# Parallelize Jacobi Relaxation Using MPI

## Experimentation data for Serial computation

| Serial Computation results with $P^*$ = 1 and $I_{max}$ = 100 | | | |
|---|---|---|---|
| **(N,R,C)** | **Runtime (seconds)** | **Iteration** | **Tolerance** |
| (2304,2302,2300) | | 100 | |
| (4320,4318,4316) | | 100 | |
| (10080,10078,10076) | | 100 | |

*: P denotes the number of processes.

## Row Decomposition

### Overview of the Implementation

While implementing, we assumed that the grid length N is evenly divisible by the number of processors P.

Each process is responsible for the boundary value updation and grip computation of N/ P number of contiguous rows. During the communication phase, processes exchange their boundary rows to the neighboring processes ( for example, a process with rank r will send its bottom-most row and topmost row to process with rank r+1 and r-1 respectively and receive the topmost row from process r+1 and bottom-most row from rank r-1. Obviously for process with rank 0 and P-1, there will be only one send and receive because they have only one neighbor instead of two.

### Experimentation data for Serial computation

#### Tabular Representation

N = Grid length
(R,C) = A single floating-point value for the temperature at cell (R,C)
Tolerance = The value of *gmaxdiff* in the code, which gives the maximum change for any point below the threshold value,
Iteration = The maximum number of iterations reached.

| Row Decomposition with P =12 and $I_{max}$ = 100 | | | |
|---|---|---|---|
| **(N,R,C)** | **Runtime (seconds)** | **Iteration** | **Tolerance** |
| (2304,2302,2300) | | 100 | |
| (4320,4318,4316) | | 100 | |
| (10080,10078,10076) | | 100 | |
| **Row Decomposition with P = 24 and $I_{max}$ = 100** | | | |
| (2304,2302,2300) | | 100 | |
| (4320,4318,4316) | | 100 | |
| (10080,10078,10076) | | 100 | |
| **Row Decomposition with P = 36 and $I_{max}$ = 100** | | | |
| (2304,2302,2300) | | 100 | |
| (4320,4318,4316) | | 100 | |
| (10080,10078,10076) | | 100 | |
| **Row Decomposition with P = 48 and $I_{max}$ = 100** | | | |
| (2304,2302,2300) | | 100 | |
| (4320,4318,4316) | | 100 | |
| (10080,10078,10076) | | 100 | |

## Graphical Representation