

# Report - HW5

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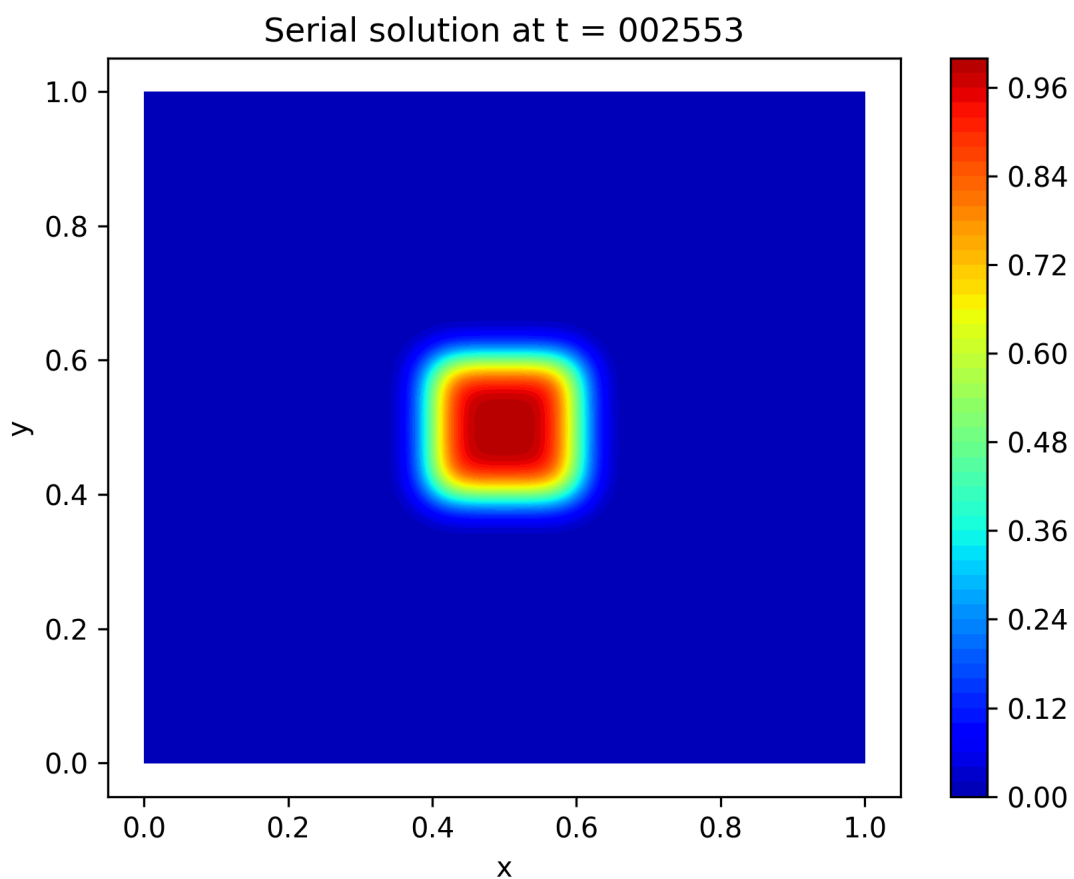
## Part (a): Contour and Line Plots

