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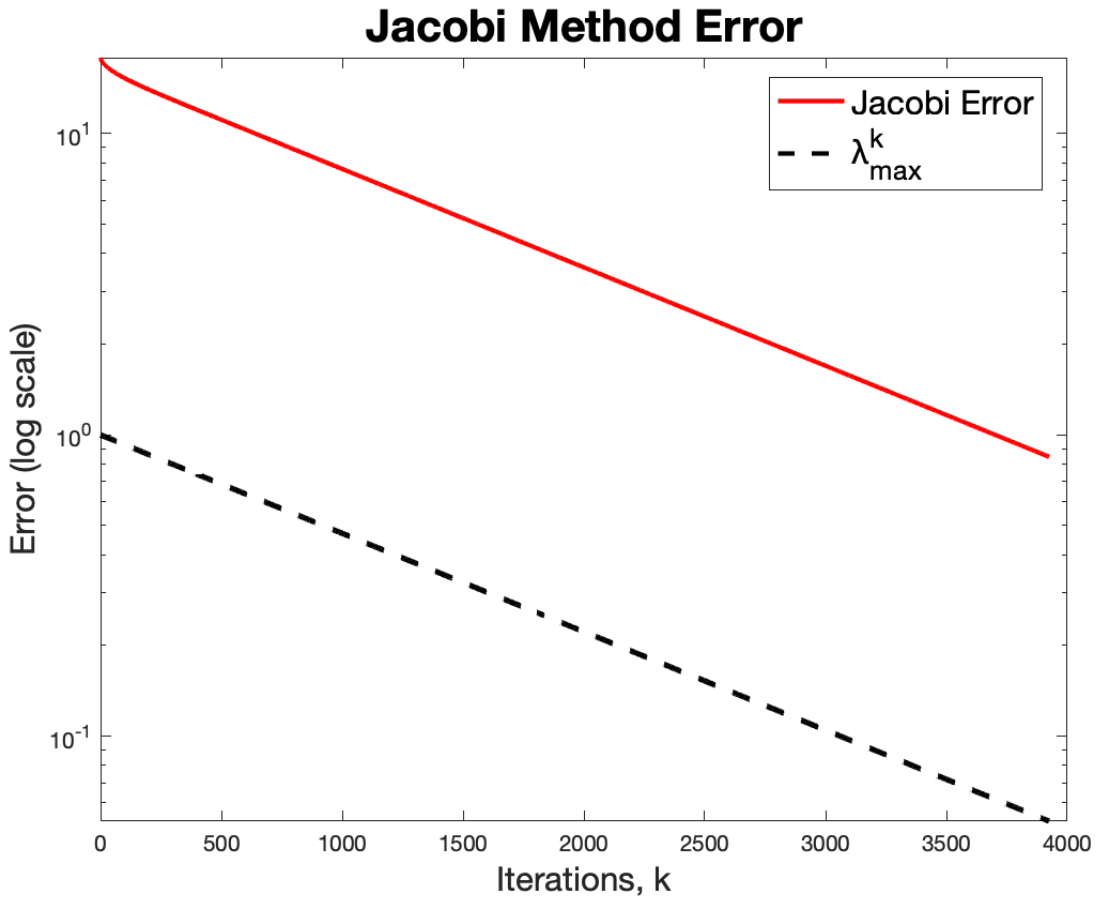
AMATH 301 Spring 2020
HW4

Problem 3

Matrix A is not strictly diagonally dominant, so it cannot determine for sure that Jacobi and Gauss-Seidel will converge.

Problem 4



The error of the Jacobi method is larger than the error given by lambda. And they both converge.

Problem 5

b c

Code

```
%% Problem4
clear; close all; clc

a1 = [1,80];
for k = 1:80
    a1(k) = 2;
end
a2 = [1,79];
for k = 1:79
    a2(k) = -1;
end
A = diag(a1) + diag(a2,1) + diag(a2,-1);

b = [80;1];
for k = 1:80
    b(k) = exp(-15*pi/10)*sin(15*pi*k/81);
end

x_exact = A\b;

x0 = 2*ones(80,1);
tol = 1e-4;
maxIter = 10000000;

D = diag(diag(A));
T = A - D;
M = -D\T;
change = 2*tol;
c = D\b;
xk = x0;
iteration = 0;

error_vector = [norm(x_exact - x0)];
k = [0];

while change > tol && iteration < maxIter
    xkplus1 = M*xk + c;
    change = norm(xkplus1-xk,inf);
    iteration = iteration + 1;
    k(iteration + 1) = iteration;
    error_vector(iteration + 1) = norm(x_exact - xkplus1);
    xk = xkplus1;
end
semilogy(k, error_vector, 'r', 'LineWidth', 2)
hold on

lambda = max(abs(eig(M)));
lambda_vector = [];
for j = 1:length(k)
    lambda_vector(j) = lambda^(j-1);
end
semilogy(k, lambda_vector, 'k--', 'LineWidth', 2)
title('Jacobi Method Error', 'fontsize', [20])
xlabel('Iterations, k', 'fontsize', [15])
ylabel('Error (log scale)', 'fontsize', [15])
```

```
legend('Jacobi Error', '@ª^k_m_a_x', 'location', 'best', 'fontsize', [15])
print('HW4_fig1.png','-dpng')
```