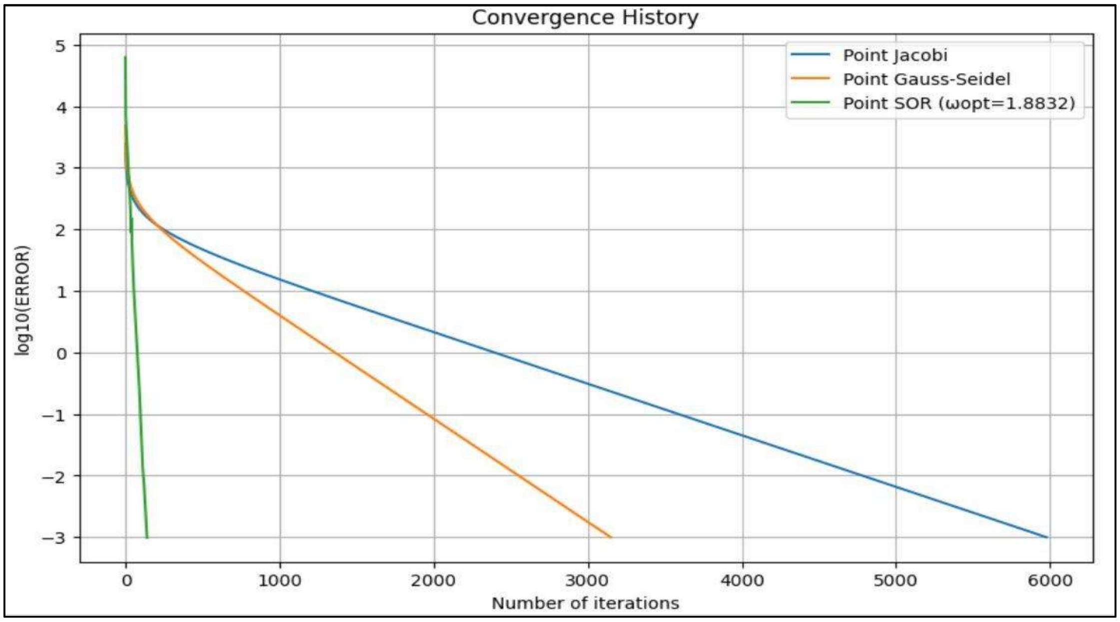
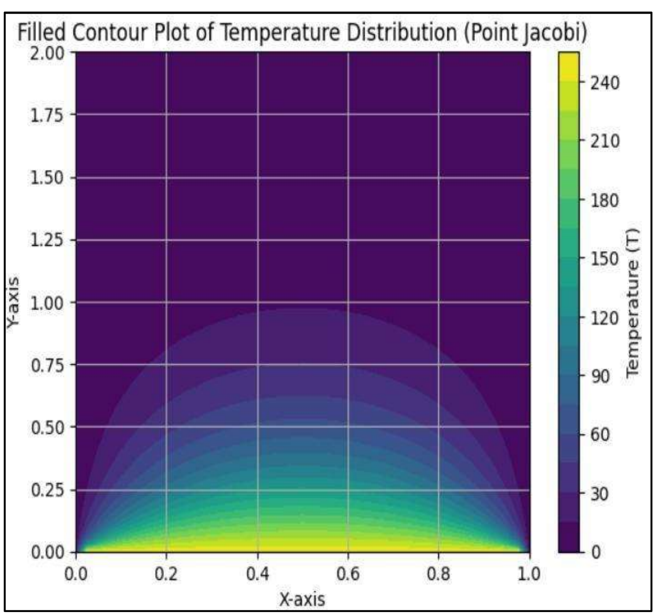
2D Heat Distribution using Iterative Methods Analysis

Point Jacobi Method: Converged in 5976 iterations.
Point Gauss-Seidel Method: Converged in 3149 iterations.
Point SOR Method (ω_{opt}=1.8832): Converged in 140 iterations.