### Contour Plots at Selected Time Steps

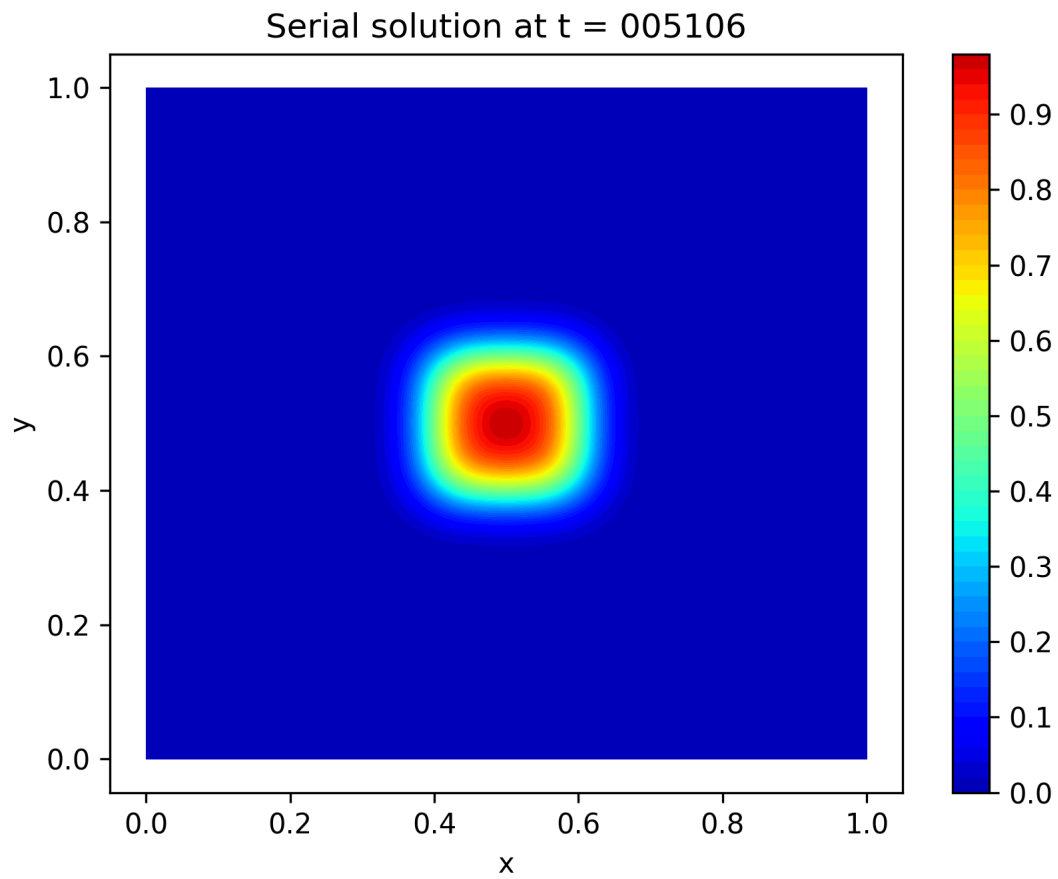
Below are the contour plots of the temperature field at three selected time steps (other than  $t = 0$ ) for both the serial and the parallel runs.

