Practical 6

Gauss-Seidel method

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Ques no:1

In[37]:=
```
GaussSeidel[A0_, b0_, x0_, maxiter_] := Module[{A = N[A0], b = N[b0], xk = x0, xk1,
    i, j, k = 0, n, m, OutputDetails, size, colHeading}, size = Dimensions[A];
   n = size[[1]];
   m = size[[2]];
   If[n ≠ m, Print["Not a square matrix, cannot proceed with Gauss-Seidel method"];
    Return[]];
   OutputDetails = {xk};
   xk1 = Table[0, {n}];
   While[k < maxiter, For[i = 1, i ≤ n, i++, xk1[[i]] = (1 / A[[i, i]]) * (b[[i]] -
         Sum[A[[i, j]] * xk1[[j]], {j, 1, i - 1}] - Sum[A[[i, j]] * xk[[j]], {j, i + 1, n}])];
    xk = xk1; OutputDetails = Append[OutputDetails, xk];
    k++;];
   colHeading = Table[Subscript[x, s], {s, 1, n}];
   Print[NumberForm[TableForm[OutputDetails, TableHeadings → {None, colHeading}], 6]];
   Print["No. of iterations performed: ", maxiter];];
A = {{5, 1, 2}, {-3, 9, 4}, {1, 2, -7}};
b = {10, -14, -33};
X0 = {0, 0, 0};
GaussSeidel[A, b, X0, 15];
```

x_1	x_2	x_3
0	0	0
2.	-0.888889	4.74603
0.279365	-3.57178	3.73369
1.22088	-2.80801	4.08641
0.927039	-3.06272	3.97166
1.02388	-2.97944	4.00929
0.992174	-3.00674	3.99696
1.00256	-2.99779	4.001
0.99916	-3.00072	3.99967
1.00028	-2.99976	4.00011
0.99991	-3.00008	3.99996
1.00003	-2.99997	4.00001
0.99999	-3.00001	4.
1.	-3.	4.
0.999999	-3.	4.
1.	-3.	4.

No. of iterations performed: 15

```
GaussSeidelMatrixForm[A0_, b0_, x0_, maxiter_] :=
  Module[{A = N[A0], b = N[b0], xk = x0, k = 0, D, L, U, DLinv, OutputDetails},
   D = DiagonalMatrix[Diagonal[A]];
   L = LowerTriangularize[A, -1];
   U = UpperTriangularize[A, 1];
   DLinv = Inverse[D + L];
   OutputDetails = {xk};
   While[k < maxiter, xk = -DLinv.U.xk + DLinv.b;
    OutputDetails = Append[OutputDetails, xk];
    k++;];
   colHeading = Table[Subscript[x, s], {s, 1, Length[x0]}];
   Print[NumberForm[TableForm[OutputDetails, TableHeadings → {None, colHeading}], 6]];
   Print["No. of iterations performed: ", maxiter];];
A = {{5, 1, 2}, {-3, 9, 4}, {1, 2, -7}};
b = {10, -14, -33};
X0 = {0, 0, 0};
GaussSeidelMatrixForm[A, b, X0, 15]
```

x_1	x_2	x_3
0	0	0
2.	−0.888889	4.74603
0.279365	−3.57178	3.73369
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0.99916	−3.00072	3.99967
1.00028	−2.99976	4.00011
0.99991	−3.00008	3.99996
1.00003	−2.99997	4.00001
0.99999	−3.00001	4.
1.	−3.	4.
0.999999	−3.	4.
1.	−3.	4.

```
No. of iterations performed: 15
```

Ques no: 3

In[16]:=
```
GaussSeidelMatrixForm[A0_, b0_, x0_, maxiter_] :=
  Module[{A = N[A0], b = N[b0], xk = x0, k = 0, D, L, U, DLinv, OutputDetails},
   D = DiagonalMatrix[Diagonal[A]];
   L = LowerTriangularize[A, -1];
   U = UpperTriangularize[A, 1];
   DLinv = Inverse[D + L];
   OutputDetails = {xk};
   While[k < maxiter, xk = -DLinv.U.xk + DLinv.b;
    OutputDetails = Append[OutputDetails, xk];
    k++;];
   colHeading = Table[Subscript[x, s], {s, 1, Length[x0]}];
   Print[NumberForm[TableForm[OutputDetails, TableHeadings → {None, colHeading}], 6]];
   Print["No. of iterations performed: ", maxiter];];
A = {{2, -1, 0}, {-1, 2, -1}, {0, -1, 2}};
b = {7, 1, 1};
X0 = {0, 0, 0};
GaussSeidelMatrixForm[A, b, X0, 15]
```

x_1	x_2	x_3
0	0	0
3.5	2.25	1.625
4.625	3.625	2.3125
5.3125	4.3125	2.65625
5.65625	4.65625	2.82813
5.82813	4.82813	2.91406
5.91406	4.91406	2.95703
5.95703	4.95703	2.97852
5.97852	4.97852	2.98926
5.98926	4.98926	2.99463
5.99463	4.99463	2.99731
5.99731	4.99731	2.99866
5.99866	4.99866	2.99933
5.99933	4.99933	2.99966
5.99966	4.99966	2.99983
5.99983	4.99983	2.99992

No. of iterations performed: 15