

Computer Science

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Numerical analysis for computer science mayors

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1. Suppose that we want to solve the system Ax = b, where

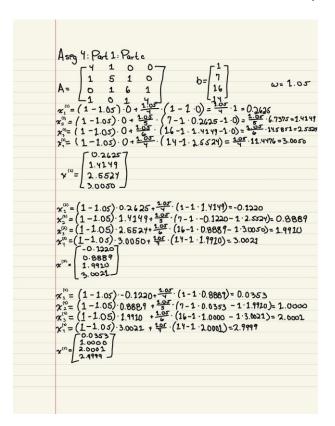
$$A = \begin{bmatrix} 4 & 1 & 0 & 0 \\ 1 & 5 & 1 & 0 \\ 0 & 1 & 6 & 1 \\ 1 & 0 & 1 & 4 \end{bmatrix}$$

and  $b = (1,7,16,14)^T$ ,

a. Do three iterations (by hand) of the Jacobi iteration for this matrix, using x(0) = (0,0,0,0).

b. Do three iterations (by hand) of the Gauss-Seidel iteration for this problem, using the same initial guess.

c. Do three iterations of SOR for Problem 1, using  $\omega$ = 1.05.



2. Consider the following nonlinear system.

$$2x_1 - x_2 + \frac{1}{9}e^{-x_1} = -1$$
$$-x_1 + 2x_2 + \frac{1}{9}e^{-x_2} = 1$$

Take  $x^{(0)} = (1,1)^T$  and do two iterations of the Newtons method.

Asign 4: Part 2

$$2x_1 - x_2 + \frac{1}{4}e^{x_1} = -1 \qquad x^{(0)} = \begin{bmatrix} 1\\1 \end{bmatrix}$$

$$-x_1 + 3x_2 + \frac{1}{4}e^{x_1} = 1$$

$$f(x^{(0)}) = \begin{bmatrix} 2(3) - 1 + \frac{1}{4}e^{x_1} + 1 \\ -1 + 2(3) + \frac{1}{4}e^{x_1} + 1 \end{bmatrix} = \begin{bmatrix} -0.4028\\ 0.2924 \end{bmatrix}$$

$$3(x^{(0)}) = \begin{bmatrix} 1.8866 & -1\\ -1 & 2.8966 \end{bmatrix}$$

$$x^{(0)} = \begin{bmatrix} 1\\1 \end{bmatrix} + \begin{bmatrix} -0.4028\\ 0.2926 \end{bmatrix} = \begin{bmatrix} -0.4028\\ 0.2926 \end{bmatrix}$$

$$f(x^{(0)}) = \begin{bmatrix} 2(-0.4028) - 0.2926 + \frac{1}{4}e^{-0.2024} + \frac{1}{4}e^{-0.2024} - 1 \end{bmatrix} = \begin{bmatrix} -0.4782\\ 0.2924 \end{bmatrix}$$

$$3(x^{(0)}) = \begin{bmatrix} 1.7328 & -1\\ -1 & 2.7856 \end{bmatrix}$$

$$x^{(2)} = \begin{bmatrix} -0.4028\\ -0.2926 \end{bmatrix} + \begin{bmatrix} -0.4782\\ 0.2924 \end{bmatrix} = \begin{bmatrix} -0.8810\\ 0.5150 \end{bmatrix}$$

3. Use MATLAB to validate the results from previous problem.