#### Serial Code Contour Plots

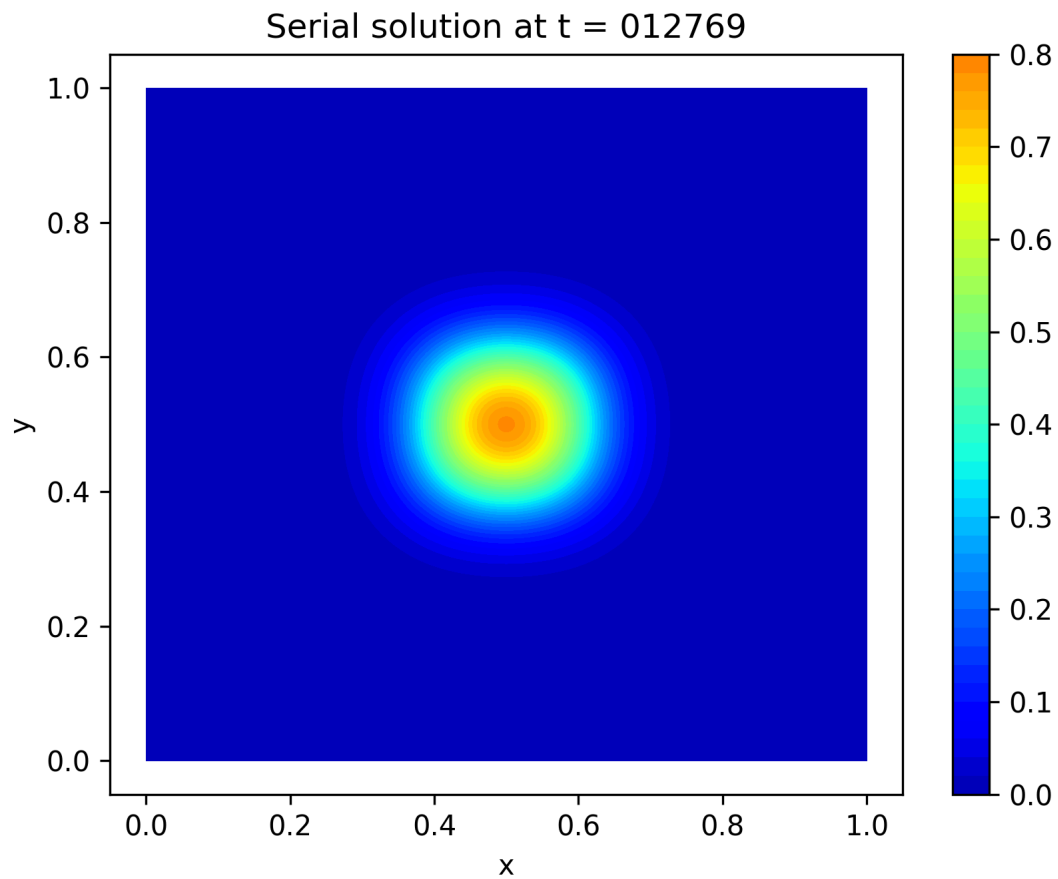
- **Time Step 1:**



- **Time Step 2:**



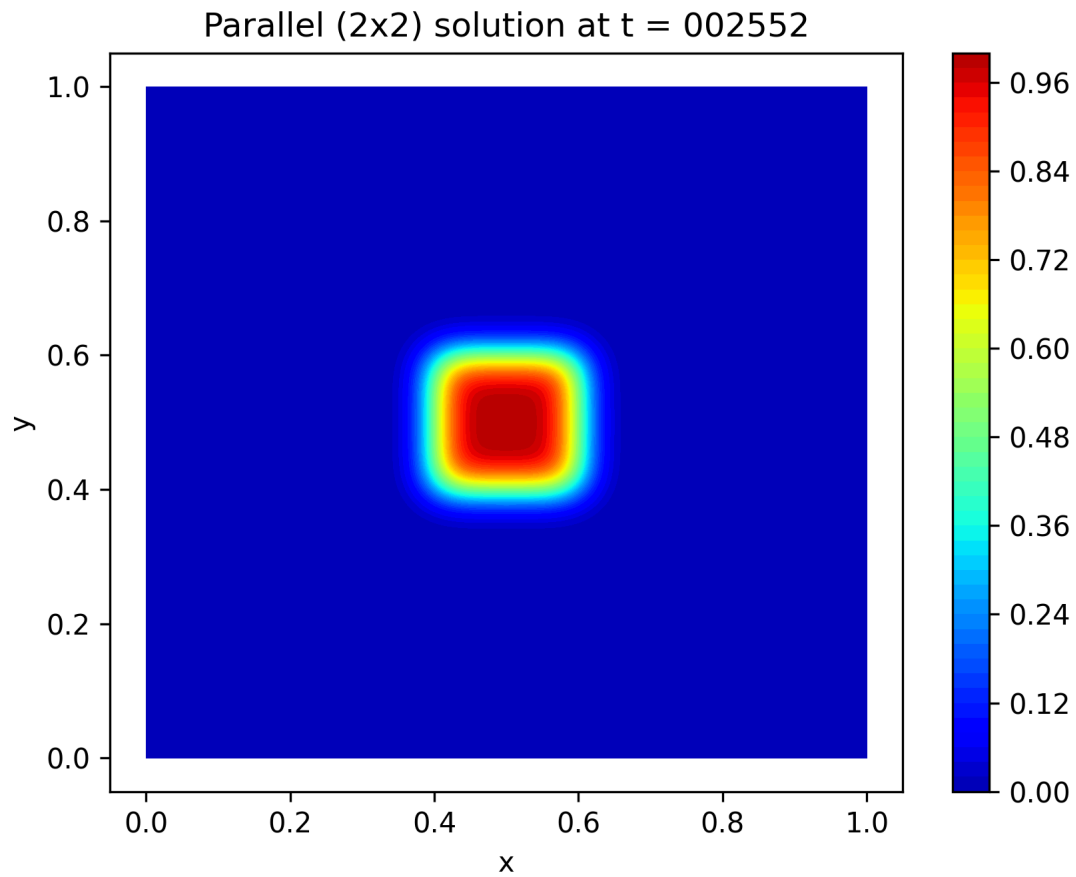
- **Time Step 3:**