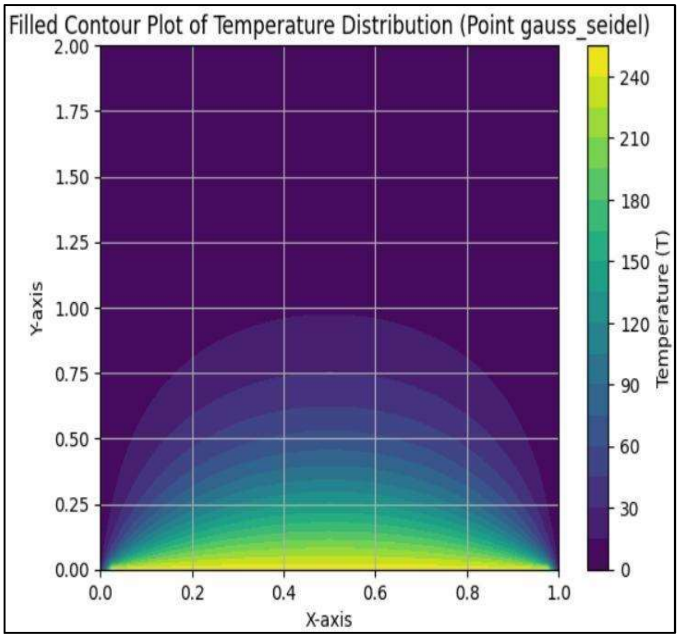


It is evident from the plot and iterations data that, the **Point SOR Method takes lesser iterations than Point Gauss-Seidel Method and further less iterations than Point Jacobi to converge**.

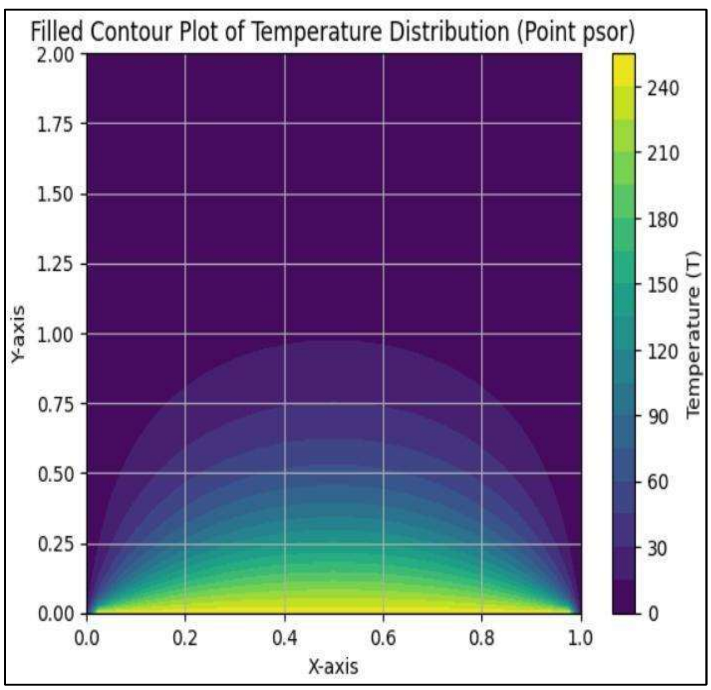
(i) Point Jacobi (PJ)



(ii) Point Gauss-Seidel (PGS)



(iii) Point Successive Over Relaxation with optimum relaxation parameter ω_{opt}



Temperature Variations along x=0.5 and y=1.0:

The temperature variation plots along x=0.5 and y=1.0 compare the numerical solutions obtained by each solver (PJ, PGS, PSOR) with the exact solution.

