VIVEKANANDA COLLEGE THAKURPUKUR KOLKATA-700063

NAAC ACCREDITED ‘A’ GRADE

Topic: Gauss-Seidel Method

Course Title: Computer Practical

Paper: PHY 425

Unit: N.A.

Semester: M.Sc. Second Semester

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Gauss_Seidel Method

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c      Gauss-Seidel Method
       Dimension x(1000), y(1000), a(20,20)
       Write (*,*)"Enter no. of equations"
       Read(*,*)n
       Write(*,*)"Enter co-efficients and RHS"
       Do i = 1,n
       Read(*,*)(a(i,j), j = 1,n+1)
       End do
       do i = 1,n
       x(i)=0.0
       y(i)=0.0
       End do
       m = 0

2        do i = 1,n
       x(i)= a(i,n+1)
       do j = 1,n
       If (i.ne.j)then
       x(i)= x(i)- a(i,j)*x(j)
       End if
       end do
       x(i)=x(i)/a(i,i)
       end do
       do k = 1,n
       If (abs(x(k)-y(k)).gt.0.001)then
       do i = 1,n
       y(i)=x(i)

       end do
       m = m+1
       go to 2
       end if
c        write (*,*) x(i)
       end do
       Write (*,*)"Solution is"
       write (*,*) (x(i), i = 1,n)
       write (*,*)"No. of iterations is", m
       Stop
       end
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The above mentioned Gauss-Seidel method is correct. Our programs did not run because this method has some limitations. Let us consider a set of equations:

$a_{11}x_1 + a_{12}x_2 + a_{13}x_3 = a_{14}$
$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 = a_{24}$
$a_{31}x_1 + a_{32}x_2 + a_{33}x_3 = a_{34}$

Then our matrix will be A = $\begin{pmatrix} a11 & a12 & a13 \\ a21 & a22 & a23 \\ a31 & a32 & a33 \end{pmatrix}$

The convergence or solution will only be possible if the matrix is ***diagonally dominant***, that is

$\sum_{j\neq i}|a_{ij}| \leq |a_{ii}|$ for each row. That means for every row of the matrix A, the magnitude of the diagonal element in a row should be equal or greater than the sum of the other elements in that row.

Let us try some examples:

1.

2x + y + 3z = 0 $\quad \begin{pmatrix} 2 & 1 & 3 & 0 \\ 2 & 1 & -2 & 5 \\ 3 & 1 & -3 & 7 \end{pmatrix}$

2x + y - 2z = 5

3x +y - 3z = 7

The matrix A = $\begin{pmatrix} 2 & 1 & 3 \\ 2 & 1 & -2 \\ 3 & 1 & -3 \end{pmatrix}$,

Here in the first row, a11 = 2, a12 + a13 = 1+3=4>a11……..solution is not possible

Second row, a22 = 1, a21+a32 = 1-2=-1<a22………………solution possible.

Third row, a33 = -3, a31+a32 = 3+1=4>-3………………….solution is not possible

Keep the second row as it is and interchange 1st and 3rd row.

A = $\begin{pmatrix} 3 & 1 & -3 \\ 2 & 1 & -2 \\ 2 & 1 & 3 \end{pmatrix}$, $\quad \begin{pmatrix} 3 & 1 & -3 & 7 \\ 2 & 1 & -2 & 5 \\ 2 & 1 & 3 & 0 \end{pmatrix}$

Now, a11=3, a12+a13=1-3=-2<a11…………solution possible

a33 = 3, a31+a32=2+1=3=a33……………… solution possible

Solution: x=1.00.., y= 0.999…, z = -1.0002….

No. of iterations=20

<u>**Try both ways and check your result.**</u>

2. Try another example.

2x + 4y +2z = 15

2x +y +2z = -5

4x + y -2z = 0

Solution: x=-3.055.., y= 6.6668…, z = -2.7778….

No. of iterations=9

You can use format to write the output