MA635P-Scientific Programming Laboratory

Lab Exercise-9 (36 Marks)   Deadline: 20 March 2025, 5:00 PM

1. Develop an algorithm for Richardson Method.   [2]

2. Develop an algorithm for Jacobi Method.   [2]

3. Develop an algorithm for SOR method.   [2]

4. Develop an algorithm for Gauss-Seidel method.   [1]

5. Develop an algorithm for JOR method.   [2]

6. Develop an algorithm for computing the $\|x\|_1, \|x\|_2, \|x\|_\infty$ norms   [3]

7. Develop an algorithm for computing the $\|A\|_1, \|A\|_2, \|A\|_F, \|A\|_\infty$ norms   [4]

8. Write a Python code for the Richardson, Jacobi, Gauss-Seidel, SOR, JOR methods. Solve the following linear system and verify whether $b - Ax \approx 0$. For SOR and JOR, use $\omega = 1.25$. Stop the algorithm if $\|r\| = \|b - Ax\| < 1e - 6$ or 100 iterations. Use different vector norms for r vector. $[4 \times 3 = 12 + 2]$

$$\begin{pmatrix} 0.2 & 0.1 & 1 & 1 & 0 \\ 0.1 & 4 & -1 & 1 & -1 \\ 1 & -1 & 60 & 0 & -2 \\ 1 & 1 & 0 & 8 & 4 \\ 0 & -1 & -2 & 4 & 700 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix} = \begin{pmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{pmatrix}$$

9. Compute the $\|A\|_1, \|A\|_2, \|A\|_F, \|A\|_\infty$ norms for the above matrix A.   [4]

10. Count the number of operations required for each algorithm and also list out the number of iterations required in each method   [2]

11. Bonus: Develop an algorithm for computing the condition number of the matrix A for different norms. Hint: Use any one of the above algorithm to compute the inverse of the matrix A.   [5].