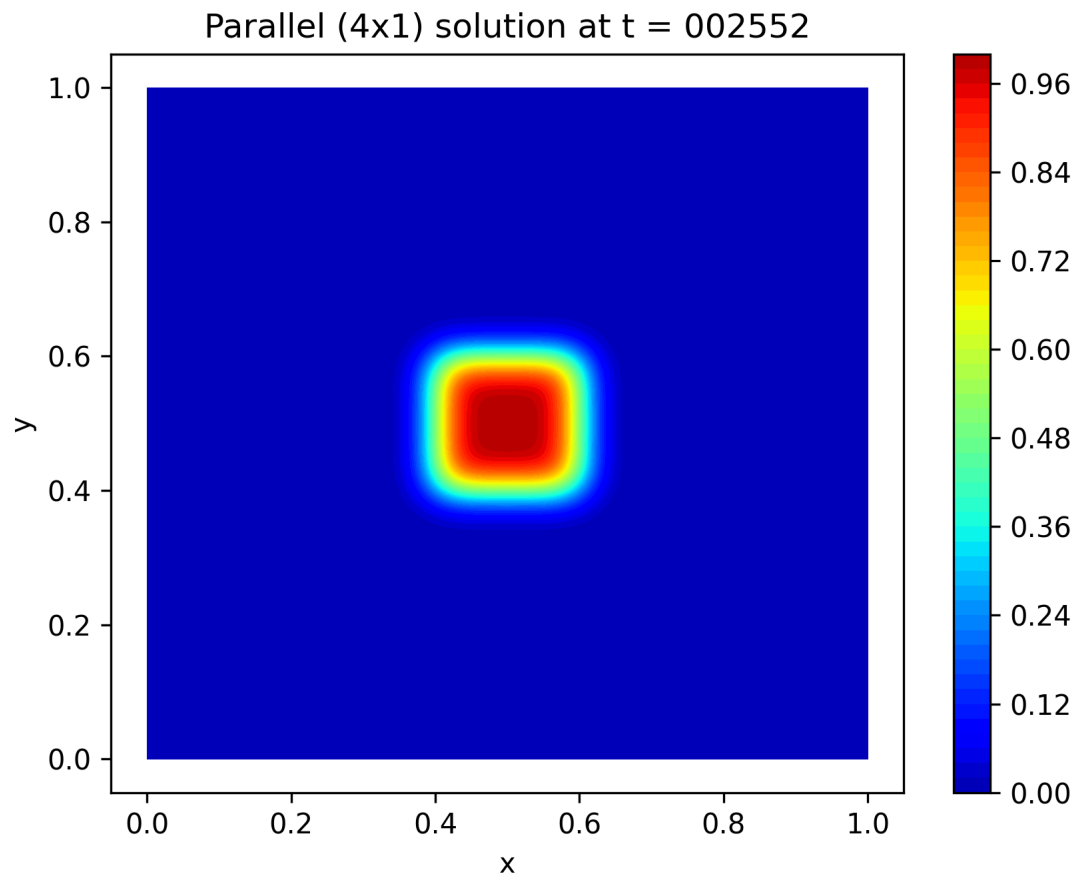
## Parallel Code Contour Plots

For each processor configuration (2×2, 4×1), include the corresponding contour plots.

