Aim: To find the solution of given equation by Gauss-seidel method.

Apparatus Required: laptop - lenovo Ideapad 3 (10S) windows 11, MATLAB 2021a.

Theory:

The Gauss seidel method is a improvisation of the Jacobi method. The method is named after mathematicians Carl friedrich Gauss (1777-1855) and philipp L Seidel (1821 - 1896). This modification often results in higher degree of accuracy within fewer iteration.

In Gauss Jacobi method, the value of x_i^k obtained in the k^{th} iteration remain unchanged untill the entire $(k+1)^{th}$ iteration has been calculated with the Gauss seidel, we use the new values, x_i^{k+1} as soon as they are known for example, once we have computed $x^{(k+1)}$, from the first equation, its value is then used in the second equation to obtain the new $x_2^{(k+1)}$, and so on.

The system given by

$$a_{11}x_1 + a_{12}x_2 + \cdots \quad a_{1n}x_n = b_1$$

$$a_{21}x_1 + a_{22}x_2 + \cdots \quad a_{2n}x_n = b_2$$

$$\vdots$$

$$a_{n1}x_1 + a_{n2}x_2 + \cdots \quad a_{nn}x_n = b_n$$

$$x_1 = \frac{1}{a_{11}}(b_1 - a_{12}x_2 - a_{13}x_3 - \cdots - a_{1n}x_n)$$

$$x_2 = \frac{1}{a_{22}}(b_2 - a_{21}x_1 - a_{23}x_3 - \cdots - a_{2n}x_n)$$

$$\vdots$$

$$x_n = \frac{1}{a_{nn}}(b_n - a_{n1}x_1 - a_{n2}x_2 - \cdots - a_{n,n-1}x_{n-1})$$

Teacher's Signature.............................

The Gauss Seidel method: for each $k \geq 1$ generate the components x_i^k of x^k from $x^{(k-1)}$ by

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

for $i = 1, 2, \ldots n$

Given Equation :- is To find the sol^n of given equation by Gauss seidel method.

$$3x + 4y + 15z = 54.8$$
$$x + 12y + z = 39.66$$
$$10x + y - 2z = 7.74$$

Sol^n:

first we have to rearrange the equation as because of the coefficient matrix of the given system is not diagonally dominant

So,
$$10x + y - 2z = 7.74$$
$$x + 12y + z = 39.66$$
$$3x + 4y + 15z = 54.8$$

Now,
$$x = \frac{1}{10}(7.74 - y + 2z)$$

$$y = \frac{1}{12}(39.66 - x - z)$$

$$z = \frac{1}{15}(54.8 - 3x - 4y)$$

n	x	y	z
1	0.774	3.2405	2.6344
2	0.9768	3.0041	2.6569
3	1.005	2.998	2.6524
4	1.0045	3.003	2.8524

So, $x \approx 1.0045$

$y \approx 3.003$

$z \approx 2.6524$

1) To find the sol^n of given equation by Gauss Seidel method

$9x - 2y + z = 50$

$x + 5y - 3z = 18$

$-2x + 2y + 7z = 19$

Here the coefficient matrix of the given system is diagonally dominant so we can rearrange the equation as.

$x = \frac{1}{9}(50 + 2y - z)$

$y = \frac{1}{5}(18 - x + 3z)$

$z = \frac{1}{7}(19 + 2x + 2y)$

So, $x \approx 6.1540$

$y \approx 4.3134$

$z \approx 3.2482$

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MATLAB CODE:

```
Clear all
clc
A = input('Enter the coefficient matrix A (In diagonal dominant):');
B= input('Enter the Constant matrix B:');
P = [A  B];
[row, col] = size(P);
X = zeros(row,1);
C= zeros (row, 1);
Err = ones (row, 1);
tol = input('Enter the tolerance of error:');
while Err > tol
    for m=1:row
        x (m; 1) =(P(m, col) - sum (A (m,:)+ x(:,1))
                  +A(m,m) x(m,1))/P(m, m);
        Err(m, 1) = abs((m, 1)- x(m,1));
        C(m,1) = x (m,1);
    end
end
disp('The required solution is :');
disp x
```

(1) INPUT:

Enter the coefficient matrix A (in diagonal dominant):
[10 1 -2 ; 1 12 1 ; 3 4 15]

Enter the Constant matrix B :[7.74 ; 37.66 ; 54.8]

Enter the tolerance of error : 0.0001

OUTPUT

The required solution is

1.0045

3.0003

2.0524

(ii) INPUT:

Enter the Coefficient matrix A (in diagonal dominant);
[9 -2 1 ; 1 5 -3 ; -2 2 7]

Enter the Constant matrix B : [50 ; 18 ; 19]

Enter the tolerance of error : 0.0001

OUTPUT

The required solution is :

6.1541

4.3133

3.2402

Conclusion: we have done this experiment in MATLAB software. By this experiment we find the solution of linear equation by using Gauss-seidel method and verify the result with MATLAB output successfully.

Reference:

B. S. Grewal, "Numerical method in engineering and ~~source~~ science." by mercury learning and information LTC, 3rd Edition 2014

16/11/22