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Lab13Simons.m

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```
clc; clear;
```

Problem 1a) Use the SOR method to solve a linear system

```
% number of unknowns / equations
n = 6;

% omega
w = [1 1.05 1.1 1.5];

% x(0)
x0 = zeros(n, 1);

% tolerance
TOL = 10^-6;

% coefficient matrix
A = [4 -1 0 0 0 0; ...
    -1 4 -1 0 0 0; ...
    0 -1 4 0 0 0; ...
    0 0 0 4 -1 0; ...
    0 0 0 -1 4 -1; ...
    0 0 0 0 -1 4];

% constant terms
b = [0; 5; 0; 6; -2; 6];

% solution to system
g = zeros(n, 4);

% how many iterations it takes
it = zeros(n, 1);

for i=1:4

    % use the SOR method to solve the system
    [g(:, i), it(i)]= gauss_seidel_sor(A, b, x0, w(i), TOL, n);
```

```
    % print the results
    fprintf('omega: %.2f\t iterations: %d\n', w(i), it(i));

end

fprintf('\n');
```

```
omega: 1.00  iterations: 9
omega: 1.05  iterations: 7
omega: 1.10  iterations: 9
omega: 1.50  iterations: 24
```

Problem 1b) Find the optimal choice for omega

```
% diagonal matrix
D = [4 0 0 0 0 0; ...
    0 4 0 0 0 0; ...
    0 0 4 0 0 0; ...
    0 0 0 4 0 0; ...
    0 0 0 0 4 0; ...
    0 0 0 0 0 4];

% lower triangular matrix
L = [0 0 0 0 0 0; ...
    1 0 0 0 0 0; ...
    0 1 0 0 0 0; ...
    0 0 0 0 0 0; ...
    0 0 0 1 0 0; ...
    0 0 0 0 1 0];

% upper triangular matrix
U = [0 1 0 0 0 0; ...
    0 0 1 0 0 0; ...
    0 0 0 0 0 0; ...
    0 0 0 0 1 0; ...
    0 0 0 0 0 1; ...
    0 0 0 0 0 0];

% spectral radius
p = @(Ao) max(abs(eig(Ao)));

% calculate Tj
Tj = inv(D) * (L + U);

% calculate optimal choice for omega
w_optimal = 2 / (1 + sqrt(1-(p(Tj))^2));

% print the results
fprintf('The optimal value for omega is %.5f\n', w_optimal);
fprintf('This value is closer to 1.05 than it is to any of the other
 \n');
fprintf('given values of omega.  Also, of all the given values of\n');
```

```
fprintf('omega, 1.05 took the least amount of iterations to solve the
\n');
fprintf('system.\n');
```

```
The optimal value for omega is 1.03337
This value is closer to 1.05 than it is to any of the other
given values of omega.  Also, of all the given values of
omega, 1.05 took the least amount of iterations to solve the
system.
```

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