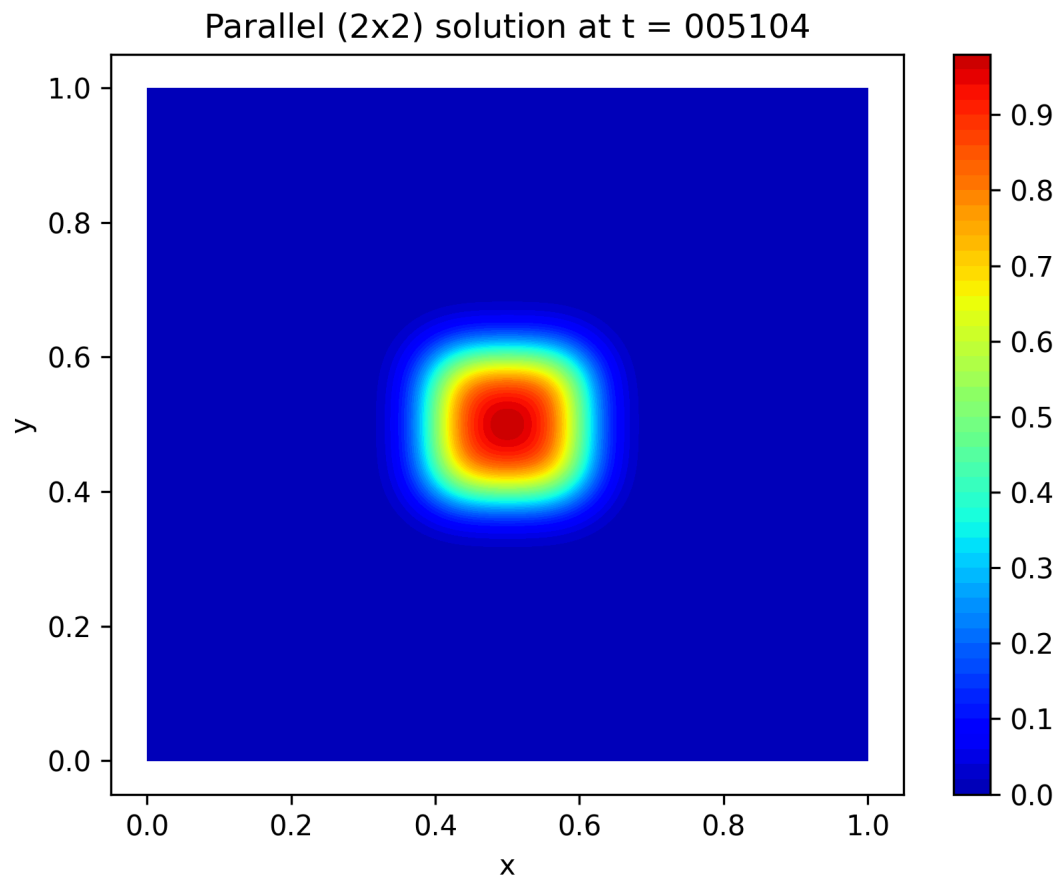
- NOTE: Due to less number of cores only 2x2 and 4x1 processor configurations are included.\*
- **Parallel (2×2) - Time Step 1:**



