Blog Entry © Wednesday, January 22, 2025, by James Pate Williams, Jr. Three Classical Iterative Linear Equation Solvers

The classical iterative methods are:

1. Gauss-Seidel Method
2. Successive Overrelaxation Method
3. Jacobi Method.

I translated my 2015 C# code to Win32 C/C++. The application consists of 708 lines of code which are contained in a Portable Document File (PDF) in this blog entry. The algorithms were taken from ***Elementary Numerical Analysis an Algorithmic Approach Third Edition*** © 1980 by S. D. Conte and Carl de Boor Chapter 5 section 3.

My test data consists of a 4x4 matrix from Conte and de Boor Exercise 5.3-7 page 234, and it is reproduced below along with the right-hand sides of the system of linear equations:

4	-1	0	0	1
-1	4	-1	0	1
0	-1	4	-1	1
0	0	-1	0	1

I also used a 3x3 system of equations found online at the Uniform Resource Locator (URL):

Lec-7.3.pdf

The equations and right-hand sides are as follows:

5	-2	3	-1
-3	9	1	2
2	-1	-7	3

The results from my application are illustrated below:

Gauss-Seidel

Solution Vector x

0.3636363636 0.4545454545 0.4545454545 0.3636363636

X - Norm - 2 = 0.0000000000

b - Norm - 2 = 0.0000000000

Iterations = 17

Runtime = 71 Microseconds

Successive Overrelaxation

Solution Vector x

0.3636363636 0.4545454545 0.4545454545 0.3636363636

X - Norm - 2 = 0.0000000000

b - Norm - 2 = 0.0000000000

Iterations = 56

Runtime = 63 Microseconds

Jacobi Method

Solution Vector x

0.3636363636 0.4545454545 0.4545454545 0.3636363636

X - Norm - 2 = 0.0000000000

b - Norm - 2 = 0.0000000000

Iterations = 31

Runtime = 38 Microseconds

Gauss-Seidel

Solution Vector x

0.1861198738 0.3312302839 -0.4227129338

X - Norm - 2 = 0.0000000000

b - Norm - 2 = 0.0000000000

Iterations = 15

Runtime = 111 Microseconds

Successive Overrelaxation (SOR) Method

Solution Vector x

0.1861198738 0.3312302839 -0.4227129338

X - Norm - 2 = 0.0000000000

b - Norm - 2 = 0.0000000000

Iterations = 27

Runtime = 22 Microseconds

Jacobi Method

Solution Vector x

0.1861198738 0.3312302839 -0.4227129338

X - Norm - 2 = 0.0000000000

b - Norm - 2 = 0.0000000000

Iterations = 23

Runtime = 21 Microseconds