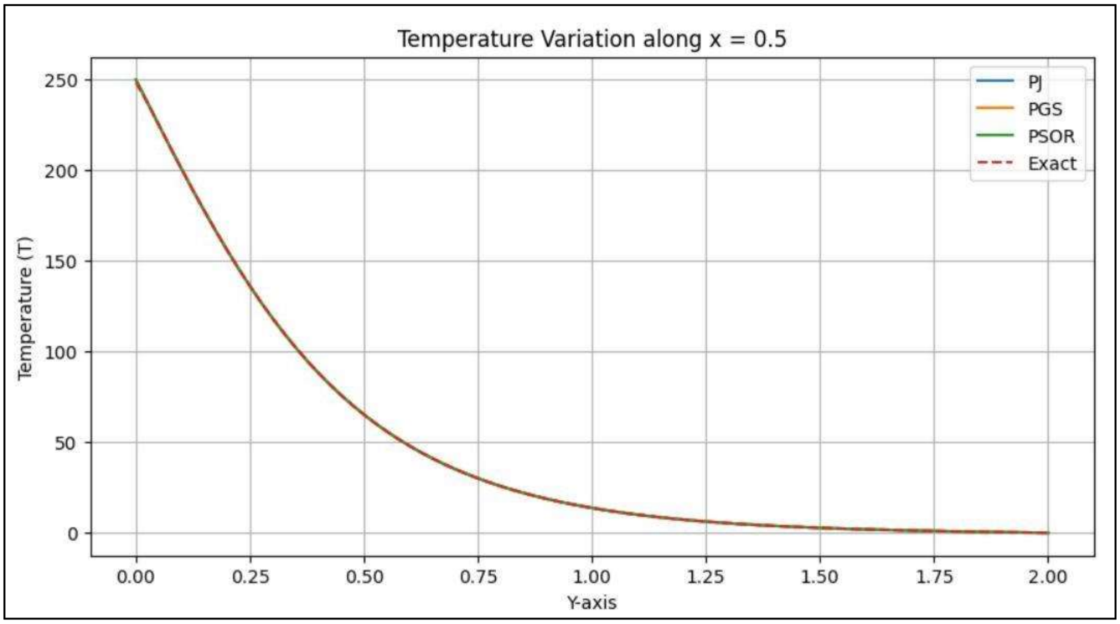


Fig 4: Plot variations of temperature T along the midline along x = 0.5 line

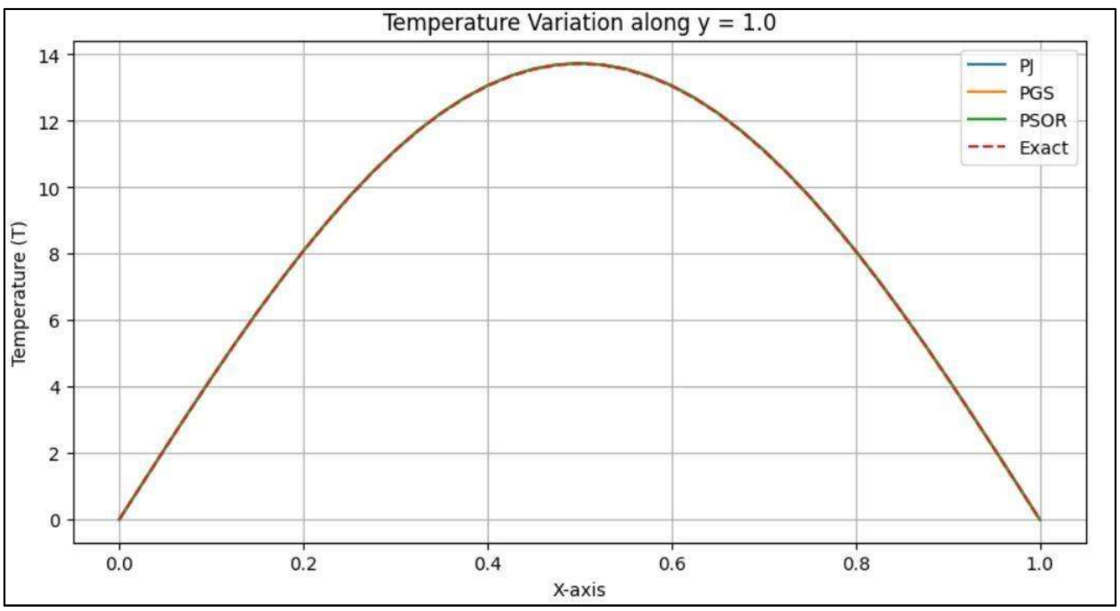


Fig 5: Plot variations of temperature T along the midline along y = 1.0 line

OBSERVATIONS:

1. The error decreases as the iterations progress.
2. Point Jacobi Method: Converged in 5976 iterations.
3. Point Gauss-Seidel Method: Converged in 3149 iterations.
4. Point SOR Method (ω_{opt}=1.8832): Converged in 140 iterations.
5. Hence, PSOR with the optimum relaxation parameter shows faster convergence compared to Jacobi and Gauss-Seidel methods.

6. PSOR tends to converge faster than Jacobi and Gauss-Seidel due to the over-relaxation introduced by the relaxation parameter.
7. It's important to note that the convergence behavior may vary depending on the solver, initial and boundary conditions.
8. PSOR, with the optimum relaxation parameter, tends to converge faster and provides a closer match to the exact solution.
9. The comparison can help identify which solver performs better in approximating the steady-state temperature distribution.