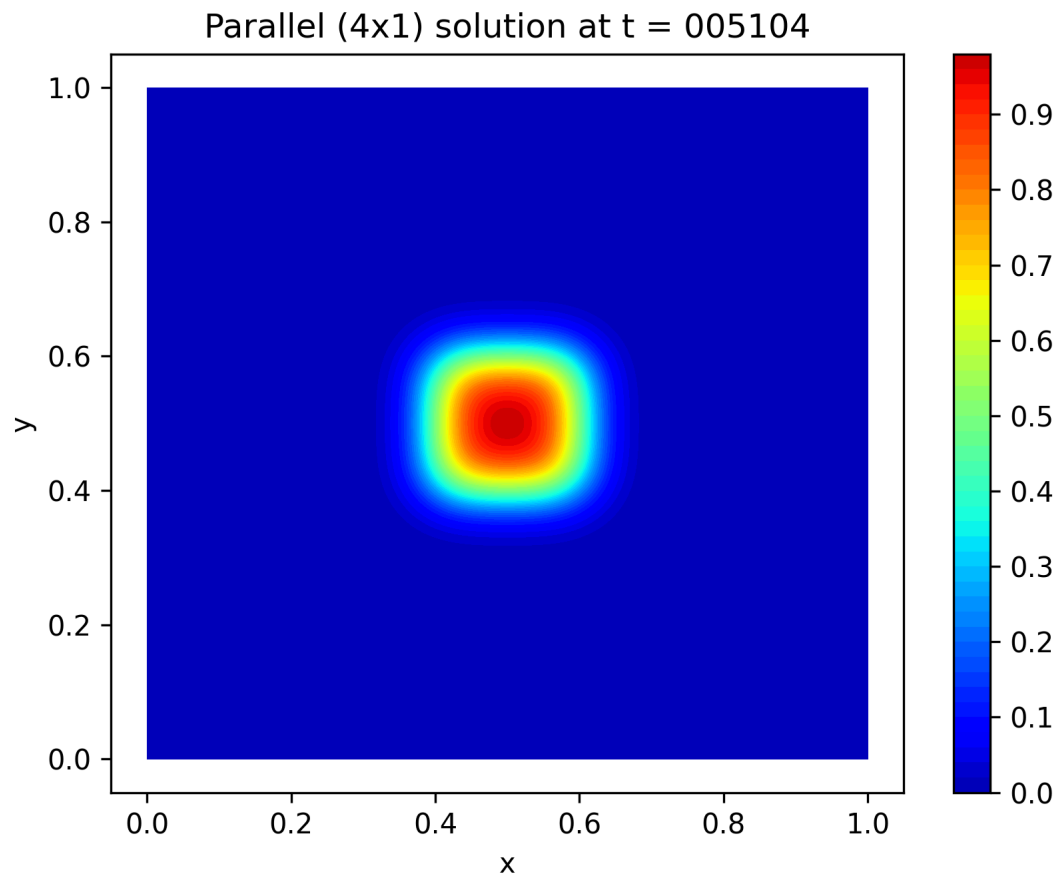
- **Parallel (4×1) - Time Step 1:**



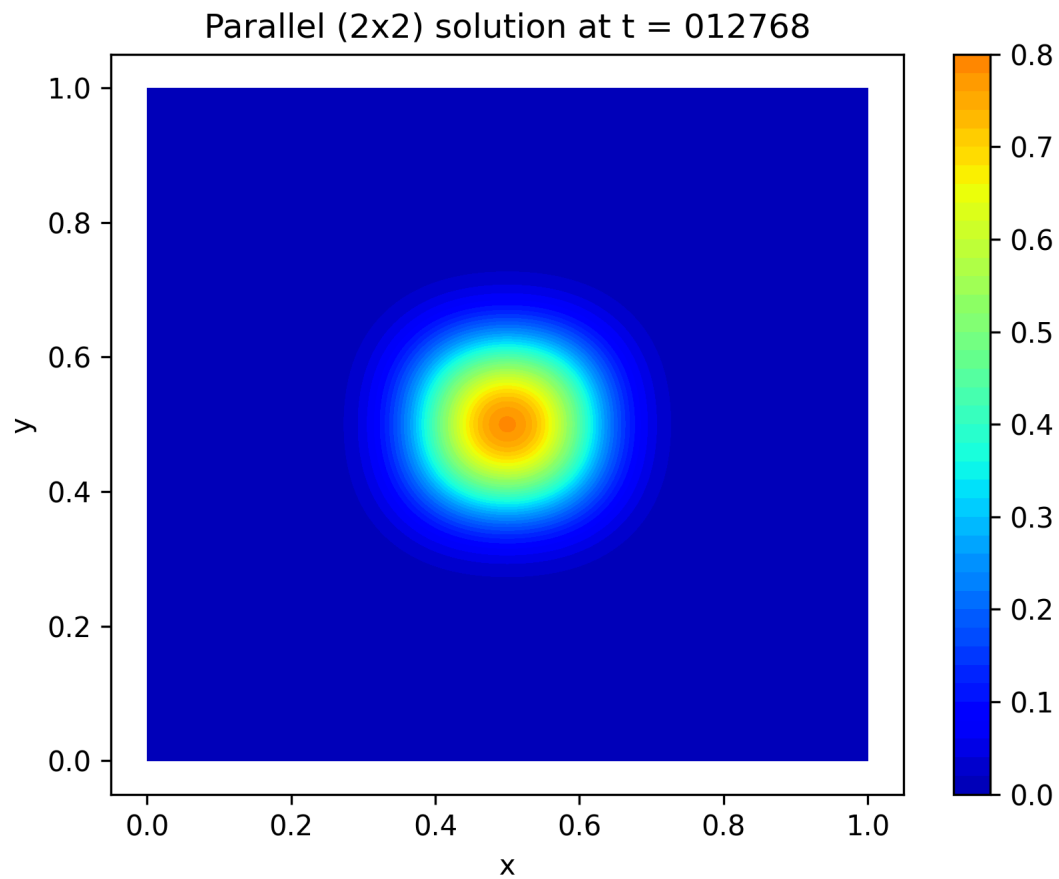
- **Parallel (2×2) - Time Step 2:**



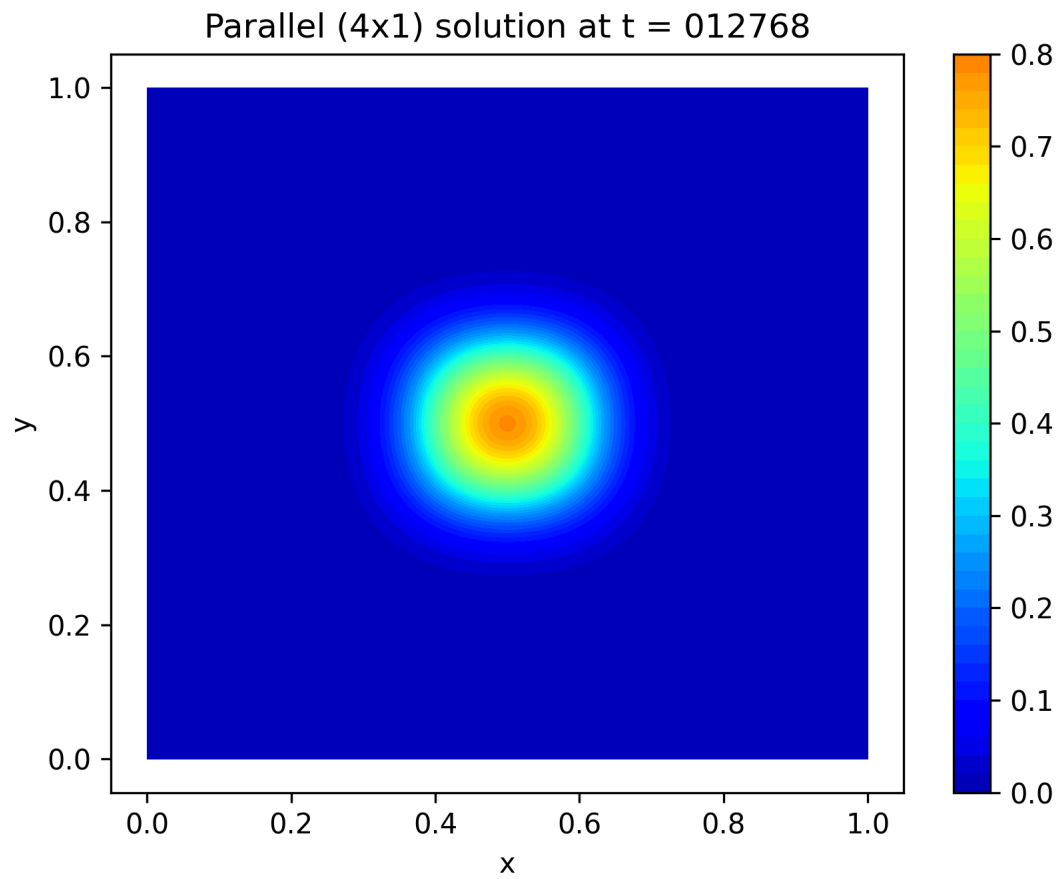
- **Parallel (4×1) - Time Step 2:**



- **Parallel (2×2) - Time Step 3:**

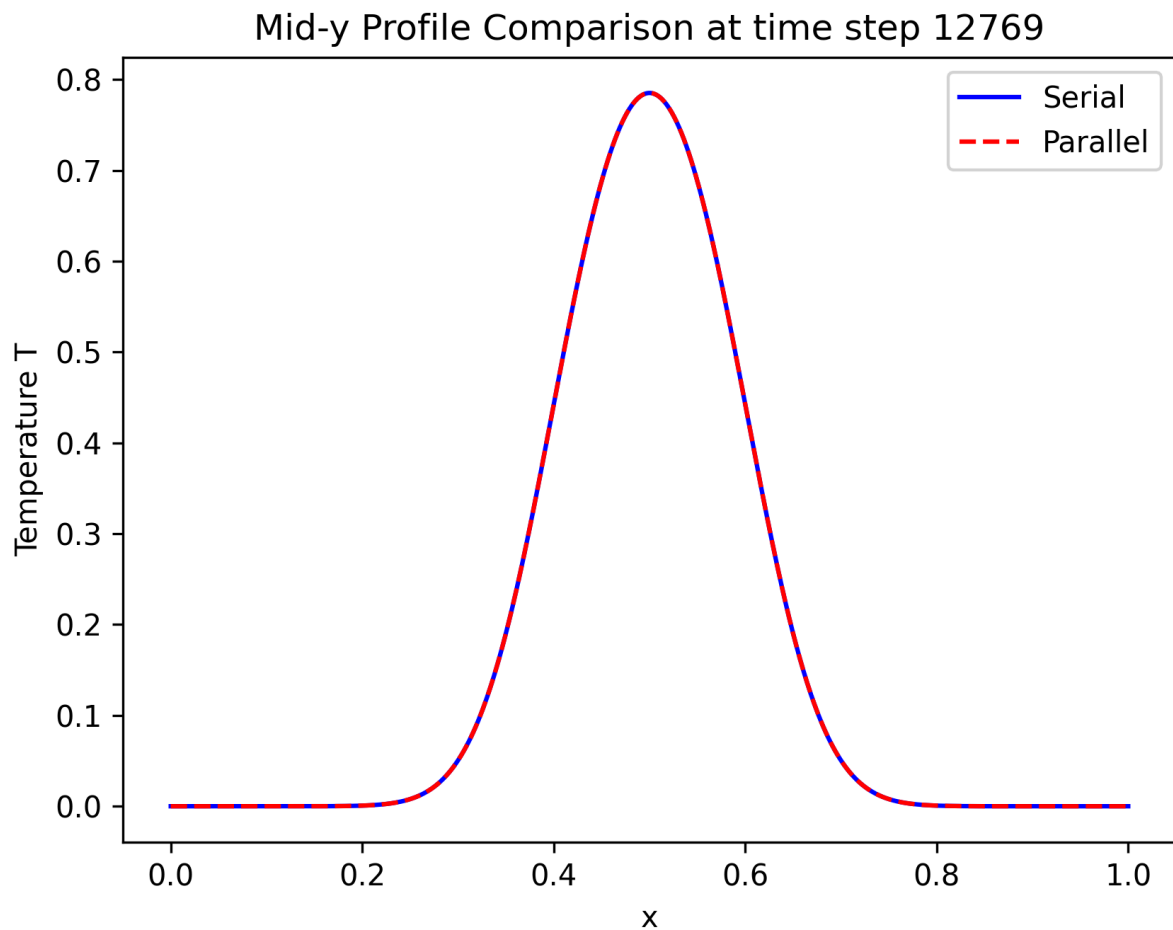


- **Parallel (4x1) - Time Step 3:**



### Line Plot Comparison

The line plot below compares the mid-y temperature profiles from the serial and parallel runs at a selected time step.



You can use the provided Python script (e.g., `plot_comparison.py`) to generate this plot.

## Part (b): Tabulated Differences Between Serial and Parallel Runs

The following table shows the differences between the serial and the parallel runs at the final time step. The differences should be nearly at machine precision.

Metric	Value
Maximum Absolute Difference	2.5e-5
L2 Norm Difference	3.5e-6

```
~/gi/I/hw5-0mDave619/hw5 main !37 ?12 ...  
python3 compare.py 7.18 KiB/s  
Comparison of Serial and Parallel Solutions at time step 12769  
Maximum absolute difference: 2.5550000000040818e-05  
L2 norm of the difference: 3.565469209730272e-06
```

## Part (c): Timing per Time Step

The timing information (time per time step) for the serial and MPI-parallel runs are tabulated below. In the serial code, timing was measured using standard C clock functions; in the MPI code, `MPI_Wtime()` was used.

```
Total simulation time: 30.084474 seconds
Time per time step: 0.002356 seconds
```

- Serial Timing:

- Parallel (2×2) Timing:

```
--- Simulation Complete ---
Total simulation wall time: 12.743162 seconds
Time per time step:      0.00099805 seconds
Final time reached:      0.002000
Number of steps taken:    12768
```

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