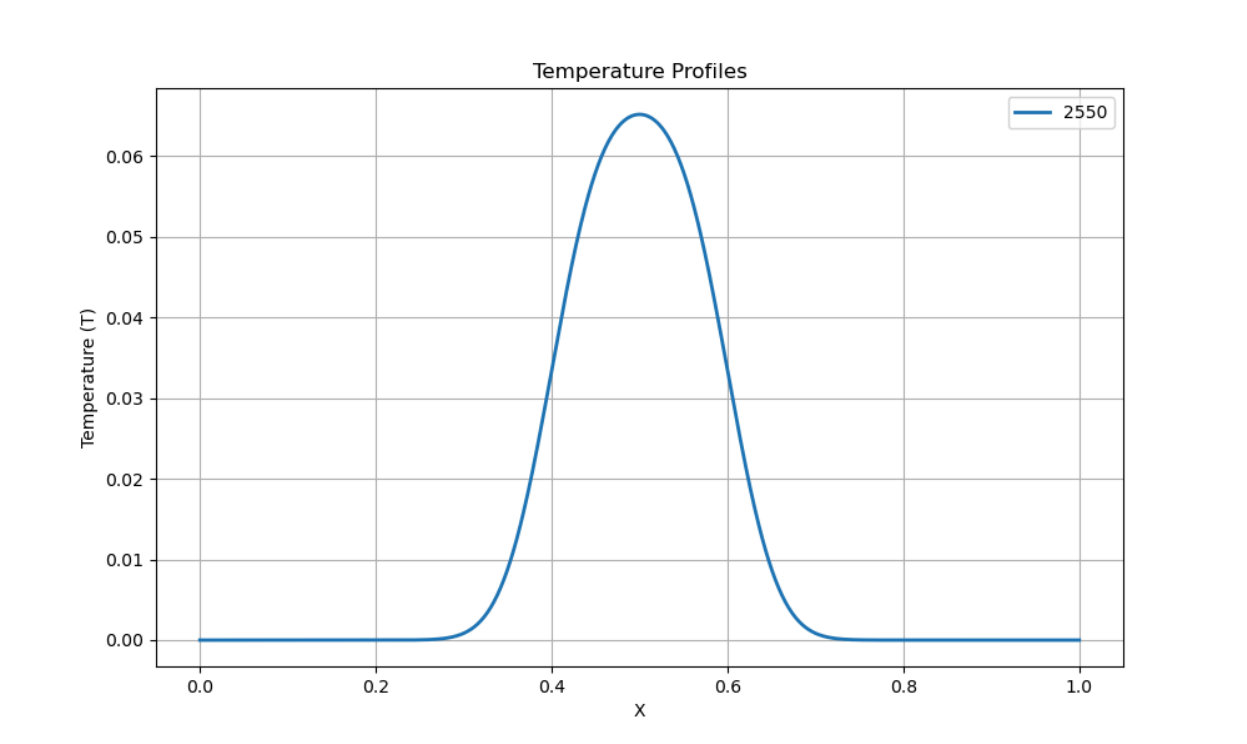
Line Plots of the parallel code with 2x2, 2x4, 4x4 processors







Line Plots of the serial code



b) After 10 time steps, almost all the difference between all the values tends to zero, it can be seen from the plots. However, there might be some differences due to machine precision and the differences will be negligible.

The **maximum difference** : 1.234846e-15
The **average difference** : 5.647861e-16

c) The time taken per time step is recorded using **MPI_Wtime**. The following table summarizes the results

configuration	Total time	Average time
Serial	4.51	4.504
2x2	2.32	2.302
2x4	1.5	1.5
4x4	1	1.002

The MPI parallelization successfully maintains numerical accuracy.
- Performance improves with increased parallelization, showing a reduction in runtime.
- The implemented halo exchange ensures correct communication between processes.