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ASSIGNMENT 5

2. Write an algorithm for Successive-Over-Relaxation (SOR) method.

1. Input matrix $A = [a_{ij}]$, b, x_0, ω, tolerance TOL, max no. of iterations
2. set $k = 1$
3. while $(k \leq N)$ do step 4 - 8
4. For $i = 1, 2, \ldots, n$

$$x_i = \frac{1}{a_{ii}} \left[-\sum_{j=1}^{i-1} (a_{ij} x_j) - \sum_{j=i+1}^{n} (a_{ij} x_{0j}) + b_i \right]$$

5. $x_i = (1 - \omega) * x_{0i} + \omega * x_i$;
6. if norm $(x_i - x_0, inf) < tol$
   break
7. $k = k + 1$
8. For $i = 1, 2, \ldots n$
   Set $x_{0i} = x_i$
9. OUTPUT $(x_1, x_2, \ldots, x_n)$
   STOP

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3. Solve this system of equations by Gauss-Seidel starting with the initial vector [0; 0; 0] and tolerance
10□3 :
4:63x1 □ 1:21x2 + 3:22x3 = 2:22
□3:07x1 + 5:48x2 + 2:11x3 = □3:17
1:26x1 + 3:11x2 + 4:57x3 = 5:11:
Sol.

```
clc;
clear all;
a=[4.63 -1.21 3.22; -3.07 5.48 2.11; 1.26 3.11 4.57];
b=[2.22; -3.17; 5.11];
tol = 0.001; N = 1000;
k=1;
[n,~]=size(a);
x0=zeros(n,1);
xi=zeros(n,1);
while k<=N
    for i=1:n
        x0(i,1)=xi(i,1);
        xi(i,1) = (b(i,1)-(a(i,1:i-1)*xi(1:i-1)+a(i,i+1:n)*x0(i+1:n)))/a(i,i);
        if norm(xi-x0,inf)<tol
            break;
        end
    end
    k=k+1;
end
xi
a\b
```

```
xi =

   -8.9807
   -9.4752
   10.0421


ans =

   -8.9893
   -9.4845
   10.0510
```

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4. Use the SOR method with ! = 1:2 to solve the linear system with an initial vector [0; 0; 0; 0] a tolerance
10⁻³ in the k:k₁ norm.
$4x_1 + x_2 - x_3 + x_4 = -2$
$x_1 + 4x_2 - x_3 - x_4 = -1$
$-x_1 - x_2 + 5x_3 + x_4 = 0$
$x_1 - x_2 + x_3 + 3x_4 = 1$:
Sol.

```
clc;
clear all;
a=[4 1 -1 1; 1 4 -1 -1; -1 -1 5 1; 1 -1 1 3];
b=[-2; -1; 0; 1];
tol = 0.001; N = 1000; w = 1.2;
k=1;
[n,~]=size(a);
x0=zeros(n,1);
xi=zeros(n,1);
while k<=N
    for i=1:n
        x0(i,1)=xi(i,1);
        xi(i,1) = (b(i,1)-(a(i,1:i-1)*xi(1:i-1)+a(i,i+1:n)*x0(i+1:n)))/a(i,i);
        xi(i,1)=(1-w)*x0(i,1)+w*xi(i,1);
        if norm(xi-x0,inf)<tol
            break;
        end
    end
    k=k+1;
end
xi
a\b
```

```
xi =

   -0.7537
    0.0408
   -0.2806
    0.6913


ans =

   -0.7534
    0.0411
   -0.2808
    0.6918
```

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